Modeling Possible Outcomes of Updated Daily Values on Nutrient Intakes of the United States Adult Population

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Abstract: The United States (US) Food and Drug Administration has updated the Daily Values (DV) for the Nutrition Facts Label on packaged foods. We used the National Health and Nutrition Examination Survey 2009–2012 data with the International Life Sciences Institute, North America Fortification Database, which identifies intrinsic, mandatory enriched, and fortified sources of nutrients in foods and beverages, to model the new DVs’ potential impact on adult (≥19 years of age) intake. We assumed that manufacturers will adjust voluntary fortification to maintain percent DV claims. We assessed the percent of the US population whose usual intake (UI) was < the Estimated Average Requirement (EAR), and ≥ the Upper Limit (UL) based on the current DVs, and modeled estimated UI and %<EAR with the new DVs (Updated DV) for 12 micronutrients. Modeling for vitamins B₁₂, A, B₆, riboflavin, niacin, thiamin, and zinc predicts fewer voluntarily fortified foods and reduced adult UI. Assuming manufacturers add more vitamins C and D and calcium to foods, the Updated DV predicts the adult UI will increase for these nutrients. Our modeling predicts a 15% reduction in overall adult vitamin A intake, a recognized “shortfall nutrient” and that even with the increased DV for vitamin D, 70% of US adults are predicted to have an intake <EAR.

Keywords: Daily Values (DV); Nutrition Facts Label; Estimated Average Requirement (EAR); Upper Limit (UL); usual intake (UI); fortification; adults; National Health and Nutrition Examination Survey (NHANES)

1. Introduction

Nutrients added through enrichment and voluntary fortification of foods make important contributions to dietary intake in the United States (US) [1–6]. However, most Americans don’t consume recommended amounts of dietary fiber and what have been termed “shortfall nutrients” including vitamins A, C, D, and E, folate, magnesium, potassium, and calcium [7–9]. In addition, US men and women in the lowest income groups are more likely to experience inadequate intakes of these nutrients compared with the highest income groups [10].

Use of food labels by US consumers has been positively associated with dietary quality [11]. Specifically, regulated nutrition labels on packaged foods and beverages enable consumers to
compare the nutrient contribution of standardized food serving sizes, which the US Food and Drug Administration (FDA) has defined as the Reference Amounts Customarily Consumed (RACCs) (FDA 21 Code of Federal Regulations 101.12) [12]. The RACCs on food and beverage products are used to generate the “% Daily Values” (%DV) on the Nutrition Facts Label, which help consumers ‘know how much a serving contributes to the total amount you need per day’ [13].

On 20 May 2016, the FDA announced a new Nutrition Facts Label for packaged foods [14]. Manufacturers with ≥$10 million and <$10 million in annual food sales will be required to display the new labels beginning 1 January 2020 and 1 January 2021, respectively. As part of the new Nutrition Facts label changes, the FDA updated the DVs for most vitamins and minerals with more recent reference values based on the newer Food and Nutrition Board (FNB) values and recommendations [15,16]. Specifically, the FDA has increased the DVs for three vitamins and five minerals, decreased the DVs for 14 vitamins and minerals, and did not change the DVs for three nutrients, with the impact on the DVs for two vitamins dependent upon their chemical structure [17].

The DVs were established in 1995 based on values in the FNB, National Academies of Sciences Engineering and Medicine report, Recommended Dietary Allowances (RDAs) [18], and an FDA-commissioned FNB consensus document on nutrition labeling [19]. From 1994 to 2005, the FNB revised and broadened the national nutrient intake recommendations as the Dietary Reference Intakes (DRIs), which include RDA values, and have been periodically updated since that time cf. [20].

In the US, the DVs are also used by food and supplement manufacturers when making nutrient content claims. A food product can be labeled as “high” or “excellent” for a nutrient if it contains ≥20% DV per RACC and a “good” source of the nutrient if it contains 10–19% DV per RACC. As manufacturers update Nutrition and DS Facts labels to meet 2020 or 2021 compliance dates and DVs, they will need to update product %DV claims. To adhere to FNB recommendations and align product claims with updated DVs, manufacturers may decide to reformulate fortified products [17].

The objective of this analysis was to examine the potential impact of the updated DVs on voluntary fortification of food products and usual nutrient intakes. We used dietary intake data from the National Health and Nutrition Examination Survey (NHANES) coupled with the International Life Sciences Institute, North America Fortification Database (ILSI NA-FD) [21], which contains information on the intrinsic, enriched, and voluntary nutrient levels of vitamins A, B1 (thiamin), B2 (riboflavin), B3 (niacin), B6 (pyridoxine), B12 (cobalamin), C, D, folate as Dietary Folate Equivalents (DFEs), calcium, iron, and zinc in foods. For this analysis, the ILSI NA-FD was replicated and the fortified nutrient contents of foods were adjusted to fulfill the updated labeling and DV requirements, while maintaining the same %DV in each fortified food.

2. Materials and Methods

2.1. Study Population and Dietary Intake Estimation

Dietary intake information reported for two consecutive NHANES cycles (2009–2010, 2011–2012) [22] was combined with the US Department of Agriculture (USDA) food patterns equivalents database and with the ILSI NA-FD [21]. The NHANES is a nationally representative, cross-sectional survey that samples noninstitutionalized, civilian US residents using a complex, stratified, multistage probability cluster sampling design and is collected by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC) on a continual basis [23].

The NHANES dietary data include two 24-h dietary recalls collected using a computer-assisted dietary interview software program: the USDA’s automated multiple-pass method. The first 24-h dietary recall is conducted as an in-person interview and the second is administered by telephone 3–10 days later. Food and beverage items reported consumed in the NHANES dietary interview component (What We Eat in America) were coded using the USDA’s Food and Nutrient Database for Dietary Studies (FNDDS) and their estimated nutrient content was obtained [24].
Although complete 24-h dietary intake data were available for 18,273 participants on Day 1 and Day 2 from the NHANES (2009–2010, 2011–2012) combined data, after exclusion of participants whose data were deemed by the interviewer to be incomplete (n = 261), participants who were <4 years of age (n = 1991), and women who were pregnant or lactating (n = 168), the sample included a total of 15,853 participants. The sample was further reduced to only include adults ≥19 years of age to produce an analytic sample of 10,698 participants in this study. In this total sample, 50.0% were male.

We also used the ILSI NA-FD (Database of Fortification, Enrichment, and Intrinsic Nutrient Levels in Foods Reported Consumed in What We Eat in America, NHANES 2009–2010 and 2011–12, version 1.0, completed 16 October 2015) [21], which contains estimates of nutrients available from three sources—as naturally occurring (i.e., intrinsic), enriched, and fortified—for those foods and beverages as reported in the two NHANES cycles (2009–2010 and 2011–2012). The ILSI NA-FD is based on the USDA’s FNDDS, and the original database was developed by Nutrition Impact LLC, Battle Creek, MI, USA and has been updated by Exponent, Inc. (Menlo Park, CA, USA). Some values for folate content of foods in the ILSI NA-FD were sourced from the USDA FNDDS (release 28; released September 2015, slightly revised May 2016).

2.2. Usual Intake Estimation

Data obtained from the two NHANES 24-h recalls were used to estimate prevalence of intake following the US National Cancer Institute (NCI) usual intake (UI) estimation methodology [25,26]. The NCI’s MIXTRAN and DISTRIB computer macros enable UI estimation at the individual level. As part of our analysis, we incorporated/controlled for age, interview day (first compared with second), and weekend day (yes/no) to account for weekend effects in intake.

Estimated UI data were generated from: (1) foods and beverages only as naturally occurring (intrinsic), (2) foods and beverages including those with enrichment, and (3) all foods and beverages including voluntary fortification for vitamins A, B\(_1\) (thiamin), B\(_2\) (riboflavin), B\(_3\) (niacin), B\(_6\) (pyridoxine), B\(_12\) (cobalamin), C, D, folate, calcium, iron, and zinc. DFEs were used for folic acid and folate [16].

2.3. Creation of the Current DV and Updated DV Datasets

First, we replicated the ILSI NA-FD (Original FD) and created a second database ILSI NA-FD (Modified FD) in which voluntary fortification levels were adjusted to maintain the same %DV in foods reported in the Original FD but applying updated DVs that will be effective in 2020 or 2021 (see Table 1). In creating the Modified FD, three assumptions were made: (1) the naturally occurring intrinsic nutrient content of a food remained constant; (2) the amount of nutrients added to a food through enrichment was held constant; and (3) food manufacturers will maintain the same %DV in food products after 2020 or 2021. Appendix A Table A1 provides details about the calculations used in creating the ILSI NA-FD Modified.

An enriched food is a product to which nutrients have been added that were typically present in the food in its original form but were lost during processing. Food enrichment in the US is expected to follow the FDA’s food restoration principle, cf. [27]. In the US, food fortification is governed by the FDA and refers to the practice of increasing the content of micronutrients in a food to improve its nutritional quality [27]. In this study, we assumed that the amount of nutrients added through enrichment would be held constant because the US regulations specifying the amounts of vitamins A, thiamin, riboflavin, niacin, D, folic acid, and iron to be added when enriching foods were not altered when the DVs were updated [12]. In addition, the amount of nutrients added during enrichment are often linked to standards of identity in the US [17]. A standard of identity establishes the name of the food, e.g., yogurt, and defines the ingredients or components, their function and levels permitted in food (21 Code of Federal Regulations 130.3) [28] or foods that substitute (21 CFR 130.10) [29].
Table 1. Current and updated Daily Values (DVs) for food labels for adults aged ≥19 years \(^1\) in the US population.

| Nutrient   | Current DV | Updated DV | Change, % |
|------------|------------|------------|-----------|
| Vitamin B\(_{12}\) | 6.0 \(µg\) | 2.4 \(µg\) | −60        |
| Vitamin A  | 5000 IU    | 900 \(µg\) RAE \(^2\) | −40        |
| Zinc       | 15 \(µg\)  | 11 \(µg\)  | −27        |
| Riboflavin | 1.7 mg     | 1.3 mg     | −24        |
| Niacin     | 20 mg NE   | 16 mg NE \(^3\) | −20        |
| Thiamin    | 1.5 mg     | 1.2 mg     | −20        |
| Vitamin B\(_{6}\) | 2.0 mg | 1.7 mg     | −15        |
| Vitamin E  | 30 IU      | 15 mg \(^4\) |  0         |
| Folate     | 400 \(µg\) | 400 \(µg\) DFE \(^5\) |  0         |
| Iron       | 18 mg      | 18 mg      |  0         |
| Calcium    | 1000 mg    | 1300 mg    |  30        |
| Vitamin C  | 60 mg      | 90 mg      |  50        |
| Vitamin D  | 400 IU     | 20 \(µg\) \(^6\) | 100        |

\(^1\) SOURCE: FDA 2018b \[12\]. DFE, Dietary Folate Equivalent; DV, Daily Value; IU, International Unit; NE, Niacin Equivalent; RAE, Retinal Activity Equivalent; US, United States. \(^2\) 1 \(µg\) RAE = 1 \(µg\) retinol = 12 \(µg\) supplemental \(β\)-carotene = 24 \(µg\) \(α\)-carotene = 24 \(µg\) \(β\)-cryptoxanthin. \(^3\) 1 mg NE = 1 mg niacin = 60 mg tryptophan. \(^4\) 1 mg a-tocopherol (label claim) = 1 mg a-tocopherol = 1 mg RRR-a-tocopherol=2 mg all-rac-a-tocopherol. \(^5\) 1 \(µg\) DFE = 1 \(µg\) naturally occurring folate = 0.6 \(µg\) folic acid. \(^6\) 1 \(µg\) vitamin D = 40 IU.

When the intrinsic and enrichment levels of a nutrient in a food would yield the same (or greater) %DV in the Modified FD as in the Original FD, we also assumed food manufacturers would discontinue voluntary fortification. Therefore, in our model, we set the fortification contribution to zero and categorized the food as non-fortified in the Modified FD. This condition was the only one where we reassigned a food/beverage from fortified in the Original FD to non-fortified in the Modified FD. Since the Original FD reports DFE for folate/folic acid, and does not report whether a vitamin E fortified food contains \(µg\) of synthetic or natural vitamin E, nutrient levels were left unchanged for these two nutrients when creating the Modified FD.

Second, the NHANES individual food intake files were merged with the Original FD, which contained the total amount of each nutrient in the specified food/beverage and proportions according to the three sources (naturally occurring, enriched, and fortified). The total amount of each nutrient in food and source type (naturally occurring, enriched, fortified) for the analysis was calculated by multiplying the number of grams per nutrient from the NHANES food file by the nutrient proportion in the ILSI NA-FD, then dividing by 100. This yielded a total nutrient intake from all foods being consumed and the proportion that was intrinsic, enriched or fortified for each individual. The same modeling approach was used with the Modified FD.

Third, nutrient by nutrient and using the DV relevant to each model, individuals were categorized according to the proportion of their nutrient intake derived from fortified foods as follows: (a) 0% of DV consumed in the form of fortified food (0% DV), (b) >0–50% of the DV in the form of fortified food (>0–50% DV), or (c) >50% of DV in the form of fortified food (>50% DV).

Fourth, using the two 24-h dietary intake recalls per person, Current DV and Updated DV models were run independently using the Original and Modified FDs, respectively, to obtain usual nutrient intake for each individual and nutrient distribution. In addition, median UI, median percentage below the Estimated Average Requirement (% <EAR), and mean percentage greater than or equal to the Tolerable Upper Limit (% ≥UL) were determined for the population in both models.

2.4. Statistical Analysis

We accounted for the NHANES clustered sampling design and oversampling in all analyses and adjusted for differential noncoverage and nonresponse across the two continuous NHANES cycles [30–32]. Frequencies were reported for sample size, number of foods that were fortified and enriched, and number of foods with ‘Good’ or ‘Excellent’ source nutrient content claims. Means and
standard errors of the mean (SEM) were calculated for average UI, percentage below the EAR (%<\textless\text{EAR}), and percentage greater than or equal to the UL (%\geq\text{UL}). SEs were estimated using Balanced Repeated Replication and NHANES weights were applied. The percent of nutrient intake derived in the form of fortified food was calculated by dividing the total fortified nutrient intake consumed by the DV times 100. We analyzed the data for all adults \geq 19 years of age for both sexes combined. All analyses were conducted using SAS version 9.4 and its complex survey-specific procedures (SAS Institute, Cary, NC USA). The NHANES survey protocol has been approved by the NCHS Research Ethics Review Board. Since this study was a secondary data analysis of publicly available federal data, Human Subject Institutional Review Board approval was not required by the Medical University of South Carolina.

3. Results

With the new FDA labeling rules, the DV was reduced for seven nutrients (vitamins A, thiamin, riboflavin, niacin, B_6, B_{12}, and zinc) and increased for vitamins C and D, and calcium (Table 1). In general, foods in the US are most often fortified with vitamins A and D and enriched with riboflavin, niacin, thiamin, folate, and iron (Table 2). In our modeling, voluntary fortification was adjusted in the Modified FD to achieve the same numerical %DV for each nutrient and food as found in the Original FD. For the seven nutrients where the DV was reduced, the number of foods predicted to be voluntarily fortified decreased for all except vitamin B_6 (Table 2). These voluntarily fortified foods (Modified FD) would contain less of these seven nutrients per serving or RACC compared to the Original FD. When a nutrient DV is not changed, the number of fortified foods does not change, as was the case for vitamin E, folate DFE, and iron. When a nutrient Updated DV is higher, such as for vitamins C and D, and calcium, the amount of nutrient added to a voluntarily fortified food was increased in the Modified FD, whereas the amount found intrinsically in foods or added via enrichment was unchanged.

Table 2. Number of foods that are fortified and enriched with specific nutrients in the Original Food Database and predicted in the Modified Food Database, NHANES 2009–2010 and 2011–2012 for the US adult population aged \geq 19 years.

| Nutrient   | 2009–2010 Food Database | 2011–2012 Food Database |
|------------|-------------------------|-------------------------|
|            | Fortified Original | Fortified Modified | Enriched | Fortified Original | Fortified Modified | Enriched |
| Vitamin B_{12} | 196           | 191           | 0         | 210           | 208           | 0         |
| Vitamin A   | 1162          | 727           | 0         | 1153          | 652           | 0         |
| Zinc        | 166           | 154           | 0         | 188           | 176           | 0         |
| Riboflavin  | 221           | 219           | 1471      | 235           | 230           | 1403      |
| Niacin      | 233           | 230           | 1594      | 248           | 247           | 1541      |
| Thiamin     | 220           | 219           | 1600      | 238           | 235           | 1539      |
| Vitamin B_{6} | 231          | 231           | 0         | 260           | 260           | 0         |
| Vitamin E   | 75            | 75            | 0         | 74            | 74            | 0         |
| Folate DFE  | 200           | 200           | 1593      | 220           | 220           | 1636      |
| Iron        | 214           | 214           | 1576      | 232           | 232           | 1520      |
| Calcium     | 196           | 196           | 7         | 204           | 204           | 6         |
| Vitamin C   | 183           | 183           | 0         | 196           | 196           | 0         |
| Vitamin D   | 855           | 855           | 0         | 854           | 854           | 0         |

1 Total of 4981 foods in the Original and Modified food database for 2009–2010 and 5192 foods in the Original and Modified food database for 2011–2012. Foods categorized as fortified may also be included in the enriched count. NHANES, National Health and Nutrition Examination Survey; US, United States.

The decisions by food manufacturers to voluntarily add more nutrients per serving to maintain the same %DV in a fortified food or to fortify new foods (vs. Original) will depend upon palatability and may require regulatory changes to ‘standards of identity’ to permit the addition of more vitamins or minerals (21 Code of Federal Regulations 130.3) [28]. In our modeling, we discounted consideration of palatability or standards of identity limitations, to estimate the number of foods that would be
predicted to carry ‘Good’ and ‘Excellent’ source claims. As shown in Table 3, we found predicted increases for the B vitamins, vitamin A, and zinc for ‘Good’ and ‘Excellent’ claims, even though nutrient density is unchanged (intrinsic and/or enrichment foods) or diminished through voluntary fortification. Presuming manufacturers add calcium and vitamins C and D to fortified foods to maintain the same %DV, the number of ‘Good’ and ‘Excellent’ source foods is reduced. This reduction occurs because the intrinsic content of a food or the enrichment amount allowed by ‘standards of identity’ regulations is insufficient to maintain the higher nutrient content claim. For example, US regulations (Code of Federal Regulations 131.110) [33] permit the addition of 400 International Units (IU) of vitamin D per quart (400 IU or 10 µg per 32 fluid ounces) of cow’s milk [17]. With the Updated DV (20 µg) being twice the Current DV (400 IU), an eight-fluid ounce glass of milk containing 100 IU (2.4 µg) vitamin D will be downgraded from an ‘Excellent’ source (25% Current DV) to a ‘Good’ source (12.5% Updated DV) of vitamin D.

Table 3. Number of Foods with Good or Excellent Source Nutrient Content Claims in the Original Food Database (Original FD), and the Predicted Number in the Modified Food Database (Modified FD), based on the NHANES 2009–2010 and 2011–2012 1.

|        | Good Source | Excellent Source | Good Source | Excellent Source |
|--------|-------------|------------------|-------------|------------------|
|        | Original    | Modified         | Original    | Modified         | Original    | Modified         | Original    | Modified         |
| Vitamin B₁₂ | 1025        | 2101             | 579         | 1189             | 1150        | 2251             | 633         | 1326             |
| Vitamin A  | 267         | 318              | 350         | 460              | 280         | 365              | 342         | 474              |
| Zinc     | 670         | 880              | 482         | 721              | 682         | 911              | 466         | 691              |
| Riboflavin| 1284        | 1451             | 494         | 849              | 1318        | 1452             | 526         | 906              |
| Niacin   | 974         | 960              | 915         | 1202             | 989         | 957              | 969         | 1266             |
| Thiamin  | 756         | 872              | 765         | 938              | 829         | 958              | 762         | 940              |
| Vitamin B₆ | 844         | 1025             | 480         | 591              | 910         | 1093             | 547         | 673              |
| Vitamin E | 420         | 420              | 223         | 223              | 484         | 484              | 245         | 245              |
| Folate ²  | 839         | 839              | 845         | 845              | 865         | 865              | 843         | 843              |
| Iron     | 887         | 887              | 434         | 434              | 869         | 869              | 437         | 437              |
| Calcium  | 752         | 516              | 334         | 229              | 794         | 504              | 332         | 236              |
| Vitamin C | 481         | 389              | 717         | 478              | 546         | 422              | 764         | 513              |
| Vitamin D | 357         | 268              | 239         | 200              | 404         | 296              | 291         | 243              |

1 Total of 4981 foods in the Original and Modified food database for 2009–2010 and 5192 foods in the Original and Modified food database for 2011–2012, NHANES, National Health and Nutrition Examination Survey. ² DFE, Dietary Folate Equivalent.

Table 4 shows that the Updated DV model predicts a small change in the number of adults aged ≥19 years consuming foods that are not voluntarily fortified with the exception of vitamin A and to a lesser extent, zinc. However, the Updated DV model predicts that more individuals should be obtaining >50% of the DV for vitamin D from fortified foods, i.e., more than 10 µg per day. The Updated DV model predicts an appreciable drop in the number of individuals obtaining vitamin A from fortified foods, i.e., >50% and >0–50% DV categories for vitamin A. This downward shift in consumption of fortified foods is exacerbated given the lower DV target in the Updated DV than the Current DV model. The Updated DV model finds a small increase in the number of people not consuming foods voluntarily fortified with B vitamins, except for niacin, vitamin B₆, and folic acid, and a large increase (40%) in the number of people not consuming foods fortified with vitamin A—a “shortfall nutrient” of national concern [8]. The number of foods voluntarily fortified with calcium, vitamin C, and vitamin D was held constant in the model; predictably, the number of people consuming these fortified foods will not change.
Table 4. Number of US adults aged ≥19 years currently obtaining or predicted to obtain 0%, >0–50%, or >50% of the Daily Value (DV) from voluntarily fortified foods in Current and Updated DV models, respectively.

| Nutrient       | Current DV Model       | Updated DV Model       |
|----------------|------------------------|------------------------|
|                | DV 0% >0–50% >50% DV 0% >0–50% >50% |
| Vitamin B₁₂    | 6.0 mg 10,831 3267 1755 1.7 mg 10,869 3259 1725 |
| Vitamin A      | 5000 IU 3644 11,687 522 900 µg RAE 5061 10,395 397 |
| Zinc           | 15 µg 12,066 3364 423 11 µg 12,140 3313 400 |
| Riboflavin     | 1.7 mg 10,550 4099 1204 1.3 mg 10,553 4128 1172 |
| Niacin         | 20 mg 10,283 4141 1429 16 mg NE 10,292 4179 1382 |
| Thiamin        | 1.5 mg 10,513 4222 1118 1.2 mg 10,522 4295 1036 |
| Vitamin B₆     | 2.0 mg 10,199 3909 1745 1.7 mg 10,199 3949 1705 |
| Vitamin E      | 30 IU 14,349 1150 354 15 mg 14,349 1150 354 |
| Folate         | 400 µg 11,083 1622 3148 400 µg DFE 11,083 1622 3148 |
| Iron           | 18 mg 10,734 3375 1744 18 mg 10,734 3375 1744 |
| Calcium        | 1000 mg 11,297 4049 507 1300 mg 11,297 4027 529 |
| Vitamin C      | 60 mg 9726 2960 3167 90 mg 9726 2934 3193 |
| Vitamin D      | 400 IU 3014 8952 3887 20 µg 2891 8686 4276 |

US, United States; DV, Daily Value; IU, International Unit; RAE, Retinal Activity Equivalents; NE, Niacin Equivalents; DFEs, Dietary Folate Equivalents.

Table 5 includes the ULs and the percent of individuals in the US with intakes below the EAR and above or equal to the UL (as available) for the ten modeled nutrients. Since the DVs were unchanged for vitamin E, folate and iron, ULs did not differ between the two models and these nutrients were excluded from these analyses. Comparing the two models with the Updated DV, the overall mean UI of vitamin B₁₂ and vitamin A is predicted to decrease, whereas the mean UI for vitamin C and vitamin D (almost double) and calcium is predicted to increase. The mean UI for thiamin, riboflavin, niacin, vitamin B₆, and zinc is predicted to remain relatively unchanged. The model predicts a reduction in %<EAR for vitamins C and D and calcium along with an increase in the percentage of the population exceeding the UL for calcium. Since a doubling of DV for vitamin D and an assumption that food manufacturers reformulate fortified food products to maintain the same %DV, approximately 70% of adults still are predicted to have a vitamin D intake <EAR. For all seven nutrients with a decreased DV, there is an increase in the percentage of the population below the EAR (Table 5). With the change in DVs, the only predicted decrease in the percentage of the population consuming more than or equal to the UL is for niacin.

Appendix B Tables A2–A5 provide comparison modeling data on adult age group subsets: 19–30 years; 31–50 years; 51–70 years; >70 years. Within these age groups, the same trends were observed as with the overall adult intakes with the Current DV and Updated DV models. However, comparisons of adults aged 19–30 years (vs. all ages reported in Table 5) predict an increased proportion of this age group would have nutrient intakes below the EAR, especially for vitamin A, with the exception of vitamin B₆ and calcium. Based on the %<EAR, adults aged 31–50 years are predicted to be generally better nourished than the overall population, whereas proportionally more adults aged 51–70 years were estimated to have intakes <EAR for vitamin B₆ and ≥UL for calcium. Compared with the overall adult population shown in Table 5, a lower percentage of adults aged >70 years would be expected to have intakes <EAR for vitamins A, C and D and more individuals of this age group would be expected to ingest <EAR for the B vitamins.
### Table 5. Comparison of Current Daily Value (DV) and Updated DV nutrient intake models with overall and percent fortification subgroups for US adults ≥ 19 years of age, (Mean ± SEM) 1,2.

| Nutrient       | Overall | Percent Fortification | Overall | Percent Fortification |
|----------------|---------|-----------------------|---------|-----------------------|
|                |         | >0-50%                | >50%    | >0-50%                | >50%    |
| **Vitamin B₁₂** |         |                       |         |                       |         |
| Sample size    | 10,677  | 7863                  | 1674    | 1140                  | 10,677  |
| Usual Intake   | 5.3 ± 0.0 | 5.3 ± 0.0          | 5.2 ± 0.0 | 5.3 ± 0.0          | 4.6 ± 0.0 | 4.6 ± 0.0 | 4.6 ± 0.0 | 4.6 ± 0.0 |
| % < EAR        | 2.8 ± 0.4 | 2.8 ± 0.4          | 2.9 ± 0.4 | 2.8 ± 0.4          | 3.6 ± 0.4 | 3.5 ± 0.4 | 3.8 ± 0.6 | 3.6 ± 0.6 |
| **Vitamin A**  |         |                       |         |                       |         |
| Sample size    | 10,681  | 2661                  | 7681    | 339                   | 10,681  | 3747      | 6664    | 270       |
| Usual Intake   | 651.1 ± 0.2 | 641.4 ± 0.6      | 654.4 ± 0.4 | 653.4 ± 1.6        | 552.8 ± 0.2 | 547.5 ± 0.4 | 555.8 ± 0.2 | 553.1 ± 1.4 |
| % < EAR        | 42.7 ± 2.2 | 44.9 ± 2.2        | 41.8 ± 2.0 | 45.3 ± 2.2         | 57.2 ± 2.4 | 58.8 ± 2.4 | 56.1 ± 2.4 | 60.3 ± 2.0 |
| **Zinc**       |         |                       |         |                       |         |
| Sample size    | 10,697  | 8666                  | 1773    | 258                   | 10,697  | 8716      | 1738    | 243       |
| Usual Intake   | 11.6 ± 0.0 | 11.6 ± 0.0         | 11.5 ± 0.0 | 11.5 ± 0.0         | 11.3 ± 0.0 | 11.3 ± 0.0 | 11.2 ± 0.0 | 11.2 ± 0.0 |
| % < EAR        | 19.4 ± 1.0 | 19.3 ± 1.0         | 19.6 ± 1.0 | 22.5 ± 1.2          | 20.7 ± 1.0 | 20.5 ± 1.0 | 21.0 ± 1.0 | 24.0 ± 1.2 |
| **Riboflavin** |         |                       |         |                       |         |
| Sample size    | 10,697  | 7744                  | 2187    | 766                   | 10,697  | 7746      | 2201    | 750       |
| Usual Intake   | 2.1 ± 0.0 | 2.1 ± 0.0          | 2.1 ± 0.0 | 2.1 ± 0.0          | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 |
| % < EAR        | 3.6 ± 0.4 | 3.6 ± 0.4          | 3.5 ± 0.4 | 4.3 ± 0.6          | 3.9 ± 0.4 | 3.9 ± 0.4 | 3.8 ± 0.4 | 4.7 ± 0.6 |
| **Niacin**     |         |                       |         |                       |         |
| Sample size    | 10,697  | 7544                  | 2257    | 896                   | 10,697  | 7552      | 2278    | 867       |
| Usual Intake   | 25.8 ± 0.0 | 25.9 ± 0.0         | 25.3 ± 0.0 | 26.1 ± 0.0         | 25.1 ± 0.0 | 25.1 ± 0.0 | 24.6 ± 0.0 | 25.4 ± 0.0 |
| % < EAR        | 1.5 ± 0.2 | 1.4 ± 0.2          | 1.7 ± 0.2 | 1.5 ± 0.2          | 1.6 ± 0.2 | 1.5 ± 0.2 | 1.9 ± 0.2 | 1.6 ± 0.2 |
| % ≥ UL         | 8.6 ± 0.6 | 8.4 ± 0.6          | 9.2 ± 0.8 | 8.7 ± 0.6          | 3.6 ± 0.4 | 3.5 ± 0.4 | 4.0 ± 0.4 | 3.7 ± 0.4 |
| **Thiamin**    |         |                       |         |                       |         |
| Sample size    | 10,697  | 7761                  | 2274    | 662                   | 10,697  | 7768      | 2316    | 613       |
| Usual Intake   | 1.6 ± 0.0 | 1.6 ± 0.0          | 1.6 ± 0.0 | 1.6 ± 0.0          | 1.6 ± 0.0 | 1.6 ± 0.0 | 1.6 ± 0.0 | 1.6 ± 0.0 |
| % < EAR        | 6.7 ± 0.6 | 6.6 ± 0.4          | 7.0 ± 0.6 | 7.2 ± 0.6          | 7.3 ± 0.6 | 7.1 ± 0.6 | 7.7 ± 0.6 | 7.7 ± 0.6 |
Table 5. Cont.

| Nutrient Overall Percent Fortification | Current DV | Updated DV | Overall Percent Fortification |
|---------------------------------------|------------|------------|-----------------------------|
| Vitamin B₆ ⁵,⁹                      | 10,697     | 7541       | 1069                        |
| Sample size                          | 7996       | 2334       | 700                        |
| Usual Intake                         | 2.1 ± 0.0  | 2.1 ± 0.0  | 2.1 ± 0.0                   |
| % < EAR                              | 8.9 ± 0.6  | 8.6 ± 0.8  | 8.5 ± 0.8                   |
| Calcium ⁷                            | 10,698     | 7996       | 2087                        |
| Sample size                          | 10,698     | 7996       | 1069                        |
| Usual Intake                         | 995.7 ± 0.4| 999.0 ± 0.4| 1069                       |
| % < EAR                              | 39.6 ± 1.0 | 38.7 ± 1.0 | 38.7 ± 1.0                  |
| % ≥ UL                               | 0.5 ± 0.0  | 0.5 ± 0.0  | 0.5 ± 0.0                   |
| Vitamin C ⁸,⁹                         | 10,661     | 7446       | 1718                        |
| Sample size                          | 10,661     | 7446       | 1487                        |
| Usual Intake                         | 85.9 ± 0.0 | 85.8 ± 0.0 | 85.8 ± 0.0                  |
| % < EAR                              | 42.6 ± 1.0 | 42.7 ± 1.0 | 42.7 ± 1.0                  |
| % ≥ UL                               | 0.4 ± 0.0  | 0.4 ± 0.0  | 0.4 ± 0.0                   |
| Vitamin D ⁷,⁹                        | 10,530     | 2127       | 2041                        |
| Sample size                          | 10,530     | 2127       | 2041                        |
| Usual Intake                         | 4.8 ± 0.0  | 4.8 ± 0.0  | 4.8 ± 0.0                   |
| % < EAR                              | 96.1 ± 0.6 | 96.2 ± 0.6 | 96.1 ± 0.6                  |

1 Data Source: What We Eat in America, NHANES 2009-2012 [22]. ² Usual intake (UI), percent below the Estimated Average Requirement (% < EAR) and percent above or equal to the Tolerable Upper Limit (% ≥ UL) distributions estimated using the National Cancer Institute Method for individuals aged ≥ 2 years, excluding pregnant and lactating women. Accessible via https://epi.cancer.gov/diet/usualintakes/method.html. ³ Using Current food label DV and Updated food label DV in Table 1 [17]. ⁴ Percent fortification subgroups for individuals consuming: (a) 0% of DV in the form of fortified food (0%), (b) >0–50% of the DV in the form of fortified food (>0–50% DV), or (c) >50% of DV in the form of fortified food (>50% DV). ⁵ Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B₆, Folate, Vitamin B₁₂, Pantothenic Acid, Biotin, and Choline (1998). ⁶ Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc (2001) [34]. ⁷ Dietary Reference Intakes for Calcium and Vitamin D (2011) [35]. ⁸ Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids (2000) [36]. ⁹ Nutrients for which the % ≥ UL = 0 for Current DV and Updated DV models. ¹⁰ A UL was not available for the following nutrients: Vitamin B₁₂, Thiamin, and Riboflavin. DV, Daily Value; US, United States; EAR, Estimated Average Requirement; UI, Usual Intake; UL, Tolerable Upper Limit.
4. Discussion

Food availability and personal food choices affect dietary nutrient density and nutrient intake. When nutrient labeling requirements, such as the DV and targets for ‘Good’ and ‘Excellent’ nutrient claims are changed, the nutrient density of many food choices also may be affected [17]. The goal of this study was to determine the potential impact of regulatory application of newer FNB nutrient recommendations and codification as Updated DVs used in nutrition labeling on voluntary food fortification and the UI of select essential nutrients among American adults. The DV was decreased for 14 nutrients and increased for eight [17]. Using the ILSI NA-FD and NHANES datasets, we modeled 13 nutrients. Our Updated DV model predicts a reduction in the number of voluntarily fortified foods for six of the seven nutrients with a decreased DV, the exception being vitamin B₆.

As part of this modeling approach, we did not transform a non-fortified food to a fortified food. Thus, the number of voluntarily fortified foods in the Modified FD was not altered for nutrients where the DV was increased (vitamins C and D and calcium), the DV was held constant (folate, iron), or the chemical form of the vitamin being added could not be determined (vitamin E and folate). However, for nutrients where the Updated DV is lower than the Current DV, food manufacturers have a choice to reduce voluntary fortification and maintain the same %DV claim on a food product. The Updated DV model predicts that a lowering of the DV may lead to a ~40% reduction in the number of foods voluntarily fortified with vitamin A and an increased number of foods meeting ‘Good’ and ‘Excellent’ nutrient content claims with a concomitant lower nutrient density.

The consumption of enriched and fortified foods is associated with increased nutrient intake and only a small percentage of US adults having total UIs below the EAR for vitamins B₆, B₁₂, thiamin, riboflavin, niacin, folate, iron, copper, and selenium [2,3,6]. Based on this analysis, mandatory food enrichment, not voluntary food fortification, is primarily responsible for UI above the EAR for thiamin, riboflavin, niacin, folate, and iron. To benefit the US population, both enriched and fortified foods need to be available in the marketplace and then selected by the consumer for consumption. For nutrients where the DV increased, e.g., vitamins C and D and calcium, and assuming food manufacturers increase voluntary fortification to maintain the same %DV, these fortified foods should become more nutrient dense. However, it is worth noting that the intrinsic and enriched contribution of these nutrients will not be sufficient for foods which currently carry ‘Good’ or ‘Excellent’ claims to continue to do so under the Updated DV regulations. There appears to be an opportunity to modify US regulations pertaining to standards of identity and enrichment of foods to allow the addition of more vitamins and minerals and align with updated DVs.

Limitations to our analysis include that dietary intakes based on 24-h dietary recalls are subject to misreporting; however, the newer multiple-pass method of dietary interviewing used to collect the data for the NHANES cycles included in this modeling has been shown to be much improved and significantly reduces bias [37–39]. Another limitation is that the vitamin E and folate/folic acid content of foods in the database could not be verified because it is not possible to ascertain the chemical structure added to foods or the conversion factor used for the label. This is unfortunate given the low intake of vitamin E among the US population [2,3,6], and the importance of folic acid in fetal development [40,41]. In addition, the food database used does not capture every food in the marketplace and food manufacturers may make different voluntary fortification adjustments. The analysis also does not evaluate the impact on consumer food choices when comparing food labels with new DVs and related nutrient content, e.g., ‘good’ source, claims. Hopefully, results from this analysis may help inform food manufacturers in product development and help identify additional opportunities, e.g., regulatory changes to standards of identity and levels of enrichment, to improve the nutrient intake of US adults.

There are several strengths to this analysis. The estimates are nationally representative of the US population and based on the ILSI NA-FD that reports the intrinsic, enriched (mandatory) and voluntary fortification of each food serving (Original FD). The nutrient database was replicated, new DVs were applied, and the need for voluntary fortification was determined for each nutrient in every food
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( Modified FD). This created two databases that were used to estimate two sets of nutrient intakes (Current DV and Updated DV) using the same dietary recalls and statistical methods. This means that the UIs, EARs, and ULs are identical in 24-h dietary recall data and foods within the database.

5. Conclusions

This analysis highlights the fact that changing the DV may affect the nutrient density of foods and nutrient content claims. When the DV increases, it may lead to a downgraded nutrient content claim, i.e., from an ‘excellent’ to a ‘good’ source or from a ‘good’ source to no claim, unless voluntary fortification is increased. When the DV is decreased, the number of foods eligible to carry ‘Good’ and ‘Excellent’ nutrient content claims increase without any change in nutrient density. There may also be an ~40% reduction in the number of foods voluntarily fortified with vitamin A. Such changes in nutrient density of foods affect UI and % below the EAR.

The Updated DV model predicts that more people will not consume foods voluntarily fortified with vitamins A, thiamin, riboflavin niacin, B_6, B_12, and zinc. Our modeling also predicts that there will be a decrease in the proportion of the population obtaining up to 50% or >50% of their nutrient DV by means of voluntarily fortification. This translates to lower UI in the Updated DV Model for vitamins A, niacin B_12, and zinc, but not thiamin, riboflavin, and vitamin B_6. The greatest reduction in UI is predicted for vitamin A. This analysis found that 75% of adults currently consume foods fortified with vitamin A, and the Updated DV model predicts this will decrease to 65%, which is troubling because vitamin A has been recognized as a nutrient already deemed of national public health concern by the 2015 Dietary Guidelines Advisory Committee [8]. Separate adult subgroup age analysis predicted that the highest proportion of individuals with intakes < EAR for vitamin A would be individuals age 19–30 year. Even with a significant increase in the DV for vitamin D, our modeling still predicts that approximately 70% of the US adult population will have a UI < the EAR for this nutrient. A number of studies have demonstrated the value of fortification and enrichment in the US food supply [1,3]. As the US continues to address the related issues of food deserts, obesity, and shortfall nutrients [8,42,43], it is disconcerting to find that approximately 70% of adults also report not consuming any fortified foods.

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Conflicts of Interest: M.I.M. is a self-employed consultant/scientific advisor to agri-food, dietary supplement, and nutritional diagnostic device industries, adjunct professor at the University of Guelph and Tufts University, and owns stock in DSM, a B2B manufacturer of vitamins, carotenoids and omega-3 fatty acids for use in human and animal products. The authors J.C.N., K.J.H., A.M.M., and B.P.M. state that they have no financial or other conflicts of interest. The opinions expressed in this report are those of the authors.

Abbreviations

CDC: Centers for Disease Control and Prevention; DFE: Dietary Folate Equivalent; DV: Daily Value; DRIs: Dietary Reference Intakes; DS: Dietary supplement; EAR: Estimated Average Requirement; FDA: US Food and Drug Administration; FNB: Food and Nutrition Board; FNDDS: Food and Nutrient Database for Dietary Studies; ILSI, North America: International Life Sciences Institute, North America; ILSI NA-FD: International Life Sciences Institute, North America Fortification Database; IU: International Unit; µg: Micrograms; NCHS: National Center for Health Statistics; NCI: National Cancer Institute; NE: Niacin Equivalent; NHANES: National Health and Nutrition Examination Survey; %DV: Percent of Daily Values; RACC: Reference Amount Customarily Consumed; RAE: Retinal Activity Equivalent; RDA: Recommended Dietary Allowance; SEM: Standard Error of the Mean; UI:
Usual Intake; UL: Upper Limit; US: United States; USDA: United States Department of Agriculture; WWEIA: What We Eat in America.

Appendix A

Table A1. Calculations applied to Modified food database to calculate % DV and predict voluntary fortification and nutrient content of foods effective January 2020 and 2021, assuming voluntary fortification levels are adjusted to maintain same % DV as in the Original food database.

| Equation Number and Purpose | Equation |
|----------------------------|----------|
| 1. Calculate % DV contributed per serving based on Current DVs | Old DV% = (Nutrient Total Value ÷ OldDV) × 100 |
| 2. Calculate Target Nutrient amount per 100 g using the NewDV | New Total NutrientTarget = (OldDV% × NewDV) × 100 |
| 3. Calculate new fortification target (if NewFortValue < 0, set to 0) | New Fort Value = New Total Nutrient − (Intrinsic Value + Enriched Value) |

DV, Daily Value.

Appendix B

Tables A2–A5, which provide comparison modeling data on adult age groups: 19–30 year; 31–50 year; 51–70 year; >70 year.
Table A2. Comparison of Current Daily Value (DV) and Updated DV nutrient intake models with overall and percent fortification subgroups for US adults (19–30 years of age) (Mean ± SEM) \textsuperscript{1,2}.

| Nutrient | Current DV \textsuperscript{3} | Updated DV \textsuperscript{3} |
|----------|-----------------------------|-----------------------------|
|          | Overall | Percent Fortification \textsuperscript{4} | Overall | Percent Fortification \textsuperscript{4} |
|          | 0% | >0–50% | >50% | 0% | >0–50% | >50% |
| Vitamin B\textsubscript{12} \textsuperscript{5,10} | | | | | |
| Sample size | 2263 | 1649 | 309 | 305 | 2263 | 1654 | 308 | 301 |
| Usual Intake | 5.4 ± 0.0 | 5.4 ± 0.0 | 5.4 ± 0.0 | 5.4 ± 0.0 | 4.7 ± 0.0 | 4.6 ± 0.0 | 4.6 ± 0.0 | 4.7 ± 0.0 |
| % <EAR | 2.4 ± 0.4 | 2.4 ± 0.4 | 2.4 ± 0.4 | 2.4 ± 0.6 | 3.3 ± 0.6 | 3.3 ± 0.6 | 3.3 ± 0.6 | 3.2 ± 0.6 |
| Vitamin A \textsuperscript{6,9} | | | | | |
| Sample size | 2264 | 728 | 1463 | 73 | 2264 | 981 | 1221 | 62 |
| Usual Intake | 587.7 ± 0.6 | 587.4 ± 1.0 | 587.5 ± 0.6 | 594.0 ± 3.0 | 502.6 ± 0.4 | 503.2 ± 0.6 | 501.9 ± 0.6 | 505.6 ± 2.6 |
| % <EAR | 52.1 ± 2.8 | 53.0 ± 3.0 | 51.5 ± 2.8 | 55.6 ± 2.6 | 66.1 ± 2.8 | 66.3 ± 2.8 | 65.7 ± 3.0 | 70.3 ± 2.8 |
| Zinc \textsuperscript{6,9} | | | | | |
| Sample size | 2266 | 1844 | 356 | 66 | 2266 | 1850 | 351 | 65 |
| Usual Intake | 11.8 ± 0.0 | 11.8 ± 0.0 | 11.8 ± 0.0 | 11.8 ± 0.0 | 11.5 ± 0.0 | 11.5 ± 0.0 | 11.5 ± 0.0 | 11.4 ± 0.0 |
| % <EAR | 18.1 ± 1.4 | 18.1 ± 1.4 | 17.0 ± 1.8 | 21.8 ± 1.4 | 19.4 ± 1.4 | 19.4 ± 1.4 | 18.3 ± 1.8 | 23.4 ± 1.4 |
| Riboflavin \textsuperscript{5,10} | | | | | |
| Sample size | 2266 | 1660 | 402 | 204 | 2266 | 1660 | 406 | 200 |
| Usual Intake | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.0 ± 0.0 | 2.0 ± 0.0 | 2.0 ± 0.0 | 2.0 ± 0.0 |
| % <EAR | 4.5 ± 0.6 | 4.5 ± 0.6 | 4.2 ± 0.6 | 5.1 ± 0.6 | 5.0 ± 0.6 | 5.0 ± 0.6 | 4.6 ± 0.6 | 5.6 ± 0.8 |
| Niacin \textsuperscript{5} | | | | | |
| Sample size | 2266 | 1575 | 421 | 270 | 2266 | 1575 | 430 | 261 |
| Usual Intake | 27.7 ± 0.0 | 27.7 ± 0.0 | 27.7 ± 0.0 | 27.7 ± 0.0 | 26.8 ± 0.0 | 26.8 ± 0.0 | 26.8 ± 0.0 | 26.9 ± 0.0 |
| % <EAR | 0.6 ± 0.2 | 0.6 ± 0.2 | 0.6 ± 0.2 | 0.7 ± 0.2 | 0.7 ± 0.2 | 0.7 ± 0.2 | 0.6 ± 0.2 | 0.8 ± 0.2 |
| % ≥UL | 10.0 ± 1.4 | 10.0 ± 1.4 | 10.0 ± 1.4 | 9.9 ± 1.4 | 4.3 ± 0.8 | 4.3 ± 0.8 | 4.5 ± 0.8 | 4.4 ± 0.8 |
Table A2. Cont.

| Nutrient     | Overall       | Percent Fortification | Overall       | Percent Fortification |
|--------------|---------------|-----------------------|---------------|-----------------------|
|              | 0%            | >0–50%                | 0%            | >0–50%                |
| Thiamin      | 2266          | 1685                  | 2266          | 1685                  |
| Sample size  |               |                       |               |                       |
| Usual Intake | 1.7 ± 0.0     | 1.7 ± 0.0             | 1.6 ± 0.0     | 1.6 ± 0.0             |
| % < EAR      | 5.6 ± 0.8     | 5.6 ± 0.8             | 6.1 ± 0.8     | 6.1 ± 0.8             |
|              |               |                       |               |                       |
| Vitamin B₆   | 2266          | 1583                  | 2266          | 1583                  |
| Sample size  |               |                       |               |                       |
| Usual Intake | 2.2 ± 0.0     | 2.2 ± 0.0             | 2.1 ± 0.0     | 2.1 ± 0.0             |
| % < EAR      | 3.7 ± 1.0     | 3.7 ± 1.0             | 4.0 ± 1.0     | 4.0 ± 1.0             |
|              |               |                       |               |                       |
| Calcium      | 2266          | 1741                  | 2266          | 1741                  |
| Sample size  |               |                       |               |                       |
| Usual Intake | 1046.8 ± 0.8  | 1047.1 ± 0.8          | 1047.4 ± 0.8  | 1047.9 ± 1.0          |
| % < EAR      | 27.3 ± 1.8    | 27.3 ± 1.8            | 27.6 ± 1.8    | 27.6 ± 1.8            |
| % ≥ UL       | 0.2 ± 0.0     | 0.2 ± 0.0             | 0.3 ± 0.0     | 0.3 ± 0.0             |
|              |               |                       |               |                       |
| Vitamin C    | 2257          | 1504                  | 2257          | 1504                  |
| Sample size  |               |                       |               |                       |
| Usual Intake | 80.0 ± 0.0    | 80.1 ± 0.2            | 90.2 ± 0.2    | 90.2 ± 0.2            |
| % < EAR      | 47.5 ± 2.0    | 47.5 ± 2.0            | 40.8 ± 2.0    | 40.8 ± 2.0            |
|              |               |                       |               |                       |
| Vitamin D    | 2220          | 563                   | 2220          | 563                   |
| Sample size  |               |                       |               |                       |
| Usual Intake | 4.5 ± 0.0     | 4.6 ± 0.0             | 7.9 ± 0.0     | 7.9 ± 0.0             |
| % < EAR      | 97.1 ± 0.6    | 97.0 ± 0.6            | 73.7 ± 2.4    | 73.6 ± 2.2            |

1 Data Source: What We Eat in America, NHANES 2009–2012 [22]. 2 Usual intake (UI), percent below the Estimated Average Requirement (% < EAR) and percent above or equal to the Tolerable Upper Limit (% ≥ UL) distributions estimated using the National Cancer Institute Method for individuals aged ≥ 2 years, excluding pregnant and lactating women. Accessible via https://epi.grants.cancer.gov/diet/usualintakes/method.html. 3 Using Current food label DV and Updated food label DV in Table 1 [17]. 4 Percent fortification subgroups for individuals consuming: (a) 0% of DV in the form of fortified food (0%), (b) >0–50% of the DV in the form of fortified food (>0–50% DV), or (c) >50% of DV in the form of fortified food (>50% DV). 5 Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B₆, Folate, Vitamin B₁₂, Pantothenic Acid, Biotin, and Choline (1998). 6 Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc (2001) [34]. 7 Dietary Reference Intakes for Calcium and Vitamin D (2011) [35]. 8 Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids (2000) [36]. 9 Nutrients for which the % ≥ UL = 0 for Current DV and Updated DV models. 10 A UL was not available for the following nutrients: Vitamin B₁₂, Thiamin, and Riboflavin. DV, Daily Value; US, United States; EAR, Estimated Average Requirement; UL, Tolerable Upper Limit.
Table A3. Comparison of Current Daily Value (DV) and Updated DV nutrient intake models with overall and percent fortification subgroups for US adults (31–50 years of age)\(^1,2\) (Mean ± SEM).

| Nutrient | Current DV\(^3\) | Updated DV\(^3\) |
|----------|------------------|------------------|
|          | Overall | Percent Fortification \(^4\) | Overall | Percent Fortification \(^4\) |
|          | 0%       | >0–50% | >50% | 0% | >0–50% | >50% |
| Vitamin B\(_{12}\)\(^5,10\) | | | | | | |
| Sample size | 3522 | 2693 | 463 | 366 | 3522 | 2701 | 458 | 363 |
| Usual Intake | 5.3 ± 0.0 | 5.3 ± 0.0 | 5.3 ± 0.0 | 5.4 ± 0.0 | 4.7 ± 0.0 | 4.7 ± 0.0 | 4.7 ± 0.0 | 4.7 ± 0.0 |
| % < EAR | 2.6 ± 0.4 | 2.6 ± 0.4 | 2.7 ± 0.4 | 2.5 ± 0.4 | 3.1 ± 0.4 | 3.1 ± 0.4 | 3.2 ± 0.6 | 3.0 ± 0.4 |
| Vitamin A\(^6,9\) | | | | | | |
| Sample size | 3518 | 986 | 2422 | 110 | 3518 | 1364 | 2069 | 85 |
| Usual Intake | 631.7 ± 0.4 | 631.1 ± 0.8 | 631.9 ± 0.6 | 632.9 ± 2.6 | 540.1 ± 0.4 | 539.6 ± 0.6 | 540.3 ± 0.4 | 553.1 ± 1.4 |
| % < EAR | 45.1 ± 2.4 | 46.2 ± 2.6 | 44.6 ± 2.4 | 47.1 ± 2.4 | 59.1 ± 2.4 | 60.1 ± 2.4 | 58.4 ± 2.4 | 60.5 ± 2.2 |
| Zinc\(^6,9\) | | | | | | |
| Sample size | 3526 | 2931 | 519 | 76 | 3526 | 2949 | 506 | 71 |
| Usual Intake | 12.1 ± 0.0 | 12.1 ± 0.0 | 12.1 ± 0.0 | 12.2 ± 0.0 | 11.9 ± 0.0 | 11.9 ± 0.0 | 11.9 ± 0.0 | 11.9 ± 0.0 |
| % < EAR | 15.9 ± 1.0 | 15.8 ± 1.0 | 15.8 ± 1.0 | 17.8 ± 1.6 | 16.6 ± 1.2 | 16.6 ± 1.2 | 16.5 ± 1.2 | 18.9 ± 1.6 |
| Riboflavin\(^5,10\) | | | | | | |
| Sample size | 3526 | 2669 | 602 | 255 | 3526 | 2670 | 606 | 250 |
| Usual Intake | 2.2 ± 0.0 | 2.2 ± 0.0 | 2.2 ± 0.0 | 2.2 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 |
| % < EAR | 3.1 ± 0.4 | 3.2 ± 0.4 | 2.8 ± 0.4 | 3.6 ± 0.6 | 3.3 ± 0.6 | 3.4 ± 0.6 | 3.0 ± 0.4 | 3.9 ± 0.6 |
| Niacin\(^5\) | | | | | | |
| Sample size | 3526 | 2584 | 631 | 311 | 3526 | 2586 | 638 | 302 |
| Usual Intake | 27.0 ± 0.0 | 26.9 ± 0.0 | 27.0 ± 0.0 | 27.0 ± 0.0 | 26.3 ± 0.0 | 26.3 ± 0.0 | 26.3 ± 0.0 | 26.3 ± 0.0 |
| % < EAR | 0.8 ± 0.2 | 0.8 ± 0.2 | 0.8 ± 0.2 | 0.8 ± 0.2 | 0.8 ± 0.2 | 0.8 ± 0.2 | 0.8 ± 0.2 | 0.9 ± 0.2 |
| % ≥ UL | 6.5 ± 0.6 | 6.5 ± 0.6 | 6.5 ± 0.8 | 6.5 ± 0.6 | 2.6 ± 0.4 | 2.6 ± 0.4 | 2.6 ± 0.4 | 2.6 ± 0.4 |
| Thiamin\(^5,10\) | | | | | | |
| Sample size | 3526 | 2677 | 644 | 205 | 3526 | 2680 | 654 | 192 |
| Usual Intake | 1.7 ± 0.0 | 1.7 ± 0.0 | 1.7 ± 0.0 | 1.7 ± 0.0 | 1.6 ± 0.0 | 1.6 ± 0.0 | 1.6 ± 0.0 | 1.6 ± 0.0 |
| % < EAR | 5.5 ± 0.6 | 5.5 ± 0.6 | 5.2 ± 0.6 | 5.5 ± 0.6 | 5.8 ± 0.6 | 5.9 ± 0.6 | 5.5 ± 0.6 | 6.0 ± 0.6 |
Table A3. Cont.

| Nutrient | Current DV | Updated DV |
|----------|------------|------------|
|          | Overall    | Percent Fortification | Overall | Percent Fortification |
|          | 0% | >0–50% | >50% | 0% | >0–50% | >50% |
| Vitamin B₆, B₁₂, Thiamin, Riboflavin, Niacin, Vitamin B₆, Folate, and Pantothenic Acid | | | | | | |
| Sample size | 3526 | 2577 | 586 | 363 | 3526 | 2577 | 590 | 359 |
| Usual Intake | 2.2 ± 0.0 | 2.2 ± 0.0 | 2.2 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 |
| % < EAR | 3.7 ± 0.6 | 3.7 ± 0.6 | 3.7 ± 0.6 | 3.8 ± 0.6 | 3.8 ± 0.6 | 3.8 ± 0.6 | 3.9 ± 0.6 |
| Calcium | | | | | | | |
| Sample size | 3527 | 2760 | 655 | 112 | 3527 | 2760 | 653 | 114 |
| Usual Intake | 1032.4 ± 0.6 | 1032.7 ± 0.8 | 1031.5 ± 1.4 | 1030.5 ± 3.4 | 1056.2 ± 0.6 | 1056.5 ± 0.8 | 1055.3 ± 1.6 | 1054.5 ± 3.6 |
| % < EAR | 28.6 ± 1.8 | 28.6 ± 1.8 | 28.7 ± 1.8 | 28.4 ± 1.6 | 27.2 ± 1.6 | 27.2 ± 1.6 | 27.3 ± 1.6 | 27.0 ± 1.4 |
| % ≥ UL | 0.2 ± 0.0 | 0.2 ± 0.0 | 0.2 ± 0.0 | 0.1 ± 0.0 | 0.3 ± 0.0 | 0.3 ± 0.0 | 0.3 ± 0.0 | 0.3 ± 0.0 |
| Vitamin C, Selenium, and Carotenoids | | | | | | | |
| Sample size | 3518 | 2561 | 417 | 540 | 3518 | 2561 | 412 | 545 |
| Usual Intake | 81.9 ± 0.0 | 81.9 ± 0.0 | 81.6 ± 0.2 | 82.1 ± 0.2 | 90.5 ± 0.0 | 90.5 ± 0.2 | 90.2 ± 0.2 | 90.7 ± 0.2 |
| % < EAR | 45.6 ± 1.6 | 45.8 ± 1.6 | 45.0 ± 1.8 | 45.4 ± 1.6 | 40.2 ± 1.4 | 40.4 ± 1.4 | 39.4 ± 1.4 | 40.0 ± 1.4 |
| Vitamin D, Arsenic, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc | | | | | | | |
| Sample size | 3474 | 764 | 2012 | 698 | 3474 | 764 | 1925 | 785 |
| Usual Intake | 4.7 ± 0.0 | 4.7 ± 0.0 | 4.7 ± 0.0 | 4.7 ± 0.0 | 8.1 ± 0.0 | 8.1 ± 0.0 | 8.1 ± 0.0 | 8.1 ± 0.0 |
| % < EAR | 96.5 ± 0.8 | 96.5 ± 0.8 | 96.5 ± 0.6 | 96.6 ± 0.8 | 71.9 ± 2.2 | 71.9 ± 2.4 | 71.9 ± 2.2 | 71.9 ± 2.2 |

1 Data Source: What We Eat in America, NHANES 2009–2012 [22]. 2 Usual intake (UI), percent below the Estimated Average Requirement (% < EAR) and percent above or equal to the Tolerable Upper Limit (% ≥ UL) distributions estimated using the National Cancer Institute Method for individuals aged ≥2 years, excluding pregnant and lactating women. Accessible via https://epi.grants.cancer.gov/diet/usualintakes/method.html. 3 Using Current food label DV and Updated food label DV in Table 1 [17]. 4 Percent fortification subgroups for individuals consuming: (a) 0% of DV in the form of fortified food (0%), (b) >0–50% of the DV in the form of fortified food (>0–50% DV), or (c) >50% of DV in the form of fortified food (>50% DV). 5 Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B₆, Folate, Pantothenic Acid, Biotin, and Choline (1998). 6 Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc (2001) [34]. 7 Dietary Reference Intakes for Calcium and Vitamin D (2011) [35]. 8 Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids (2000) [36]. 9 Nutrients for which the % ≥ UL = 0 for Current DV and Updated DV models. 10 A UL was not available for the following nutrients: vitamin B₁₂, Thiamin, and Riboflavin. DV, Daily Value; US, United States; EAR, Estimated Average Requirement; UL, Tolerable Upper Limit.
Table A4. Comparison of Current Daily Value (DV) and Updated DV nutrient intake models with overall and percent fortification subgroups for US adults (51–70 years of age) (Mean ± SEM) \(^1,2\).

| Nutrient | Current DV \(^3\) | Updated DV \(^3\) |
|----------|------------------|------------------|
|          | Overall | Percent Fortification \(^4\)  | Overall | Percent Fortification \(^4\)  |
|          | 0% | >0–50% | >50% | 0% | >0–50% | >50% |

Vitamin B\(_{12}\) \(^5,10\)

| Sample size | Overall | Percent Fortification \(^4\)  | Overall | Percent Fortification \(^4\)  |
|-------------|---------|------------------|---------|------------------|
|             | 3319    | 2528             | 511     | 280               | 3319    | 2532             | 510     | 277               |
| Usual Intake| 5.2 ± 0.0 | 5.2 ± 0.0      | 5.2 ± 0.0 | 5.2 ± 0.0      | 4.5 ± 0.0 | 4.5 ± 0.0      | 4.5 ± 0.0 | 4.5 ± 0.0      |
| % < EAR     | 3.0 ± 0.6 | 3.0 ± 0.6      | 3.0 ± 0.6 | 3.1 ± 0.6      | 3.8 ± 0.6 | 3.8 ± 0.6      | 3.8 ± 0.6 | 3.8 ± 0.6      |

Vitamin A \(^6,9\)

| Sample size | Overall | Percent Fortification \(^4\)  | Overall | Percent Fortification \(^4\)  |
|-------------|---------|------------------|---------|------------------|
|             | 3326    | 746              | 2496    | 84                | 3326    | 1097             | 2164    | 65                |
| Usual Intake| 686.7 ± 0.4 | 688.8 ± 1.0 | 686.1 ± 0.6 | 684.1 ± 3.2 | 585.0 ± 0.4 | 586.5 ± 0.8 | 584.3 ± 0.6 | 583.4 ± 3.0 |
| % < EAR     | 37.7 ± 3.0 | 38.2 ± 2.8      | 37.4 ± 3.0 | 41.4 ± 3.6      | 51.8 ± 3.6 | 52.4 ± 3.4      | 51.3 ± 3.6 | 56.3 ± 4.0      |

Zinc \(^6,9\)

| Sample size | Overall | Percent Fortification \(^4\)  | Overall | Percent Fortification \(^4\)  |
|-------------|---------|------------------|---------|------------------|
|             | 3330    | 2761             | 512     | 57                | 3330    | 2776             | 503     | 51                |
| Usual Intake| 11.5 ± 0.0 | 11.5 ± 0.0     | 11.5 ± 0.0 | 11.5 ± 0.0     | 11.2 ± 0.0 | 11.2 ± 0.0     | 11.2 ± 0.0 | 11.2 ± 0.0     |
| % < EAR     | 20.1 ± 1.6 | 20.3 ± 1.6     | 19.2 ± 1.6 | 22.1 ± 2.0     | 21.3 ± 1.6 | 21.4 ± 1.6     | 20.2 ± 1.6 | 22.3 ± 2.0     |

Riboflavin \(^5,10\)

| Sample size | Overall | Percent Fortification \(^4\)  | Overall | Percent Fortification \(^4\)  |
|-------------|---------|------------------|---------|------------------|
|             | 3330    | 2482             | 701     | 147               | 3330    | 2488             | 667     | 175               |
| Usual Intake| 2.2 ± 0.0 | 2.2 ± 0.0      | 2.2 ± 0.0 | 2.2 ± 0.0      | 2.1 ± 0.0 | 2.1 ± 0.0      | 2.1 ± 0.0 | 2.1 ± 0.0      |
| % < EAR     | 3.0 ± 0.4 | 3.0 ± 0.4      | 2.9 ± 0.4 | 3.3 ± 0.4      | 3.2 ± 0.4 | 3.2 ± 0.4      | 3.0 ± 0.6 | 3.4 ± 0.6      |

Niacin \(^5\)

| Sample size | Overall | Percent Fortification \(^4\)  | Overall | Percent Fortification \(^4\)  |
|-------------|---------|------------------|---------|------------------|
|             | 3330    | 2459             | 672     | 199               | 3330    | 2463             | 674     | 193               |
| Usual Intake| 25.1 ± 0.0 | 25.1 ± 0.0     | 25.1 ± 0.0 | 25.1 ± 0.0     | 24.5 ± 0.0 | 24.5 ± 0.0     | 24.5 ± 0.0 | 24.4 ± 0.0     |
| % < EAR     | 1.5 ± 0.2 | 1.5 ± 0.2      | 1.4 ± 0.2 | 1.6 ± 0.2      | 1.6 ± 0.2 | 1.6 ± 0.2      | 1.5 ± 0.2 | 1.7 ± 0.2      |
| % ≥ UL      | 7.2 ± 1.0 | 7.2 ± 1.0      | 7.3 ± 1.0 | 7.3 ± 1.0      | 2.9 ± 0.6 | 2.9 ± 0.6      | 2.9 ± 0.6 | 2.9 ± 0.6      |

Thiamin \(^5,10\)

| Sample size | Overall | Percent Fortification \(^4\)  | Overall | Percent Fortification \(^4\)  |
|-------------|---------|------------------|---------|------------------|
|             | 3330    | 2479             | 691     | 160               | 3330    | 2482             | 701     | 147               |
| Usual Intake| 1.6 ± 0.0 | 1.6 ± 0.0      | 1.6 ± 0.0 | 1.6 ± 0.0      | 1.6 ± 0.0 | 1.6 ± 0.0      | 1.6 ± 0.0 | 1.6 ± 0.0      |
| % < EAR     | 6.8 ± 0.8 | 6.8 ± 0.8      | 6.6 ± 0.8 | 7.2 ± 1.0      | 7.3 ± 0.8 | 7.3 ± 0.8      | 7.2 ± 0.8 | 7.6 ± 1.0      |
Table A4. Cont.

| Nutrient | Current DV \(^3\) | Updated DV \(^3\) |
|----------|-------------------|-----------------|
|          | Overall | Percent Fortification \(^4\) | Overall | Percent Fortification \(^4\) |
|          | 0% | >0–50% | >50% | 0% | >0–50% | >50% |
| Vitamin B\(_6\) \(^5,9\) | | | | | | |
| Sample size | 3330 | 2455 | 619 | 256 | 3330 | 2455 | 626 | 249 |
| Usual Intake | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.1 ± 0.0 | 2.0 ± 0.0 | 2.0 ± 0.0 | 2.0 ± 0.0 | 2.0 ± 0.0 |
| % < EAR | 13.2 ± 1.0 | 13.1 ± 1.2 | 13.0 ± 1.0 | 13.8 ± 1.2 | 14.1 ± 1.2 | 14.0 ± 1.2 | 13.9 ± 1.2 | 14.6 ± 1.2 |
| Calcium \(^7\) | | | | | | | | |
| Sample size | 3330 | 2483 | 736 | 111 | 3330 | 2483 | 733 | 114 |
| Usual Intake | 972 ± 0.6 | 972 ± 0.8 | 972.7 ± 1.4 | 478.8 ± 3.2 | 997.1 ± 0.6 | 997.7 ± 0.8 | 997.9 ± 1.4 | 991.3 ± 3.4 |
| % < EAR | 46.5 ± 2.4 | 46.1 ± 2.4 | 47.8 ± 2.4 | 44.3 ± 2.2 | 44.2 ± 2.4 | 43.9 ± 2.4 | 45.5 ± 2.2 | 42.3 ± 2.2 |
| % ≥ UL | 1.0 ± 0.2 | 1.0 ± 0.2 | 1.0 ± 0.2 | 0.8 ± 0.4 | 1.4 ± 0.2 | 1.3 ± 0.2 | 1.4 ± 0.4 | 1.2 ± 0.4 |
| Vitamin C \(^8,9\) | | | | | | | | |
| Sample size | 3315 | 2392 | 461 | 462 | 3315 | 2392 | 458 | 465 |
| Usual Intake | 90.8 ± 0.0 | 90.8 ± 0.2 | 90.7 ± 0.2 | 90.8 ± 0.2 | 100.0 ± 0.2 | 100.0 ± 0.2 | 100.0 ± 0.2 | 100.1 ± 0.2 |
| % < EAR | 38.7 ± 1.8 | 38.9 ± 1.8 | 38.1 ± 2.0 | 38.4 ± 1.8 | 33.9 ± 1.6 | 34.1 ± 1.6 | 33.2 ± 1.8 | 33.7 ± 1.6 |
| Vitamin D \(^7,9\) | | | | | | | | |
| Sample size | 3273 | 624 | 2104 | 545 | 3273 | 624 | 2104 | 639 |
| Usual Intake | 4.9 ± 0.0 | 4.9 ± 0.0 | 4.9 ± 0.0 | 4.9 ± 0.0 | 8.5 ± 0.0 | 8.5 ± 0.0 | 8.5 ± 0.0 | 8.5 ± 0.0 |
| % < EAR | 95.9 ± 0.6 | 95.9 ± 0.6 | 96.0 ± 0.8 | 95.9 ± 0.6 | 69.3 ± 1.8 | 69.1 ± 1.6 | 69.3 ± 1.8 | 69.3 ± 1.8 |

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1 Data Source: What We Eat in America, NHANES 2009–2012 [22]. 2 Usual intake (UI), percent below the Estimated Average Requirement (% < EAR) and percent above or equal to the Tolerable Upper Limit (% ≥ UL) distributions estimated using the National Cancer Institute Method for individuals aged ≥2 years, excluding pregnant and lactating women. Accessible via https://epi.grants.cancer.gov/diet/usualintakes/method.html. 3 Using Current food label DV and Updated food label DV in Table 1 [17]. 4 Percent fortification subgroups for individuals consuming: (a) 0% of DV in the form of fortified food (0%), (b) >0–50% of the DV in the form of fortified food (>0–50% DV), or (c) >50% of the DV in the form of fortified food (>50% DV). 5 Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B\(_6\), Folate, Vitamin B\(_12\), Pantothenic Acid, Biotin, and Choline (1998). 6 Dietary Reference Intakes for Vitamin A, Vitamin K,Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum,Nickel,Silicon, Vanadium, and Zinc (2001) [34]. 7 Dietary Reference Intakes for Calcium and Vitamin D (2011) [35]. 8 Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids (2000) [36]. 9 Nutrients for which the % ≥ UL = 0 for Current DV and Updated DV models. 10 A UL was not available for the following nutrients: Vitamin B\(_12\), Thiamin, and Riboflavin. DV, Daily Value; US, United States; EAR, Estimated Average Requirement; UL, Tolerable Upper Limit.
Table A5. Comparison of Current Daily Value (DV) and Updated DV nutrient intake models with overall and percent fortification subgroups for US adults (> 70 years of age) (Mean ± SEM) 1,2.

| Nutrient      | Current DV 3 |                       | Updated DV 3 |                       |
|---------------|--------------|-----------------------|--------------|-----------------------|
|               | Overall      | Percent Fortification 4 | Overall      | Percent Fortification 4 |
|               | 0%           | >0–50%                | >50%         | 0%                     | >0–50%                | >50%         |
| **Vitamin B12** |              |                       |              |                       |
| Sample size   | 1573         | 993                   | 391          | 189                   | 1573                  | 996          | 392          | 185         |
| Usual Intake  | 5.1 ± 0.0    | 5.1 ± 0.0             | 5.1 ± 0.0    | 5.1 ± 0.0             | 4.4 ± 0.0             | 4.4 ± 0.0    | 4.4 ± 0.0    | 4.4 ± 0.0    |
| % < EAR       | 3.3 ± 0.6    | 3.2 ± 0.6             | 3.4 ± 0.8    | 3.4 ± 0.8             | 4.8 ± 1.0             | 4.7 ± 1.0    | 4.9 ± 1.2    | 5.2 ± 1.6    |
| **Vitamin A** |              |                       |              |                       |
| Sample size   | 1573         | 201                   | 1300         | 72                    | 1573                  | 305          | 1210         | 58          |
| Usual Intake  | 710.6 ± 0.8  | 711.2 ± 2.0           | 710.5 ± 0.8  | 709.3 ± 3.4           | 585.6 ± 0.6           | 585.6 ± 1.4  | 585.6 ± 0.6  | 586.1 ± 3.2  |
| % < EAR       | 34.3 ± 2.2   | 35.2 ± 2.2            | 34.0 ± 2.2   | 36.9 ± 2.4            | 51.4 ± 2.2            | 51.9 ± 2.4   | 51.1 ± 2.2   | 53.7 ± 2.4   |
| **Zinc**      |              |                       |              |                       |
| Sample size   | 1575         | 1130                  | 386          | 59                    | 1575                  | 1141         | 378          | 56          |
| Usual Intake  | 10.4 ± 0.0   | 10.4 ± 0.0            | 10.4 ± 0.0   | 10.4 ± 0.0            | 10.1 ± 0.0            | 10.1 ± 0.0   | 10.1 ± 0.0   | 10.1 ± 0.0   |
| % < EAR       | 27.9 ± 1.6   | 28.0 ± 1.6            | 27.6 ± 1.6   | 29.8 ± 2.2            | 30.6 ± 1.6            | 30.5 ± 1.6   | 30.6 ± 1.6   | 32.7 ± 2.0   |
| **Riboflavin**|              |                       |              |                       |
| Sample size   | 1575         | 927                   | 520          | 128                   | 1575                  | 928          | 522          | 125         |
| Usual Intake  | 2.0 ± 0.0    | 2.0 ± 0.0             | 2.0 ± 0.0    | 2.0 ± 0.0             | 2.0 ± 0.0             | 2.0 ± 0.0    | 2.0 ± 0.0    | 2.0 ± 0.0    |
| % < EAR       | 4.7 ± 0.6    | 4.6 ± 0.6             | 4.7 ± 0.6    | 5.8 ± 1.4             | 5.3 ± 0.6             | 5.2 ± 0.6    | 5.3 ± 0.6    | 6.5 ± 1.6    |
| **Niacin**    |              |                       |              |                       |
| Sample size   | 1575         | 926                   | 533          | 116                   | 1575                  | 928          | 536          | 111         |
| Usual Intake  | 21.8 ± 0.0   | 21.8 ± 0.0            | 21.8 ± 0.0   | 21.7 ± 0.0            | 21.1 ± 0.0            | 21.1 ± 0.0   | 21.1 ± 0.0   | 21.0 ± 0.0   |
| % < EAR       | 4.2 ± 0.4    | 4.1 ± 0.4             | 4.2 ± 0.6    | 5.0 ± 1.0             | 4.8 ± 0.6             | 4.6 ± 0.6    | 4.8 ± 0.6    | 5.6 ± 1.2    |
| % ≥ UL        | 14.2 ± 1.6   | 14.2 ± 1.6            | 14.3 ± 1.6   | 14.1 ± 1.8            | 6.5 ± 1.0             | 6.5 ± 1.0    | 6.6 ± 1.0    | 6.2 ± 1.2    |
| **Thiamin**   |              |                       |              |                       |
| Sample size   | 1575         | 920                   | 542          | 113                   | 1575                  | 921          | 552          | 102         |
| Usual Intake  | 1.5 ± 0.0    | 1.5 ± 0.0             | 1.5 ± 0.0    | 1.5 ± 0.0             | 1.4 ± 0.0             | 1.4 ± 0.0    | 1.4 ± 0.0    | 1.5 ± 0.0    |
| % < EAR       | 10.9 ± 1.0   | 10.8 ± 1.0            | 10.9 ± 1.0   | 11.9 ± 1.6            | 12.4 ± 1.0            | 12.3 ± 1.0   | 12.4 ± 1.0   | 13.2 ± 1.6   |
| **Vitamin B6**|              |                       |              |                       |
| Sample size   | 1575         | 926                   | 482          | 167                   | 1575                  | 926          | 485          | 164         |
| Usual Intake  | 1.9 ± 0.0    | 1.9 ± 0.0             | 1.9 ± 0.0    | 1.9 ± 0.0             | 1.9 ± 0.0             | 1.9 ± 0.0    | 1.9 ± 0.0    | 1.9 ± 0.0    |
| % < EAR       | 19.1 ± 1.4   | 18.9 ± 1.4            | 19.1 ± 1.4   | 19.8 ± 1.8            | 21.0 ± 1.6            | 20.9 ± 1.6   | 21.0 ± 1.6   | 21.8 ± 1.8   |
| Nutrient    | Overall | Percent Fortification | Overall | Percent Fortification |
|-------------|---------|-----------------------|---------|-----------------------|
|             | 0%      | >0–50%                | >50%    | 0%                    | >0–50%                | >50%    |
| Calcium     | 1575    | 1012                  | 508     | 55                    | 1575                 | 1012    | 507     | 56       |
| Usual Intake| 890.0 ± 0.8 | 890.3 ± 1.0            | 889.5 ± 1.4 | 889.1 ± 4.4          | 920.6 ± 0.8         | 920.9 ± 1.0       | 920.1 ± 1.6 | 919.5 ± 4.6 |
| % < EAR     | 67.5 ± 1.4 | 67.4 ± 1.4            | 67.6 ± 1.4 | 67.0 ± 1.8            | 64.0 ± 1.6          | 64.0 ± 1.6       | 64.1 ± 1.6       | 63.5 ± 1.6       |
| % ≥ UL      | 0.5 ± 0.0 | 0.5 ± 0.0             | 0.5 ± 0.0 | 0.5 ± 0.2             | 0.8 ± 0.2           | 0.8 ± 0.2       | 0.8 ± 0.2       | 0.7 ± 0.2       |
| Vitamin C   | 1571    | 989                   | 337     | 245                   | 1571                | 989             | 335     | 247       |
| Usual Intake| 92.8 ± 0.2 | 92.6 ± 0.2             | 93.0 ± 0.2 | 93.1 ± 0.4              | 102.8 ± 0.2        | 102.6 ± 0.2     | 103.0 ± 0.4     | 103.2 ± 0.4     |
| % < EAR     | 36.8 ± 1.8 | 36.9 ± 1.8            | 36.8 ± 1.8 | 36.4 ± 1.8             | 31.9 ± 1.6          | 32.0 ± 1.6      | 32.0 ± 1.6      | 31.4 ± 1.8      |
| Vitamin D   | 1563    | 176                   | 1055    | 332                   | 1563                | 176             | 1018    | 369       |
| Usual Intake| 5.3 ± 0.0 | 5.4 ± 0.0             | 5.3 ± 0.0 | 5.3 ± 0.0             | 9.5 ± 0.0          | 9.5 ± 0.0      | 9.5 ± 0.0      | 9.5 ± 0.0      |
| % < EAR     | 94.1 ± 0.8 | 94.0 ± 0.8             | 94.1 ± 1.0 | 94.0 ± 0.8              | 61.2 ± 2.0          | 61.1 ± 2.0     | 61.2 ± 2.0     | 61.3 ± 2.0     |

1 Data Source: What We Eat in America, NHANES 2009-2012 [22]. 2 Usual intake (UI), percent below the Estimated Average Requirement (% < EAR) and percent above or equal to the Tolerable Upper Limit (% ≥ UL) distributions estimated using the National Cancer Institute Method for individuals aged ≥2 years, excluding pregnant and lactating women. Accessible via [https://epi.grants.cancer.gov/diet/usualintakes/method.html](https://epi.grants.cancer.gov/diet/usualintakes/method.html). 3 Using Current food label DV and Updated food label DV in Table 1 [17]. 4 Percent fortification subgroups for individuals consuming: (a) 0% of DV in the form of fortified food (0%), (b) >0–50% of the DV in the form of fortified food (>0–50% DV), or (c) >50% of DV in the form of fortified food (>50% DV). 5 Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B<sub>6</sub>, Folate, Vitamin B<sub>12</sub>, Pantothenic Acid, Biotin, and Choline (1998) 6 Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc (2001) [34]. Dietary Reference Intakes for Calcium and Vitamin D (2011) [35]. Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids (2000) [36]. 7 Nutrients for which the % ≥ UL = 0 for Current DV and Updated DV models. 10 A UL was not available for the following nutrients: Vitamin B<sub>12</sub>, Thiamin, and Riboflavin.

DV, Daily Value; US, United States; EAR, Estimated Average Requirement; UL, Tolerable Upper Limit.
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