# Supplementary Information

**Table S1.** USDA food codes and logic for apportioning dietary intake

|  |  |
| --- | --- |
| **Food Group** | **USDA Food Code and Additional Logic** |
| Milk and Milk Products | DR1IFDCD = 1 |
| Meat, Poultry, and Mixtures | DR1IFDCD = 2 |
| Eggs | DR1IFDCD = 3 |
| Legumes, Nuts, and Seeds | DR1IFDCD = 4 |
| Grain Products | DR1IFDCD = 5 |
| Fruits | DR1IFDCD = 6 |
| Vegetables | DR1IFDCD = 7 |
| Fats, Oils, and Salad Dressings | DR1IFDCD = 8 |
| Sugars, Sweets, and Beverages | DR1IFDCD = 9 |
| Beer | DR1IFDCD = 93101000, 93102000, 93102100, 93102200, or 93102300Then subtract total mass from DR1IFDCD = 9 |
| Wine | DR1IFDCD = 934Then subtract total mass from DR1IFDCD = 9 |

**Table S2**. Sample-weighted geometric means, medians and selected percentiles of urinary MA concentration (µg/L) among NHANES 2005 – 2006 and 2011 – 2012 (N = 4690).

|  |  | **Median** |  |  | **Percentile** |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **GM [95%CI]a** | **[25th, 75th percentile]** | **2.5th**  | **5th**  | **10th**  | **90th**  | **95th**  | **97.5th**  | **N** |
| **Smoking Status** |  |  |  |  |  |  |  |  |  |
|  Exclusive Smoker | 240 [212, 269] | 243 [143, 425] | 30.1 | 55.4 | 84.8 | 702 | 893 | 1050 | 867 |
|  Non-user | 109 [103, 116] | 118 [63.5, 196] | 17.1 | 25.6 | 37.1 | 287 | 374 | 457 | 3823 |
| **Age (yr)** |  |  |  |  |  |  |  |  |  |
| 6 - 11 | 88.4 [80.6, 96.1] | 89.7 [52.1, 154] | 16.9 | 22.2 | 32.0 | 230 | 302 | 370 | 276 |
|  12 - 19  | 124 [112, 137] | 133 [75.2, 219] | 20.8 | 30.2 | 47.1 | 302 | 370 | 561 | 1135 |
|  20 - 39  | 135 [122, 148] | 146 [77.8, 243] | 17.5 | 27.5 | 39.5 | 422 | 577 | 845 | 1274 |
|  40 - 59  | 140 [124, 156] | 148 [77.7, 252] | 17.4 | 27.8 | 43.0 | 413 | 621 | 879 | 1035 |
|  ≥ 60  | 112 [103, 121] | 116 [65.7, 199] | 19.4 | 25.4 | 37.4 | 326 | 441 | 586 | 970 |
| **Race/ethnicity** |  |  |  |  |  |  |  |  |  |
|  Mexican-American | 124 [114, 135] | 141 [73.1, 215] | 20.7 | 27.0 | 38.2 | 314 | 412 | 618 | 925 |
|  Non-Hispanic Black | 160 [149, 172] | 162 [102, 253] | 26.5 | 38.7 | 61.4 | 421 | 594 | 758 | 1231 |
|  Non-Hispanic White | 124 [114, 134] | 128 [68.7, 227] | 16.8 | 26.4 | 39.5 | 384 | 538 | 798 | 1851 |
|  Other Hispanic or other/multi race | 125 [106, 144] | 134 [67.7, 229] | 18.7 | 27.1 | 39.3 | 370 | 571 | 680 | 683 |
| **Sex** |  |  |  |  |  |  |  |  |  |
|  Female | 110 [102, 119] | 116 [59.5, 208] | 15.4 | 24.5 | 34.9 | 337 | 461 | 642 | 2419 |
|  Male | 150 [140, 161] | 154 [90.7, 257] | 24.1 | 36.0 | 50.2 | 423 | 579 | 850 | 2271 |
| **Poverty Status** |  |  |  |  |  |  |  |  |  |
|  No | 126 [118, 135] | 132 [71.5, 227] | 18.2 | 27.4 | 40.5 | 375 | 511 | 720 | 3592 |
|  Yes | 139 [121, 157] | 146 [74.2, 258] | 17.0 | 29.9 | 40.9 | 420 | 623 | 814 | 1098 |
| **BMI** |  |  |  |  |  |  |  |  |  |
| Healthy weight | 114 [104, 125] | 122 [59.4, 222] | 13.1 | 24.5 | 37.3 | 350 | 476 | 681 | 1760 |
|  Overweight/Obese | 136 [127, 146] | 140 [81.9, 235] | 21.6 | 30.3 | 43.0 | 394 | 555 | 804 | 2838 |
|  Underweight | 134 [90.9, 178] | 131 [75.3, 244] | 20.7 | 21.4 | 35.9 | 466 | 560 | 790 | 92 |

a Geometric mean [95% confidence intervals]

**Table S3**. Sample-weighted geometric means, medians and selected percentiles of urinary MA concentration (µg/g, creatinine adjusted) among NHANES 2005 – 2006 and 2011 – 2012 (N = 4690).

|  |  | **Median** |  |  | **Percentile** |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **GM [95%CI]a** | **[25th, 75th percentile]** | **2.5th**  | **5th**  | **10th**  | **90th**  | **95th**  | **97.5th**  | **N** |
| **Smoking Status** |  |  |  |  |  |  |  |  |  |
|  Exclusive Smoker | 241 [220, 261] | 246 [159, 382] | 53.8 | 79.6 | 100 | 585 | 736 | 803 | 867 |
|  Non-user | 119 [115, 124] | 121 [88.4, 161] | 39.2 | 54.2 | 66.4 | 220 | 274 | 324 | 3823 |
| **Age (yr)** |  |  |  |  |  |  |  |  |  |
| 6 - 11 | 128 [116, 140] | 129 [94.6, 176] | 44.2 | 59.5 | 66.7 | 223 | 254 | 292 | 276 |
|  12 - 19  | 107 [100, 113] | 105 [79.5, 146] | 40.1 | 48.4 | 58.6 | 189 | 250 | 289 | 1135 |
|  20 - 39  | 135 [126, 143] | 130 [94.8, 193] | 41.4 | 53.8 | 66.2 | 297 | 392 | 526 | 1274 |
|  40 - 59  | 156 [143, 170] | 143 [105, 222] | 48.0 | 67.0 | 75.6 | 381 | 540 | 690 | 1035 |
|  ≥60  | 138 [129, 146] | 135 [93.9, 200] | 38.2 | 56.6 | 69.7 | 298 | 409 | 599 | 970 |
| **Race/ethnicity** |  |  |  |  |  |  |  |  |  |
|  Mexican-American | 127 [120, 134] | 124 [94.8, 169] | 39.1 | 53.6 | 70.5 | 255 | 328 | 518 | 925 |
|  Non-Hispanic Black | 117 [109, 125] | 117 [80.8, 165] | 37.5 | 47.6 | 57.2 | 251 | 343 | 442 | 1231 |
|  Non-Hispanic White | 143 [134, 152] | 137 [96.6, 201] | 43.5 | 58.4 | 70.2 | 323 | 469 | 670 | 1851 |
|  Other Hispanic or other/multi race | 137 [126, 149] | 131 [98.7, 191] | 48.4 | 59.9 | 71.3 | 275 | 372 | 473 | 683 |
| **Sex** |  |  |  |  |  |  |  |  |  |
|  Female | 144 [135, 153] | 139 [100, 198] | 43.7 | 58.4 | 70.6 | 313 | 460 | 620 | 2419 |
|  Male | 131 [126, 137] | 124 [89.4, 189] | 41.4 | 53.1 | 67.0 | 293 | 414 | 586 | 2271 |
| **Poverty Status** |  |  |  |  |  |  |  |  |  |
|  No | 138 [131, 144] | 132 [95.1, 193] | 42.9 | 57.4 | 70.1 | 298 | 416 | 581 | 3592 |
|  Yes | 138 [119, 156] | 131 [91.5, 196] | 39.5 | 51.0 | 63.6 | 362 | 486 | 656 | 1098 |
| **BMI** |  |  |  |  |  |  |  |  |  |
| Healthy weight | 139 [128, 149] | 132 [94.1, 202] | 39.5 | 52.3 | 66.9 | 311 | 427 | 668 | 1760 |
|  Overweight/Obese | 137 [130, 143] | 132 [94.6, 190] | 44.0 | 57.3 | 70.1 | 300 | 431 | 576 | 2838 |
|  Underweight | 160 [137, 183] | 157 [123, 188] | 68.2 | 73.9 | 97.8 | 300 | 407 | . | 92 |

a Geometric mean [95% confidence intervals]

**Table S4**. Sample-weighted geometric means, medians and selected percentiles of urinary PGA concentration (µg/L) among NHANES 2005 – 2006 and 2011 – 2012 (N = 4690).

|  |  | **Median** |  |  | **Percentile** |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **GM [95%CI]a** | **[25th, 75th percentile]** | **2.5th**  | **5th**  | **10th**  | **90th**  | **95th**  | **97.5th**  | **N** |
| **Smoking Status** |  |  |  |  |  |  |  |  |  |
|  Exclusive Smoker | 206 [177, 234] | 284 [112, 466] | . | . | 26.9 | 868 | 1090 | 1330 | 867 |
|  Non-user | 116 [108, 125] | 154 [61.8, 276] | . | . | 15.4 | 418 | 548 | 660 | 3823 |
| **Age (yr)** |  |  |  |  |  |  |  |  |  |
| 6 - 11 | 156 [144, 167] | 181 [98.9, 263] | 23.5 | 33.1 | 54.0 | 377 | 436 | 542 | 276 |
|  12 - 19  | 137 [120, 154] | 175 [81.9, 325] | . | . | 18.4 | 470 | 636 | 822 | 1135 |
|  20 - 39  | 134 [118, 150] | 172 [68.9, 334] | . | . | 18.3 | 558 | 729 | 931 | 1274 |
|  40 - 59  | 130 [111, 149] | 181 [68.1, 327] | . | . | . | 481 | 672 | 952 | 1035 |
|  ≥60  | 118 [108, 129] | 161 [57.7, 260] | . | . | 13.7 | 430 | 617 | 817 | 970 |
| **Race/ethnicity** |  |  |  |  |  |  |  |  |  |
|  Mexican-American | 122 [106, 139] | 156 [66.6, 279] | . | . | 18.1 | 429 | 555 | 693 | 925 |
|  Non-Hispanic Black | 162 [139, 186] | 199 [101, 341] | . | . | 27.4 | 517 | 706 | 931 | 1231 |
|  Non-Hispanic White | 126 [115, 137] | 170 [63.3, 316] | . | . | . | 485 | 702 | 901 | 1851 |
|  Other Hispanic or other/multi race | 137 [118, 156] | 170 [70.5, 315] | . | . | 27.8 | 484 | 622 | 842 | 683 |
| **Sex** |  |  |  |  |  |  |  |  |  |
|  Female | 116 [106, 126] | 145 [57.3, 287] | . | . | 13.3 | 441 | 646 | 823 | 2419 |
|  Male | 149 [136, 162] | 198 [83.1, 343] | . | . | 19.3 | 537 | 718 | 974 | 2271 |
| **Poverty Status** |  |  |  |  |  |  |  |  |  |
|  No | 126 [116, 136] | 169 [64.8, 313] | . | . | 12.8 | 471 | 667 | 875 | 3592 |
|  Yes | 163 [146, 180] | 193 [88.3, 354] | . | 13.6 | 32.6 | 563 | 680 | 951 | 1098 |
| **BMI** |  |  |  |  |  |  |  |  |  |
| Healthy weight | 115 [104, 126] | 143 [57.1, 297] | . | . | 10.9 | 465 | 605 | 852 | 1760 |
|  Overweight/Obese | 139 [128, 150] | 185 [77.7, 330] | . | . | 17.2 | 493 | 687 | 890 | 2838 |
|  Underweight | 162 [96.0, 228] | 172 [94.4, 328] | . | . | 41.6 | 517 | 922 | 1060 | 92 |

a Geometric mean [95% confidence intervals]

**Table S5**. Sample-weighted geometric means, medians and selected percentiles of urinary PGA concentration (µg/g, creatinine adjusted) among NHANES 2005 – 2006 and 2011 – 2012 (N = 4690).

|  |  | **Median** |  |  | **Percentile** |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **GM [95%CI]a** | **[25th, 75th percentile]** | **2.5th**  | **5th**  | **10th**  | **90th**  | **95th**  | **97.5th**  | **N** |
| **Smoking Status** |  |  |  |  |  |  |  |  |  |
|  Exclusive Smoker | 206 [188, 224] | 258 [156, 416] | 9.39 | 17.2 | 47.2 | 578 | 740 | 850 | 867 |
|  Non-user | 127 [118, 137] | 164 [101, 231] | 8.00 | 13.9 | 31.4 | 301 | 358 | 417 | 3823 |
| **Age (yr)** |  |  |  |  |  |  |  |  |  |
| 6 - 11 | 225 [211, 238] | 227 [178, 305] | 75.1 | 104 | 138 | 385 | 430 | 496 | 276 |
|  12 - 19  | 118 [103, 132] | 158 [95.0, 220] | 4.73 | 7.89 | 29.1 | 279 | 335 | 413 | 1135 |
|  20 - 39  | 134 [121, 147] | 164 [103, 240] | 7.89 | 12.4 | 32.5 | 342 | 443 | 598 | 1274 |
|  40 - 59  | 146 [128, 163] | 184 [102, 267] | 9.22 | 15.3 | 30.6 | 398 | 523 | 671 | 1035 |
|  ≥ 60  | 146 [131, 160] | 182 [106, 267] | 10.5 | 15.3 | 30.3 | 378 | 502 | 695 | 970 |
| **Race/ethnicity** |  |  |  |  |  |  |  |  |  |
|  Mexican-American | 124 [108, 141] | 157 [97.7, 225] | 6.87 | 10.6 | 33.1 | 292 | 387 | 451 | 925 |
|  Non-Hispanic Black | 119 [101, 136] | 149 [97.2, 209] | 4.92 | 8.87 | 35.7 | 295 | 373 | 447 | 1231 |
|  Non-Hispanic White | 145 [133, 157] | 186 [107, 268] | 8.93 | 14.3 | 30.0 | 388 | 509 | 654 | 1851 |
|  Other Hispanic or other/multi race | 150 [135, 165] | 171 [113, 248] | 14.4 | 25.6 | 53.0 | 336 | 430 | 557 | 683 |
| **Sex** |  |  |  |  |  |  |  |  |  |
|  Female | 151 [138, 164] | 187 [111, 271] | 9.68 | 16.1 | 36.7 | 375 | 481 | 612 | 2419 |
|  Male | 130 [121, 139] | 164 [100, 233] | 7.24 | 11.4 | 28.2 | 349 | 444 | 578 | 2271 |
| **Poverty Status** |  |  |  |  |  |  |  |  |  |
|  No | 137 [127, 148] | 175 [102, 252] | 7.98 | 13.8 | 30.3 | 357 | 447 | 593 | 3592 |
|  Yes | 161 [142, 180] | 184 [119, 273] | 9.60 | 23.8 | 54.9 | 404 | 538 | 632 | 1098 |
| **BMI** |  |  |  |  |  |  |  |  |  |
| Healthy weight | 140 [126, 153] | 176 [102, 261] | 8.66 | 12.6 | 29.0 | 379 | 508 | 648 | 1760 |
|  Overweight/Obese | 140 [130, 149] | 175 [106, 249] | 8.46 | 14.8 | 34.0 | 358 | 448 | 576 | 2838 |
|  Underweight | 192 [151, 234] | 191 [155, 286] | 45.3 | 49.3 | 92.0 | 424 | 441 | . | 92 |

a Geometric mean [95% confidence intervals]

**Table S6**. Sample-weighted multiple regression slopes for molar sum (MA + PGA) concentrations (µmol/L) among NHANES 2005 – 2006 and NHANES 2011 – 2012 exclusivesmokersa (N = 867).

| **Variable** | **Molar Sum (MA + PGA) (µmol/L)** |
| --- | --- |
| **Slope [95% CI]d** | ***p-*valuee** | **𝚫Y [95%CI]f** |
| **Intercept** | -0.083 [-0.312, 0.147] | 0.4680 | -0.262 [-0.864, 0.489] |
| **Creatinine, Urine [g/L]b** | 0.731 [0.639, 0.823] | <.0001 | 3.56 [2.98, 4.20] |
| **Fasting Time [HH.00]c** | 0.010 [-0.0004, 0.020] | 0.0595 | 0.033 [-9.49E-05, 0.066] |
| **Cotinine, Serum [ng/mL]** | 0.001 [0.0006, 0.002] | 0.0001 | 3.52E-03 [1.97E-03, 5.08E-03] |
| **NHANES Cycle** |  |  |  |
| 2005 – 2006 | Ref. | . | Ref. |
| 2011 – 2012 | 0.056 [-0.083, 0.194] | 0.4205 | 0.189 [-0.248, 0.688] |
| **Age (yr)** |  |  |  |
| 6 – 11 | — | . | — |
| 12 – 19 | -0.094 [-0.293, 0.106] | 0.3466 | -0.295 [-0.820, 0.342] |
| 20 – 39 | Ref. | . | Ref. |
| 40 – 59 | 0.140 [0.003, 0.277] | 0.0451 | 0.497 [0.028, 1.03] |
| ≥60 | 0.185 [0.004, 0.365] | 0.0450 | 0.670 [0.037, 1.42] |
| **Race/ethnicity** |  |  |  |
| Mexican-American | -0.235 [-0.392, -0.079] | 0.0044 | -0.693 [-1.06, -0.269] |
| Non-Hispanic Black | -0.170 [-0.270, -0.069] | 0.0016 | -0.516 [-0.772, -0.233] |
| Non-Hispanic White | Ref. | . | Ref. |
| Other Hispanic or Multi Race | -0.027 [-0.236, 0.182] | 0.7939 | -0.088 [-0.673, 0.627] |
| **Sex** |  |  |  |
| Female | 0.152 [0.039, 0.266] | 0.0100 | 0.544 [0.146, 0.988] |
| Male | Ref. | . | Ref. |
| **Poverty Status**  |  |  |  |
| No | Ref. | . | Ref. |
| Yes | 0.084 [-0.051, 0.219] | 0.2129 | 0.290 [-0.147, 0.788] |
| **BMI** |  |  |  |
| Healthy Weight | Ref. | . | Ref. |
| Overweight/Obese | 0.018 [-0.115, 0.152] | 0.7844 | 0.060 [-0.345, 0.522] |
| Underweight | 0.120 [-0.154, 0.393] | 0.3794 | 0.420 [-0.442, 1.54] |
| **Food Group** |  |  |  |
| Milk Products [kg/d] | -0.048 [-0.233, 0.137] | 0.5981 | -0.156 [-0.669, 0.457] |
| Meat, Poultry [kg/d] | -0.141 [-0.404, 0.121] | 0.2814 | -0.436 [-1.08, 0.390] |
| Eggs [kg/d] | 0.239 [-0.606, 1.08] | 0.5685 | 0.892 [-1.44, 6.15] |
| Legumes, Nuts, Seeds [kg/d] | 0.131 [-0.483, 0.746] | 0.6661 | 0.464 [-1.22, 3.50] |
| Grain Products [kg/d] | 0.159 [-0.004, 0.322] | 0.0548 | 0.571 [8.85E-03, 1.23] |
| Fruits [kg/d] | -0.469 [-0.739, -0.199] | 0.0013 | -1.24 [-1.71, -0.623] |
| Vegetables [kg/d] | -0.287 [-0.577, 0.003] | 0.0521 | -0.825 [-1.43, -0.027] |
| Fats, Oils, Salad Dressings [kg/d] | -0.990 [-2.79, 0.813] | 0.2717 | -2.08 [-3.09, 3.66] |
| Sugars, Sweets, Beverages [kg/d] | -0.018 [-0.061, 0.025] | 0.3946 | -0.060 [-0.191, 0.077] |
| Beer [kg/d] | 0.044 [-0.099, 0.187] | 0.5324 | 0.150 [-0.294, 0.659] |
| Wine [kg/d] | -0.192 [-0.811, 0.426] | 0.5310 | -0.579 [-1.80, 1.64] |

a Participants with serum cotinine measurement >10 ng/mL

b Although urinary creatinine concentration is usually reported in mg/dL, here this concentration is in g/L so that its slope simplifies to the more readily interpretable scale of μg/g creatinine.

c The time between when the participant last ate or drank anything other than water and the time of the venipuncture.

d 95% confidence interval

e *p*-Values estimated from identical models where the dependent variable was natural log-transformed

f 𝚫Y is the expected change in biomarker concentration in µmol/L associated with a unit-increase in the predictor, controlling for other predictors in the model. 𝚫Y [95%CI] computed with GM[Y] = 3.31 µmol/L

**Table S7**. Sample-weighted multiple regression slopes for molar sum (MA + PGA) concentrations (µmol/L) among NHANES 2005 – 2006 and NHANES 2011 – 2012 non-usersa (N = 3823).

| **Variable** | **Molar Sum (MA + PGA) (µmol/L)** |
| --- | --- |
| **Slope [95% CI]d** | ***p-*valuee** | **𝚫Y [95%CI]f** |
| **Intercept** | -0.732 [-0.961, -0.502] | <.0001 | -0.857 [-1.01, -0.661] |
| **Creatinine, Urine [g/L]b** | 0.826 [0.761, 0.891] | <.0001 | 2.12 [1.89, 2.37] |
| **Fasting Time [HH.00]c** | 0.005 [-0.001, 0.011] | 0.1236 | 8.24E-03 [-1.97E-03, 0.0185] |
| **Cotinine, Serum [ng/mL]** | 0.026 [0.010, 0.042] | 0.0018 | 0.043 [0.018, 0.069] |
| **NHANES Cycle** |  |  |  |
| 2005 – 2006 | Ref. | . | Ref. |
| 2011 – 2012 | 0.275 [0.210, 0.339] | <.0001 | 0.522 [0.390, 0.662] |
| **Age (yr)** |  |  |  |
| 6 – 11 | 0.192 [0.078, 0.305] | 0.0016 | 0.349 [0.142, 0.580] |
| 12 – 19 | -0.056 [-0.139, 0.027] | 0.1758 | -0.091 [-0.210, 0.039] |
| 20 – 39 | Ref. | . | Ref. |
| 40 – 59 | 0.099 [0.007, 0.190] | 0.0366 | 0.171 [0.017, 0.340] |
| ≥60 | 0.138 [0.058, 0.219] | 0.0014 | 0.245 [0.103, 0.398] |
| **Race/ethnicity** |  |  |  |
| Mexican-American | 0.009 [-0.083, 0.102] | 0.8400 | 0.015 [-0.127, 0.170] |
| Non-Hispanic Black | -0.192 [-0.268, -0.116] | <.0001 | -0.288 [-0.384, -0.185] |
| Non-Hispanic White | Ref. | . | Ref. |
| Other Hispanic or Multi Race | -0.048 [-0.123, 0.027] | 0.2046 | -0.077 [-0.186, 0.041] |
| **Sex** |  |  |  |
| Female | 0.078 [-0.005, 0.160] | 0.0653 | 0.133 [-3.44E-03, 0.281] |
| Male | Ref. | . | Ref. |
| **Poverty Status** |  |  |  |
| No | Ref. | . | Ref. |
| Yes | 0.006 [-0.087, 0.100] | 0.8917 | 0.010 [-0.132, 0.167] |
| **BMI** |  |  |  |
| Healthy Weight | Ref. | . | Ref. |
| Overweight/Obese | 0.007 [-0.063, 0.078] | 0.8318 | 0.012 [-0.097, 0.129] |
| Underweight | 0.114 [-0.091, 0.318] | 0.2666 | 0.199 [-0.132, 0.601] |
| **Food Group** |  |  |  |
| Milk Products [kg/d] | 0.085 [-0.034, 0.205] | 0.1553 | 0.147 [-0.048, 0.366] |
| Meat, Poultry [kg/d] | 0.041 [-0.102, 0.183] | 0.5640 | 0.069 [-0.151, 0.321] |
| Eggs [kg/d] | 0.472 [-0.144, 1.09] | 0.1285 | 0.995 [-0.188, 3.13] |
| Legumes, Nuts, Seeds [kg/d] | -0.153 [-0.514, 0.207] | 0.3930 | -0.235 [-0.650, 0.353] |
| Grain Products [kg/d] | 0.040 [-0.090, 0.169] | 0.5386 | 0.067 [-0.135, 0.295] |
| Fruits [kg/d] | -0.110 [-0.220, 0.0005] | 0.0509 | -0.172 [-0.321, -6.12E-03] |
| Vegetables [kg/d] | -0.093 [-0.270, 0.083] | 0.2889 | -0.147 [-0.382, 0.131] |
| Fats, Oils, Salad Dressings [kg/d] | -0.086 [-1.28, 1.10] | 0.8839 | -0.136 [-1.17, 3.11] |
| Sugars, Sweets, Beverages [kg/d] | -0.014 [-0.044, 0.016] | 0.3416 | -0.023 [-0.070, 0.024] |
| Beer [kg/d] | 0.138 [0.033, 0.243] | 0.0116 | 0.244 [0.062, 0.446] |
| Wine [kg/d] | -0.073 [-0.570, 0.424] | 0.7676 | -0.116 [-0.700, 0.826] |

a Participants with serum cotinine measurement >10 ng/mL

b Although urinary creatinine concentration is usually reported in mg/dL, here this concentration is in g/L so that its slope simplifies to the more readily interpretable scale of μg/g creatinine.

c The time between when the participant last ate or drank anything other than water and the time of the venipuncture.

d 95% confidence interval

e *p*-Values estimated from identical models where the dependent variable was natural log-transformed

f 𝚫Y is the expected change in biomarker concentration in µmol/L associated with a unit-increase in the predictor, controlling for other predictors in the model. 𝚫Y [95%CI] computed with GM[Y] =1.65 µmol/L

**Table S8**. Sample-weighted multiple regression slopes for urinary MA and PGA

concentrations (µg/L) among NHANES 2005 – 2006 and NHANES 2011 – 2012 (N = 4500).

|  |  |  |
| --- | --- | --- |
| **Variable** | **MA (µg/L)**  | **PGA (µg/L)**  |
| **Slope [95% CI]d** | ***p-*valuee** | **𝚫Y [95%CI]f** | **Slope [95% CI]d** | ***p-*valuee** | **𝚫Y [95%CI]f** |
| **Intercept** | 3.81 [3.61, 4.01] | <.0001 | 5.63E+03 [4.62E+03, 6.85E+03] | 3.12 [2.82, 3.42] | <.0001 | 2.82E+03 [2.07E+03, 3.82E+03] |
| **Creatinine, urine [g/L]a** | 0.717 [0.665, 0.769] | <.0001 | 133 [120, 146] | 0.925 [0.855, 0.996] | <.0001 | 198 [177, 221] |
| **Fasting time [HH.00]b** | -0.001 [-0.006, 0.004] | 0.6969 | -0.118 [-0.707, 0.473] | 0.015 [0.007, 0.023] | 0.0007 | 1.92 [0.916, 2.93] |
| **CPD Groupc** |  |  |  |  |  |  |
| ≤0.05 ng/mL cotinine, serum | Ref. | . | Ref. | Ref. | . | Ref. |
| >0.05 – ≤10 ng/mL cotinine, serum | 0.018 [-0.051, 0.087] | 0.5934 | 2.34 [-5.96, 11.2] | 0.054 [-0.040, 0.148] | 0.2526 | 7.22 [-4.71, 20.3] |
| 1-10 CPD (0.5 pack) | 0.572 [0.469, 0.675] | <.0001 | 97.9 [76.8, 121] | 0.426 [0.319, 0.534] | <.0001 | 69.3 [49.7, 91.0] |
| 11-20 CPD (1 pack) | 0.954 [0.850, 1.06] | <.0001 | 202 [171, 237] | 0.745 [0.531, 0.960] | <.0001 | 144 [93.2, 207] |
| >20 CPD (>1 pack) | 1.11 [0.849, 1.37] | <.0001 | 257 [173, 366] | 0.971 [0.655, 1.29] | <.0001 | 214 [123, 336] |
| **NHANES Cycle** |  |  |  |  |  |  |
| 2005 – 2006 | Ref. | . | Ref. | Ref. | . | Ref. |
| 2011 – 2012 | 0.012 [-0.077, 0.102] | 0.7787 | 1.59 [-9.01, 13.1] | 0.700 [0.593, 0.808] | <.0001 | 132 [106, 161] |
| **Age (yr)** |  |  |  |  |  |  |
| 6-11 | 0.020 [-0.102, 0.142] | 0.7390 | 2.57 [-11.7, 18.7] | 0.330 [0.177, 0.482] | 0.0001 | 50.9 [26.1, 79.5] |
| 12-19 | -0.091 [-0.163, -0.019] | 0.0146 | -11.1 [-18.8, -2.77] | -0.055 [-0.150, 0.039] | 0.2422 | -7.01 [-17.7, 4.73] |
| 20-39 | Ref. | . | Ref. | Ref. | . | Ref. |
| 40-59 | 0.100 [0.003, 0.198] | 0.0444 | 13.4 [0.805, 27.1] | 0.074 [-0.055, 0.202] | 0.2501 | 9.99 [-6.32, 28.4] |
| ≥60 | 0.067 [-0.012, 0.145] | 0.0933 | 8.74 [-1.12, 19.4] | 0.145 [0.037, 0.254] | 0.0101 | 20.4 [5.48, 36.9] |
| **Race/ethnicity** |  |  |  |  |  |  |
| Mexican-American | 0.055 [-0.019, 0.129] | 0.1400 | 7.17 [-2.04, 17.1] | -0.062 [-0.190, 0.066] | 0.3285 | -7.88 [-22.1, 8.17] |
| Non-Hispanic Black | -0.096 [-0.172, -0.020] | 0.0155 | -11.6 [-19.7, -2.81] | -0.254 [-0.361, -0.147] | <.0001 | -29.2 [-39.1, -18.3] |
| Non-Hispanic White | Ref. | . | Ref. | Ref. | . | Ref. |
| Other Hispanic or Multi Race | -0.008 [-0.088, 0.072] | 0.8411 | -0.998 [-10.3, 9.02] | -0.036 [-0.127, 0.055] | 0.4273 | -4.60 [-15.1, 6.90] |
| **Sex** |  |  |  |  |  |  |
| Female | 0.019 [-0.062, 0.101] | 0.6304 | 2.48 [-7.24, 13.0] | 0.152 [0.035, 0.269] | 0.0124 | 21.4 [5.27, 39.5] |
| Male | Ref. | . | Ref. | Ref. | . | Ref. |
| **Poverty Status** |  |  |  |  |  |  |
| No | Ref. | . | Ref. | Ref. | . | Ref. |
| Yes | -0.032 [-0.120, 0.056] | 0.4608 | -4.02 [-14.0, 6.82] | 0.053 [-0.048, 0.153] | 0.2955 | 7.02 [-5.64, 21.0] |
| **BMI** |  |  |  |  |  |  |
| Healthy weight | Ref. | . | Ref. | Ref. | . | Ref. |
| Overweight/Obese | 0.008 [-0.062, 0.078] | 0.8173 | 1.01 [-7.27, 9.87] | 0.009 [-0.076, 0.093] | 0.8378 | 1.12 [-9.13, 12.2] |
| Underweight | 0.055 [-0.115, 0.225] | 0.5158 | 7.15 [-13.1, 30.9] | 0.207 [-0.059, 0.472] | 0.1228 | 29.9 [-6.22, 76.6] |
| **Food Group** |  |  |  |  |  |  |
| Milk Products [kg/d] | 0.006 [-0.107, 0.118] | 0.9209 | 0.704 [-12.4, 15.3] | 0.053 [-0.049, 0.154] | 0.2958 | 7.08 [-5.69, 21.2] |
| Meat, Poultry [kg/d] | 0.033 [-0.107, 0.172] | 0.6360 | 4.21 [-12.2, 23.0] | -0.030 [-0.250, 0.189] | 0.7804 | -3.89 [-28.0, 25.8] |
| Eggs [kg/d] | 0.478 [0.017, 0.938] | 0.0425 | 77.7 [4.45, 192] | 0.448 [-0.425, 1.32] | 0.3037 | 73.7 [-42.3, 343] |
| Legumes, Nuts, Seeds [kg/d] | 0.070 [-0.262, 0.402] | 0.6698 | 9.20 [-28.0, 60.3] | -0.260 [-0.801, 0.280] | 0.3340 | -29.9 [-70.6, 38.7] |
| Grain Products [kg/d] | 0.058 [-0.058, 0.173] | 0.3162 | 7.55 [-6.60, 23.4] | 0.088 [-0.074, 0.249] | 0.2768 | 11.9 [-8.51, 35.8] |
| Fruits [kg/d] | -0.037 [-0.172, 0.099] | 0.5848 | -4.58 [-19.5, 12.5] | -0.414 [-0.557, -0.271] | <.0001 | -44.2 [-55.3, -31.4] |
| Vegetables [kg/d] | -0.158 [-0.293, -0.023] | 0.0229 | -18.6 [-31.7, -3.56] | -0.013 [-0.227, 0.202] | 0.9056 | -1.63 [-25.6, 27.9] |
| Fats, Oils, Salad Dressings [kg/d] | 0.306 [-0.738, 1.35] | 0.5546 | 45.4 [-63.8, 344] | -1.31 [-2.98, 0.365] | 0.1210 | -95.2 [-123, 45.9] |
| Sugars, Sweets, Beverages [kg/d] | -0.010 [-0.037, 0.017] | 0.4497 | -1.26 [-4.43, 1.99] | -0.004 [-0.035, 0.028] | 0.8150 | -0.479 [-4.39, 3.55] |
| Beer [kg/d] | 0.068 [-0.047, 0.183] | 0.2400 | 8.88 [-5.35, 24.8] | 0.072 [-0.043, 0.186] | 0.2109 | 9.66 [-4.89, 25.9] |
| Wine [kg/d] | 0.123 [-0.189, 0.435] | 0.4295 | 16.5 [-20.6, 66.7] | -0.384 [-0.870, 0.102] | 0.1172 | -41.6 [-74.7, 11.3] |

a Although urinary creatinine concentration is usually reported in mg/dL, here this concentration is in g/L so that its slope simplifies to the more readily interpretable scale of μg/g creatinine.

b The time between when the participant last ate or drank anything other than water and the time of the venipuncture.

c CPD: cigarettes smoked per day (exclusive smokers). Among exclusive smokers, 8.50% of participants smoked 1 – 10 CPD, 5.11% smoked 11 – 20 CPD, and 1.42% smoked >20 CPD.

d 95% confidence interval

e *p*-Values estimated from identical models where the dependent variable was natural log-transformed

f 𝚫Y is the expected change in biomarker concentration in µmol/L associated with a unit-increase in the predictor, controlling for other predictors in the model. 𝚫Y [95%CI] computed with GM[Y] = 127 µg/L for MA and GM[Y] = 130 µg/L for PGA.

|  |  |
| --- | --- |
| **Variable** | **Molar Sum (MA + PGA) (µmol/L)** |
| **Slope [95% CI]d** | ***p-*valuee** | **𝚫Y [95%CI]f** |
| **Intercept** | -0.660 [-0.876, -0.444] | <.0001 | -0.911 [-1.09, -0.686] |
| **Creatinine, urine [g/L]a** | 0.809 [0.756, 0.861] | <.0001 | 2.35 [2.14, 2.57] |
| **Fasting time [HH.00]b** | 0.005 [-0.0003, 0.011] | 0.0632 | 9.63E-03 [-1.77E-04, 0.020] |
| **CPD Groupc** |  |  |  |
| ≤0.05 ng/mL cotinine, serum | Ref. | . | Ref. |
| >0.05 – ≤10 ng/mL cotinine, serum | 0.022 [-0.044, 0.087] | 0.5062 | 0.041 [-0.077, 0.167] |
| 1-10 CPD (0.5 pack) | 0.494 [0.418, 0.570] | <.0001 | 1.21 [0.988, 1.44] |
| 11-20 CPD (1 pack) | 0.879 [0.758, 0.999] | <.0001 | 2.66 [2.16, 3.21] |
| >20 CPD (>1 pack) | 1.02 [0.787, 1.25] | <.0001 | 3.33 [2.29, 4.61] |
| **NHANES Cycle** |  |  |  |
| 2005 – 2006 | Ref. | . | Ref. |
| 2011 – 2012 | 0.255 [0.183, 0.328] | <.0001 | 0.548 [0.384, 0.724] |
| **Age (yr)** |  |  |  |
| 6-11 | 0.186 [0.063, 0.308] | 0.0042 | 0.384 [0.132, 0.669] |
| 12-19 | -0.069 [-0.136, -0.001] | 0.0457 | -0.126 [-0.236, -7.41E-03] |
| 20-39 | Ref. | . | Ref. |
| 40-59 | 0.089 [-0.002, 0.180] | 0.0561 | 0.175 [1.91E-03, 0.364] |
| ≥60 | 0.111 [0.045, 0.177] | 0.0017 | 0.222 [0.092, 0.360] |
| **Race/ethnicity** |  |  |  |
| Mexican-American | -0.012 [-0.092, 0.068] | 0.7600 | -0.023 [-0.161, 0.127] |
| Non-Hispanic Black | -0.177 [-0.240, -0.115] | <.0001 | -0.307 [-0.399, -0.209] |
| Non-Hispanic White | Ref. | . | Ref. |
| Other Hispanic or Multi Race | -0.049 [-0.111, 0.012] | 0.1120 | -0.091 [-0.194, 0.019] |
| **Sex** |  |  |  |
| Female | 0.070 [-0.010, 0.150] | 0.0831 | 0.137 [-0.013, 0.299] |
| Male | Ref. | . | Ref. |
| **Poverty Status** |  |  |  |
| No | Ref. | . | Ref. |
| Yes | 0.008 [-0.072, 0.089] | 0.8337 | 0.016 [-0.125, 0.168] |
| **BMI** |  |  |  |
| Healthy weight | Ref. | . | Ref. |
| Overweight/Obese | -0.0005 [-0.070, 0.069] | 0.9878 | -9.92E-04 [-0.123, 0.129] |
| Underweight | 0.081 [-0.113, 0.275] | 0.4017 | 0.159 [-0.189, 0.579] |
| **Food Group** |  |  |  |
| Milk Products [kg/d] | 0.046 [-0.046, 0.138] | 0.3206 | 0.088 [-0.079, 0.271] |
| Meat, Poultry [kg/d] | -0.008 [-0.143, 0.128] | 0.9102 | -0.014 [-0.242, 0.246] |
| Eggs [kg/d] | 0.442 [-0.109, 0.993] | 0.1123 | 1.05 [-0.160, 3.10] |
| Legumes, Nuts, Seeds [kg/d] | -0.053 [-0.409, 0.302] | 0.7630 | -0.098 [-0.616, 0.632] |
| Grain Products [kg/d] | 0.046 [-0.072, 0.163] | 0.4330 | 0.088 [-0.122, 0.324] |
| Fruits [kg/d] | -0.153 [-0.261, -0.045] | 0.0068 | -0.268 [-0.427, -0.091] |
| Vegetables [kg/d] | -0.098 [-0.227, 0.039] | 0.1606 | -0.169 [-0.375, 0.066] |
| Fats, Oils, Salad Dressings [kg/d] | -0.258 [-1.33, 0.816] | 0.6277 | -0.429 [-1.37, 2.21] |
| Sugars, Sweets, Beverages [kg/d] | -0.009 [-0.034, 0.017] | 0.4945 | -0.016 [-0.061, 0.030] |
| Beer [kg/d] | 0.067 [-0.044, 0.179] | 0.2289 | 0.131 [-0.074, 0.360] |
| Wine [kg/d] | -0.092 [-0.434, 0.250] | 0.5860 | -0.166 [-0.649, 0.504] |

**Table S9**. Sample-weighted multiple regression slopes for molar sum (MA + PGA)

concentrations (µmol/L) among NHANES 2005 – 2006 and NHANES 2011 – 2012 (N = 4500).

a Although urinary creatinine concentration is usually reported in mg/dL, here this concentration is in g/L so that its slope simplifies to the more readily interpretable scale of μg/g creatinine.

b The time between when the participant last ate or drank anything other than water and the time of the venipuncture.

c CPD: cigarettes smoked per day (exclusive smokers). Among exclusive smokers, 8.50% of participants smoked 1 – 10 CPD, 5.11% smoked 11 – 20 CPD, and 1.42% smoked >20 CPD.

d 95% confidence interval

e *p*-Values estimated from identical models where the dependent variable was natural log-transformed

f 𝚫Y is the expected change in biomarker concentration in µmol/L associated with a unit-increase in the predictor, controlling for other predictors in the model. 𝚫Y [95%CI] computed with GM[Y] = 1.89 µmol/L