**Biomarkers of Exposure among Adult Smokeless Tobacco Users in the Population Assessment of Tobacco and Health Study (Wave 1)**

**Online Data Supplements**

Table S1. Urinary BOEs in PATH Study Wave 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Panel** | **Reference** | **Analyte** | **Abbreviation** | **Limit of Detection (LOD)** | **Quality Material Precision CV (%)** | |
| **Low concentration** | **High concentration** |
| Nicotine metabolites | Wei et al., 2014; Bernert et al. 2005(1,2) | cotinine | COTT | 0.03 ng/mL | 3.52 | 3.08 |
| trans-3'-hydroxycotinine | HCTT | 0.03 ng/mL | 3.82 | 3.49 |
| anabasine | ANBT | 0.51 ng/mL | 6.26 | 4.93 |
| anatabine | ANTT | 0.39 ng/mL | 3.48 | 4.13 |
| cotinine N-oxide | COXT | 2.02 ng/mL | 5.82 | 4.04 |
| norcotinine | NCTT | 1.11 ng/mL | 3.64 | 3.63 |
| nicotine | NICT | 10.50 ng/mL | 7.42 | 3.35 |
| nornicotine | NNCT | 2.50 ng/mL | 5.79 | 5.66 |
| nicotine 1'-Oxide | NOXT | 2.50 ng/mL | 4.58 | 4.42 |
| Total Nicotine Equivalent-2 | TNE-2 | N/A (calculated as molar sum of COTT and HCTT) | N/A | N/A |
| Tobacco Specific Nitrosamines (TSNAs) | Xia et al. 2014(3) | 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanonol | NNAL | 0.0006 ng/mL | 2.86 | 2.82 |
| N'-nitrosoanabasine | NAB | 0.0016 ng/mL | 2.64 | 2.59 |
| N'-nitrosoanatabine | NAT | 0.0042 ng/mL | 5.02 | 3.84 |
| N'-nitrosonornicotine | NNN | 0.0028 ng/mL | 2.40 | 2.22 |
| Polycyclic Aromatic Hydocarbons (PAHs) | Wang et al., 2017(4) | 1-hydroxypyrene | 1-PYR | 70 ng/L | 12.57 | 9.02 |
| 3-hydroxyfluorene | 3-FLU | 8 ng/L | 5.96 | 5.77 |
| 2-hydroxyfluorene | 2-FLU | 8 ng/L | 5.34 | 5.64 |
| 1-hydroxynapthalene | 1-NAP | 60 ng/L | 7.32 | 5.03 |
| 2-hydroxynapthalene | 2-NAP | 90 ng/L | 5.67 | 5.23 |
| 1-hydroxyphenanthrene | 1-PHE | 9 ng/L | 7.86 | 6.66 |
| 2-hydroxyphenanthrene and 3-hydroxyphenanthrene | 2,3-PHE | 10 ng/L | 5.36 | 5.24 |
| Volatile Organic Compounds (VOCs) | Alwis et al. 2012; Alwis et al. 2016(5,6) | 2-Methylhippuric acid | 2MHA | 5.0 ng/mL | 9.13 | 7.27 |
| 3-Methylhippuric acid+4-Methylhippuric acid | 34MH | 8.0 ng/mL | 6.54 | 6.68 |
| N-Acetyl-S-(2-carbamoylethyl)-L-cysteine | AAMA | 2.2 ng/mL | 9.06 | 8.98 |
| N-Acetayl-S-(N-methylcarbamoyl)-L-cysteine | AMCA | 6.26 ng/mL | 10.65 | 6.88 |
| N-Acetyl-S-(benzyl)-L-cysteine | BMA | 0.5 ng/mL | 10.37 | 9.80 |
| N-Acetyl-S-(2-carboxyethyl)-L-cysteine | CEMA | 6.96 ng/mL | 7.46 | 6.25 |
| N-Acetyl-S-(1-cyano-2-hydroxyethyl)-L-cysteine | CYHA | 2.6 ng/mL | 8.98 | 4.93 |
| N-Acetyl-S-(2-cyanoethyl)-L-cysteine | CYMA | 0.5 ng/mL | 8.62 | 6.09 |
| N-Acetyl-S-(3,4-dihydroxybutyl)-L-cysteine | DHBM | 5.25 ng/mL | 6.37 | 8.26 |
| N-Acetyl-S-(2-carbamoyl-2-hydroxyethyl)-L-cysteine | GAMA | 9.4 ng/mL | 7.26 | 4.75 |
| N-Acetyl-S-(2-hydroxyethyl)-L-cysteine | HEMA | 0.791 ng/mL | 10.07 | 6.16 |
| N-Acetyl-S-(2-hydroxypropyl)-L-cysteine | HPM2 | 5.3 ng/mL | 7.60 | 7.21 |
| N-Acetyl-S-(3-hydroxypropyl)-L-cysteine | HPMA | 13 ng/mL | 8.28 | 9.64 |
| N-Acetyl-S-(3-hydroxypropyl-1-methyl)-L-cysteine | HPMM | 3.0 ng/mL | 7.35 | 5.49 |
| N-Acetyl-S-(4-hydroxy-2-methyl-2-buten-1-yl)-L-cysteine | IPM3 | 0.74 ng/mL | 9.45 | 5.91 |
| Mandelic acid | MADA | 12.0 ng/mL | 10.18 | 6.36 |
| N-Acetyl-S-(4-hydroxy-2-buten-1-yl)-L-cysteine | MHB3 | 0.6 ng/mL | 12.96 | 6.51 |
| Phenylglyoxylic acid | PHGA | 12.0 ng/mL | 12.21 | 12.93 |
| N-Acetyl-S-(phenyl)-L-cysteine | PMA | 0.6 ng/mL | 9.48 | 9.01 |
| 2-Thioxothiazolidine-4-carboxylic acid | TTCA | 11.2 ng/mL | 13.02 | 8.49 |
| Metals | Caldwell et al., 2005; Jarrett et al., 2008(7,8) | Cadmium | UCD | 0.036 µg/L | 10.28 | 4.89 |
| Lead | UPB | 0.03 µg/L | 5.36 | 1.39 |
| Beryllium | UBE | 0.016 µg/L | 3.76 | 2.49 |
| Cobalt | UCO | 0.023 µg/L | 14.46 | 3.96 |
| Manganese | UMN | 0.13 µg/L | 7.18 | 8.20 |
| Strontium | USR | 2.34 µg/L | 2.80 | 3.22 |
| Thallium | UTL | 0.018 µg/L | 5.12 | 2.78 |
| Uranium | UUR | 0.002 µg/L | 6.14 | 2.81 |
| Inorganic Arsenic Species | Caldwell et al., 2009; Verdon et al., 2009(9,10) | Arsenite | UAS3 | 0.12 µg/L | 5.07 | 5.11 |
| Arsenate | UAS5 | 0.79 µg/L | 4.14 | 3.37 |
| Dimethylarsinic acid | UDMA | 1.91 µg/L | 6.14 | 4.00 |
| Monomethylarsonic acid | UMMA | 0.20 µg/L | 4.19 | 5.11 |
| total inorganic arsenic |  | N/A (calculated as sum of the arsenous acid, arsenic acid, dimethylarsinic acid, and monomethylarsonic acid | N/A | N/A |

Table S2. Urinary BOEs of Nicotine Metabolites in PATH Study Wave 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Exclusive Current Est. Cig Users DAILY** | | | | | **Exclusive Current Est. Cig Users NONDAILY** | | | | | **Exclusive Current Est. SLT Users DAILY** | | | | |
| Analyte\* | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| TNE2 | umol/g creatinine | 1988 | 46.27 | 43.20 | 49.55 |  | 434 | 2.13 | 1.32 | 3.45 | † | 351 | 68.64 | 60.23 | 78.23 |  |
| COTT | ug/g creatinine | 1989 | 3013.03 | 2813.78 | 3226.39 |  | 437 | 136.55 | 86.14 | 216.45 |  | 351 | 4321.26 | 3774.42 | 4947.34 |  |
| HCTT | ug/g creatinine | 1988 | 5138.26 | 4733.14 | 5578.06 |  | 434 | 229.98 | 139.89 | 378.10 |  | 351 | 7911.31 | 6927.40 | 9034.96 |  |
| ANBT | ug/g creatinine | 1974 | 9.70 | 9.04 | 10.41 |  | 343 | 1.55 | 1.13 | 2.12 | † | 345 | 18.06 | 15.78 | 20.66 |  |
| ANTT | ug/g creatinine | 1972 | 16.77 | 15.45 | 18.20 |  | 342 | 2.06 | 1.46 | 2.91 |  | 345 | 37.88 | 32.67 | 43.92 |  |
| COXT | ug/g creatinine | 1974 | 365.62 | 344.90 | 387.58 |  | 343 | 62.88 | 47.69 | 82.90 |  | 345 | 517.31 | 465.24 | 575.20 |  |
| NCTT | ug/g creatinine | 1974 | 111.19 | 105.96 | 116.67 |  | 343 | 18.36 | 13.22 | 25.48 |  | 345 | 135.30 | 121.08 | 151.19 |  |
| NICT | ug/g creatinine | 1972 | 1446.22 | 1318.43 | 1586.40 |  | 343 | 138.44 | 99.79 | 192.07 |  | 345 | 1929.62 | 1682.91 | 2212.51 |  |
| NNCT | ug/g creatinine | 1967 | 75.70 | 71.23 | 80.46 |  | 342 | 11.35 | 8.39 | 15.36 |  | 344 | 99.90 | 88.40 | 112.91 |  |
| NOXT | ug/g creatinine | 1974 | 431.41 | 402.95 | 461.87 |  | 343 | 46.88 | 33.34 | 65.91 |  | 345 | 661.29 | 585.22 | 747.23 |  |
|  |  | **Exclusive Current Est. SLT Users NONDAILY** | | | | | **DAILY CIG+DAILY SLT** | | | | | **DAILY CIG+NONDAILY SLT** | | | | |
| Analyte\* | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| TNE2 | umol/g creatinine | 97 | 5.36 | 2.60 | 11.06 |  | 33 | 60.71 | 33.71 | 109.35 | † | 56 | 47.80 | 41.26 | 55.38 |  |
| COTT | ug/g creatinine | 97 | 341.45 | 169.52 | 687.73 |  | 33 | 4357.67 | 2157.61 | 8801.09 | † | 56 | 3521.00 | 3028.83 | 4093.16 |  |
| HCTT | ug/g creatinine | 97 | 605.81 | 285.18 | 1286.96 |  | 33 | 6514.03 | 3795.45 | 11179.85 | † | 56 | 5005.50 | 4090.20 | 6125.62 |  |
| ANBT | ug/g creatinine | 80 | 3.93 | 2.36 | 6.55 |  | 32 | 17.90 | 10.72 | 29.87 | † | 56 | 9.59 | 8.19 | 11.23 |  |
| ANTT | ug/g creatinine | 80 | 6.52 | 3.43 | 12.39 |  | 32 | 31.78 | 16.51 | 61.16 | † | 56 | 16.94 | 14.30 | 20.07 |  |
| COXT | ug/g creatinine | 80 | 104.13 | 63.54 | 170.66 |  | 32 | 543.57 | 408.48 | 723.33 | † | 56 | 367.29 | 321.12 | 420.10 |  |
| NCTT | ug/g creatinine | 80 | 31.04 | 18.46 | 52.18 |  | 32 | 159.79 | 123.00 | 207.58 | † | 56 | 104.66 | 90.69 | 120.77 |  |
| NICT | ug/g creatinine | 80 | 267.44 | 139.27 | 513.59 |  | 32 | 2138.74 | 1091.44 | 4190.98 | † | 56 | 1460.22 | 1162.88 | 1833.58 |  |
| NNCT | ug/g creatinine | 80 | 22.13 | 12.99 | 37.68 |  | 32 | 111.58 | 69.37 | 179.47 | † | 56 | 74.24 | 64.20 | 85.85 |  |
| NOXT | ug/g creatinine | 80 | 87.29 | 43.05 | 176.98 |  | 32 | 645.46 | 386.85 | 1076.96 | † | 56 | 410.68 | 347.91 | 484.79 |  |
|  |  | **NONDAILY CIG+DAILY SLT** | | | | | **NONDAILY CIG+ NONDAILY SLT** | | | | | **Never Tobacco Users** | | | | |
| Analyte\* | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| TNE2 | umol/g creatinine | 35 | 53.58 | 39.89 | 71.97 | † | 16 | 9.35 | 3.89 | 22.46 | † | 1633 | 0.01 | 0.01 | 0.01 |  |
| COTT | ug/g creatinine | 35 | 3491.60 | 2605.57 | 4678.93 | † | 16 | 645.91 | 278.14 | 1499.94 | † | 1644 | 0.42 | 0.36 | 0.48 |  |
| HCTT | ug/g creatinine | 35 | 6229.91 | 4564.57 | 8502.84 | † | 16 | 1047.85 | 417.48 | 2630.04 | † | 1641 | 0.69 | 0.59 | 0.80 |  |
| ANBT | ug/g creatinine | 35 | 10.97 | 6.82 | 17.65 | † | 15 | 1.59 | 0.76 | 3.33 | † | 88 | 0.61 | 0.35 | 1.05 | †, ‡ (73.9%) |
| ANTT | ug/g creatinine | 35 | 20.00 | 11.27 | 35.51 | † | 15 | 2.57 | 1.04 | 6.35 | † | 88 | 0.62 | 0.31 | 1.23 | †, ‡ (61.4%) |
| COXT | ug/g creatinine | 35 | 411.99 | 303.65 | 558.98 | † | 15 | 98.63 | 55.32 | 175.87 | † | 88 | 13.86 | 6.86 | 28.03 |  |
| NCTT | ug/g creatinine | 35 | 89.18 | 65.42 | 121.57 | † | 15 | 23.40 | 13.33 | 41.05 | † | 88 | 4.27 | 2.27 | 8.02 |  |
| NICT | ug/g creatinine | 35 | 1195.64 | 683.93 | 2090.22 | † | 15 | 195.30 | 62.07 | 614.55 | † | 88 | 31.30 | 12.32 | 79.51 |  |
| NNCT | ug/g creatinine | 35 | 59.69 | 40.33 | 88.33 | † | 15 | 12.35 | 5.99 | 25.45 | † | 88 | 3.39 | 1.85 | 6.22 | ‡ (63.6%) |
| NOXT | ug/g creatinine | 35 | 362.50 | 216.18 | 607.85 | † | 15 | 80.31 | 31.67 | 203.68 | † | 88 | 11.50 | 4.25 | 31.15 |  |

\*For samples with cotinine levels above or equal to 20 ng/mL, anatabine, anabasine, and nicotine plus its six major metabolites (cotinine-N-oxide, nicotine-N-oxide, trans-3'-hydroxycotinine, norcotinine, cotinine and nornicotine) were measured. For samples with cotinine levels less than 20 ng/mL, cotinine (COTT) and trans-3’-hydroxycotinine (HCTT) were measured.

† Estimate should be interpreted with caution because it has low precision. It is based on a sample size of less than 50, or the coefficient of variation of the estimate is larger than 30 percent. (i.e. RSE > 30% or n <50)

‡ Estimates were flagged due to more than 40% of the samples below LOD in the tobacco user group. The percentage of samples below LOD are in quotes.

Table S3. Urinary BOEs of TSNAs in PATH Study Wave 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Exclusive Current Est. Cig Users DAILY** | | | | | **Exclusive Current Est. Cig Users NONDAILY** | | | | | **Exclusive Current Est. SLT Users DAILY** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| NNAL | ng/g creatinine | 1988 | 298.30 | 276.26 | 322.10 |  | 436 | 27.09 | 21.66 | 33.88 |  | 351 | 996.71 | 852.08 | 1165.88 |  |
| NAB | ng/g creatinine | 1981 | 21.38 | 19.48 | 23.47 |  | 437 | 3.11 | 2.54 | 3.83 | ‡ (47.4%) | 351 | 41.97 | 35.71 | 49.32 |  |
| NAT | ng/g creatinine | 1965 | 141.04 | 128.51 | 154.78 |  | 434 | 12.75 | 9.81 | 16.57 | ‡ (42.1%) | 345 | 453.44 | 382.76 | 537.17 |  |
| NNN | ng/g creatinine | 1898 | 14.88 | 13.82 | 16.03 |  | 428 | 3.36 | 2.84 | 3.97 | ‡ (58.1%) | 335 | 33.90 | 29.61 | 38.81 |  |
|  |  | **Exclusive Current Est. SLT Users NONDAILY** | | | | | **DAILY CIG+DAILY SLT** | | | | | **DAILY CIG+NONDAILY SLT** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| NNAL | ng/g creatinine | 97 | 117.49 | 69.77 | 197.85 |  | 33 | 863.09 | 634.58 | 1173.89 | † | 56 | 358.00 | 298.67 | 429.12 |  |
| NAB | ng/g creatinine | 97 | 6.32 | 4.22 | 9.48 |  | 33 | 52.53 | 24.95 | 110.61 | † | 55 | 31.75 | 26.20 | 38.49 |  |
| NAT | ng/g creatinine | 97 | 39.47 | 22.94 | 67.89 |  | 33 | 454.54 | 193.82 | 1066.00 | † | 56 | 209.48 | 167.09 | 262.63 |  |
| NNN | ng/g creatinine | 94 | 7.37 | 4.97 | 10.94 | ‡ (46.4%) | 33 | 33.56 | 18.28 | 61.63 | † | 55 | 16.94 | 13.67 | 20.99 |  |
|  |  | **NONDAILY CIG+DAILY SLT** | | | | | **NONDAILY CIG+ NONDAILY SLT** | | | | | **Never Tobacco Users** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| NNAL | ng/g creatinine | 35 | 680.22 | 479.35 | 965.26 | † | 16 | 98.37 | 54.34 | 178.07 | † | 1653 | 0.92 | 0.82 | 1.04 | †, ‡ (45.5%) |
| NAB | ng/g creatinine | 35 | 30.63 | 20.13 | 46.61 | † | 15 | 7.65 | 4.72 | 12.41 | † | 1655 | 1.07 | 1.00 | 1.14 | †, ‡ (97.4%) |
| NAT | ng/g creatinine | 34 | 277.82 | 167.57 | 460.60 | † | 16 | 46.79 | 24.32 | 90.01 | † | 1648 | 2.92 | 2.74 | 3.11 | ‡ (97.5%) |
| NNN | ng/g creatinine | 34 | 18.11 | 11.58 | 28.31 | † | 16 | 4.43 | 2.41 | 8.14 | † | 1647 | 1.92 | 1.81 | 2.04 | ‡ (98.1%) |

† Estimate should be interpreted with caution because it has low precision. It is based on a sample size of less than 50, or the coefficient of variation of the estimate is larger than 30 percent (i.e. RSE > 30% or n <50)

‡ Estimates were flagged due to more than 40% of the samples below LOD in the tobacco user group. The percentage of samples below LOD are in quotes.

Table S4. Urinary BOEs of PAHs in PATH Study Wave 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Exclusive Current Est. Cig Users Daily** | | | | | **Exclusive Current Est. Cig Users Nondaily** | | | | | **Exclusive Current Est. SLT Users Daily** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| 1-PYR | ng/g creatinine | 1990 | 333.93 | 316.86 | 351.93 |  | 437 | 173.43 | 155.51 | 193.42 |  | 351 | 173.08 | 158.29 | 189.24 |  |
| 3-FLU | ng/g creatinine | 1990 | 709.56 | 676.58 | 744.14 |  | 437 | 165.64 | 141.19 | 194.33 |  | 351 | 164.05 | 149.15 | 180.44 |  |
| 2-FLU | ng/g creatinine | 1990 | 1228.17 | 1172.20 | 1286.82 |  | 437 | 334.43 | 295.75 | 378.17 |  | 351 | 324.07 | 299.46 | 350.71 |  |
| 1-NAP | ug/g creatinine | 1990 | 14.38 | 13.20 | 15.67 |  | 437 | 2.63 | 2.16 | 3.18 |  | 351 | 1.36 | 1.22 | 1.52 |  |
| 2-NAP | ug/g creatinine | 1990 | 15.84 | 15.22 | 16.49 |  | 437 | 6.49 | 5.70 | 7.38 |  | 351 | 4.44 | 3.97 | 4.98 |  |
| 1-PHE | ng/g creatinine | 1990 | 192.11 | 183.72 | 200.87 |  | 437 | 113.82 | 100.21 | 129.28 |  | 351 | 141.69 | 128.11 | 156.71 |  |
| 2,3-PHE | ng/g creatinine | 1990 | 338.00 | 321.74 | 355.09 |  | 437 | 166.26 | 151.68 | 182.24 |  | 351 | 224.92 | 207.37 | 243.95 |  |
|  |  | **Exclusive Current Est. SLT Users Nondaily** | | | | | **Daily CIG+Daily SLT** | | | | | **Daily CIG+Nondaily SLT** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| 1-PYR | ng/g creatinine | 97 | 151.81 | 125.28 | 183.96 |  | 33 | 289.28 | 229.70 | 364.32 | † | 56 | 343.58 | 239.32 | 493.26 |  |
| 3-FLU | ng/g creatinine | 96 | 99.71 | 79.40 | 125.21 |  | 33 | 463.76 | 327.81 | 656.11 | † | 56 | 656.44 | 519.67 | 829.20 |  |
| 2-FLU | ng/g creatinine | 97 | 213.81 | 176.72 | 258.69 |  | 33 | 872.83 | 635.01 | 1199.73 | † | 56 | 1194.03 | 940.72 | 1515.54 |  |
| 1-NAP | ug/g creatinine | 97 | 1.27 | 1.01 | 1.59 | † | 33 | 7.69 | 4.90 | 12.07 | † | 56 | 11.58 | 9.43 | 14.22 |  |
| 2-NAP | ug/g creatinine | 97 | 3.71 | 3.11 | 4.44 |  | 33 | 11.58 | 8.36 | 16.05 | † | 56 | 14.18 | 12.11 | 16.62 |  |
| 1-PHE | ng/g creatinine | 97 | 108.33 | 88.59 | 132.48 |  | 33 | 151.09 | 118.07 | 193.34 | † | 56 | 179.09 | 132.00 | 242.98 |  |
| 2,3-PHE | ng/g creatinine | 97 | 151.91 | 124.65 | 185.12 |  | 33 | 300.88 | 240.98 | 375.66 | † | 56 | 343.29 | 258.15 | 456.51 |  |
|  |  | **Nondaily CIG+Daily SLT** | | | | | **Nondaily CIG+ Nondaily SLT** | | | | | **Never Tobacco Users** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| 1-PYR | ng/g creatinine | 35 | 181.67 | 145.84 | 226.31 | † | 16 | 173.55 | 119.70 | 251.63 | † | 1655 | 128.13 | 120.68 | 136.04 |  |
| 3-FLU | ng/g creatinine | 35 | 229.60 | 178.40 | 295.48 | † | 16 | 197.92 | 127.89 | 306.30 | † | 1655 | 63.97 | 60.32 | 67.85 |  |
| 2-FLU | ng/g creatinine | 35 | 436.86 | 347.28 | 549.55 | † | 16 | 426.19 | 298.61 | 608.26 | † | 1655 | 167.20 | 158.05 | 176.88 |  |
| 1-NAP | ug/g creatinine | 35 | 2.28 | 1.57 | 3.31 | † | 16 | 3.13 | 2.01 | 4.87 | † | 1649 | 1.40 | 1.28 | 1.53 |  |
| 2-NAP | ug/g creatinine | 35 | 5.11 | 3.91 | 6.67 | † | 16 | 6.32 | 4.83 | 8.29 | † | 1652 | 4.63 | 4.34 | 4.94 |  |
| 1-PHE | ng/g creatinine | 35 | 125.93 | 102.21 | 155.17 | † | 16 | 104.29 | 78.72 | 138.17 | † | 1655 | 106.27 | 101.08 | 111.72 |  |
| 2,3-PHE | ng/g creatinine | 35 | 232.71 | 188.77 | 286.89 | † | 16 | 173.47 | 128.89 | 233.45 | † | 1655 | 129.09 | 123.14 | 135.33 |  |

† Estimate should be interpreted with caution because it has low precision. It is based on a sample size of less than 50, or the coefficient of variation of the estimate is larger than 30 percent (i.e. RSE > 30% or n <50).

Table S5. Urinary BOEs of VOCs in PATH Study Wave 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Exclusive Current Est. Cig Users Daily** | | | | | **Exclusive Current Est. Cig Users Nondaily** | | | | | **Exclusive Current Est. SLT Users Daily** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| 2MHA | ng/g creatinine | 1950 | 120012.66 | 113057.92 | 127395.22 |  | 429 | 38502.21 | 33821.78 | 43830.35 |  | 339 | 34073.23 | 29293.49 | 39632.86 |  |
| 34MH | ng/g creatinine | 1988 | 801413.65 | 757852.03 | 847479.21 |  | 437 | 260461.72 | 232546.39 | 291728.05 |  | 349 | 188053.52 | 164608.05 | 214838.37 |  |
| AAMA | ng/g creatinine | 1974 | 149828.00 | 143873.10 | 156029.36 |  | 434 | 71382.84 | 61633.48 | 82674.38 |  | 346 | 47720.21 | 44388.95 | 51301.47 |  |
| AMCA | ng/g creatinine | 1960 | 565534.61 | 538033.23 | 594441.71 |  | 433 | 193679.75 | 172770.76 | 217119.19 |  | 348 | 131970.61 | 123291.98 | 141260.14 |  |
| BMA | ng/g creatinine | 1980 | 6528.16 | 6076.45 | 7013.46 |  | 434 | 6325.53 | 5309.83 | 7535.52 |  | 345 | 5453.29 | 5074.68 | 5860.14 |  |
| CEMA | ng/g creatinine | 1869 | 309766.77 | 292804.42 | 327711.76 |  | 410 | 127686.85 | 111543.32 | 146166.81 |  | 333 | 95586.26 | 87689.90 | 104193.68 |  |
| CYHA | ng/g creatinine | 1989 | 28896.44 | 27074.77 | 30840.67 |  | 437 | 4558.12 | 3696.11 | 5621.16 | ‡ (50.1%) | 349 | 1960.34 | 1779.31 | 2159.80 | ‡ (94.8%) |
| CYMA | ng/g creatinine | 1989 | 176057.44 | 164689.84 | 188209.67 |  | 437 | 17454.75 | 13078.48 | 23295.39 |  | 349 | 1758.15 | 1546.84 | 1998.32 |  |
| DHBM | ng/g creatinine | 1772 | 523427.78 | 507651.96 | 539693.86 |  | 399 | 368245.42 | 344100.94 | 394084.06 |  | 319 | 360658.46 | 344411.27 | 377672.10 |  |
| GAMA | ng/g creatinine | 1869 | 18777.71 | 18096.62 | 19484.43 |  | 409 | 10447.26 | 9314.25 | 11718.09 | ‡ (41.2%) | 331 | 8693.44 | 8055.40 | 9382.03 | ‡ (57.9%) |
| HEMA | ng/g creatinine | 1717 | 3213.39 | 3001.22 | 3440.56 |  | 375 | 1233.91 | 1015.68 | 1499.04 |  | 318 | 875.13 | 798.72 | 958.85 | ‡ (48.7%) |
| HPM2 | ng/g creatinine | 1973 | 79841.45 | 75993.16 | 83884.61 |  | 433 | 36485.79 | 32316.89 | 41192.48 |  | 348 | 27866.75 | 25107.20 | 30929.61 |  |
| HPMA | ng/g creatinine | 1962 | 1387615.97 | 1300690.84 | 1480350.30 |  | 427 | 402487.78 | 345139.24 | 469365.40 |  | 342 | 250137.95 | 230630.03 | 271295.95 |  |
| HPMM | ng/g creatinine | 1989 | 2904648.33 | 2726442.18 | 3094502.41 |  | 437 | 719961.13 | 644948.02 | 803698.92 |  | 349 | 438283.52 | 407286.86 | 471639.18 |  |
| IPM3 | ng/g creatinine | 1987 | 45027.80 | 42059.07 | 48206.07 |  | 434 | 7341.99 | 6182.16 | 8719.41 |  | 344 | 3382.84 | 3062.88 | 3736.24 |  |
| MADA | ng/g creatinine | 1818 | 304670.92 | 293948.24 | 315784.75 |  | 398 | 173048.55 | 161773.22 | 185109.75 |  | 316 | 139993.69 | 128478.95 | 152540.44 |  |
| MHB3 | ng/g creatinine | 1989 | 34453.69 | 32599.19 | 36413.68 |  | 437 | 8871.14 | 7465.53 | 10541.40 |  | 348 | 4355.02 | 4014.23 | 4724.74 |  |
| PHGA | ng/g creatinine | 1881 | 404224.82 | 388639.52 | 420435.11 |  | 416 | 244724.14 | 223848.78 | 267546.27 |  | 337 | 222231.57 | 207893.16 | 237558.90 |  |
| PMA | ng/g creatinine | 1989 | 1096.50 | 1034.84 | 1161.84 |  | 437 | 911.10 | 815.88 | 1017.43 |  | 349 | 964.72 | 871.75 | 1067.59 |  |
| TTCA | ng/g creatinine | 1737 | 21928.14 | 20481.43 | 23477.03 |  | 381 | 19864.08 | 17270.31 | 22847.41 |  | 304 | 18141.95 | 15747.07 | 20901.07 |  |
|  |  | **Exclusive Current Est. SLT Users Nondaily** | | | | | **Daily CIG+Daily SLT** | | | | | **Daily CIG+Nondaily SLT** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| 2MHA | ng/g creatinine | 94 | 27834.28 | 20125.97 | 38494.89 |  | 32 | 101423.23 | 71993.60 | 142883.15 | † | 56 | 121635.20 | 96137.07 | 153896.13 |  |
| 34MH | ng/g creatinine | 97 | 171591.25 | 131076.20 | 224629.32 |  | 32 | 568121.15 | 383409.88 | 841818.79 | † | 56 | 830523.52 | 684555.95 | 1007615.70 |  |
| AAMA | ng/g creatinine | 96 | 41986.32 | 36359.62 | 48483.75 |  | 31 | 126860.33 | 87472.13 | 183984.82 | † | 56 | 126110.17 | 105589.72 | 150618.59 |  |
| AMCA | ng/g creatinine | 97 | 127384.54 | 109780.13 | 147812.01 |  | 32 | 414615.90 | 286845.44 | 599299.54 | † | 56 | 496887.12 | 431709.54 | 571904.92 |  |
| BMA | ng/g creatinine | 97 | 6019.86 | 4823.99 | 7512.18 |  | 31 | 4551.71 | 3326.90 | 6227.44 | † | 54 | 5432.67 | 4070.25 | 7251.13 |  |
| CEMA | ng/g creatinine | 91 | 92120.70 | 78223.81 | 108486.46 |  | 30 | 266442.44 | 174525.17 | 406769.82 | † | 54 | 238527.00 | 199774.09 | 284797.34 |  |
| CYHA | ng/g creatinine | 97 | 2195.85 | 1815.15 | 2656.39 | ‡ (94.8%) | 32 | 18535.56 | 10571.87 | 32498.22 | † | 56 | 30386.85 | 24618.68 | 37506.51 |  |
| CYMA | ng/g creatinine | 97 | 1481.70 | 1165.03 | 1884.43 |  | 32 | 99735.06 | 45011.62 | 220989.17 | † | 56 | 153780.10 | 121574.18 | 194517.60 |  |
| DHBM | ng/g creatinine | 86 | 324281.99 | 292069.70 | 360046.97 |  | 29 | 494465.78 | 380721.27 | 642192.67 | † | 49 | 398479.59 | 320196.00 | 495902.46 | † |
| GAMA | ng/g creatinine | 89 | 9010.87 | 7630.80 | 10640.54 | ‡ (67.0%) | 32 | 15991.63 | 12361.05 | 20688.55 | †, ‡ (46.9%) | 51 | 16865.14 | 14166.26 | 20078.20 |  |
| HEMA | ng/g creatinine | 83 | 857.33 | 711.32 | 1033.32 | ‡ (56.7%) | 29 | 2214.19 | 1606.93 | 3050.94 | † | 49 | 2588.95 | 2077.66 | 3226.07 | † |
| HPM2 | ng/g creatinine | 95 | 35672.59 | 26935.17 | 47244.31 |  | 31 | 65762.43 | 47779.84 | 90513.01 | † | 56 | 75455.31 | 62386.26 | 91262.16 |  |
| HPMA | ng/g creatinine | 97 | 267514.85 | 229408.17 | 311951.38 |  | 32 | 1031151.28 | 620326.41 | 1714054.01 | † | 53 | 1211544.10 | 988622.70 | 1484731.34 |  |
| HPMM | ng/g creatinine | 97 | 424346.58 | 368194.56 | 489062.13 |  | 32 | 1982942.11 | 1147802.22 | 3425729.05 | † | 56 | 2482233.71 | 1973291.62 | 3122439.75 |  |
| IPM3 | ng/g creatinine | 97 | 3397.02 | 2838.40 | 4065.57 |  | 30 | 31980.41 | 18026.68 | 56735.16 | † | 56 | 41994.43 | 34176.47 | 51600.77 |  |
| MADA | ng/g creatinine | 91 | 147051.78 | 119154.76 | 181480.16 |  | 29 | 294425.40 | 209935.36 | 412919.09 | † | 50 | 262071.97 | 227192.94 | 302305.68 |  |
| MHB3 | ng/g creatinine | 97 | 3988.51 | 3400.32 | 4678.44 |  | 32 | 24963.88 | 16200.98 | 38466.51 | † | 56 | 29718.70 | 24777.80 | 35644.86 |  |
| PHGA | ng/g creatinine | 94 | 217127.87 | 177993.40 | 264866.63 |  | 32 | 384216.70 | 286710.46 | 514883.44 | † | 52 | 357527.77 | 298317.16 | 428490.63 |  |
| PMA | ng/g creatinine | 97 | 981.94 | 820.19 | 1175.59 |  | 32 | 1299.47 | 900.85 | 1874.49 | † | 56 | 946.61 | 758.84 | 1180.83 |  |
| TTCA | ng/g creatinine | 82 | 22914.58 | 17905.67 | 29324.68 |  | 28 | 26708.52 | 17639.52 | 40440.17 | † | 54 | 14813.57 | 11336.86 | 19356.49 |  |
|  |  | **Nondaily CIG+Daily SLT** | | | | | **Nondaily CIG+ Nondaily SLT** | | | | | **Never Tobacco Users** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| 2MHA | ng/g creatinine | 35 | 40283.96 | 28725.98 | 56492.33 | † | 15 | 48446.96 | 27786.72 | 84468.70 | † | 1589 | 22258.40 | 20620.95 | 24025.88 |  |
| 34MH | ng/g creatinine | 35 | 259838.86 | 191259.74 | 353008.08 | † | 16 | 301497.99 | 167843.12 | 541583.34 | † | 1651 | 152328.24 | 143741.51 | 161427.92 |  |
| AAMA | ng/g creatinine | 35 | 62172.22 | 48842.99 | 79138.98 | † | 16 | 81238.75 | 59825.29 | 110316.80 | † | 1645 | 45301.98 | 43124.87 | 47589.00 |  |
| AMCA | ng/g creatinine | 34 | 165600.24 | 128999.66 | 212585.36 | † | 16 | 171955.74 | 135674.53 | 217939.02 | † | 1653 | 104256.20 | 98326.35 | 110543.66 |  |
| BMA | ng/g creatinine | 35 | 6673.19 | 5068.19 | 8786.47 | † | 16 | 4734.35 | 3448.68 | 6499.33 | † | 1653 | 6124.62 | 5781.64 | 6487.95 |  |
| CEMA | ng/g creatinine | 32 | 108242.07 | 94641.84 | 123796.69 | † | 16 | 116133.84 | 86403.35 | 156094.27 | † | 1599 | 93948.50 | 89656.31 | 98446.18 |  |
| CYHA | ng/g creatinine | 35 | 3734.49 | 2392.43 | 5829.41 | †, ‡ (51.4%) | 16 | 6665.26 | 3831.11 | 11596.03 | † | 1653 | 1817.60 | 1710.12 | 1931.83 | ‡ (95.7%) |
| CYMA | ng/g creatinine | 35 | 14073.39 | 8126.11 | 24373.32 | † | 16 | 33273.37 | 17242.17 | 64209.85 | † | 1653 | 1271.47 | 1192.49 | 1355.68 |  |
| DHBM | ng/g creatinine | 34 | 380609.32 | 322146.68 | 449681.67 | † | 14 | 400229.15 | 298266.60 | 537047.63 | † | 1481 | 347474.47 | 335686.77 | 359676.10 |  |
| GAMA | ng/g creatinine | 31 | 10193.70 | 7582.70 | 13703.78 | † | 16 | 9804.76 | 6954.75 | 13822.70 | † | 1581 | 8581.73 | 8098.27 | 9094.05 | ‡ (54.9%) |
| HEMA | ng/g creatinine | 31 | 954.92 | 665.41 | 1370.38 | † | 11 | 1251.75 | 667.62 | 2346.96 | † | 1508 | 961.54 | 891.29 | 1037.32 | ‡ (41.0%) |
| HPM2 | ng/g creatinine | 35 | 32979.28 | 26009.42 | 41816.88 | † | 16 | 43022.79 | 29818.38 | 62074.47 | † | 1605 | 32196.18 | 29213.08 | 35483.90 |  |
| HPMA | ng/g creatinine | 34 | 289010.80 | 228866.55 | 364960.47 | † | 16 | 383937.27 | 286609.45 | 514316.01 | † | 1653 | 261728.18 | 247178.69 | 277134.09 |  |
| HPMM | ng/g creatinine | 35 | 673603.35 | 524541.78 | 865024.47 | † | 16 | 770704.68 | 539126.02 | 1101756.70 | † | 1653 | 440946.09 | 416420.01 | 466916.69 |  |
| IPM3 | ng/g creatinine | 35 | 6736.92 | 4732.92 | 9589.44 | † | 16 | 10411.11 | 5183.71 | 20909.98 | † | 1637 | 3245.50 | 3043.03 | 3461.44 |  |
| MADA | ng/g creatinine | 33 | 169256.76 | 133566.51 | 214483.78 | † | 16 | 147713.74 | 109032.81 | 200117.27 | † | 1464 | 128056.60 | 122435.02 | 133936.29 |  |
| MHB3 | ng/g creatinine | 35 | 6880.81 | 5219.17 | 9071.47 | † | 16 | 10335.11 | 6752.80 | 15817.80 | † | 1653 | 4438.25 | 4241.12 | 4644.55 |  |
| PHGA | ng/g creatinine | 33 | 252338.61 | 205832.06 | 309353.04 | † | 16 | 229181.73 | 170223.22 | 308561.11 | † | 1550 | 202536.88 | 194481.51 | 210925.91 |  |
| PMA | ng/g creatinine | 35 | 908.48 | 690.72 | 1194.90 | † | 16 | 1198.84 | 757.23 | 1898.00 | † | 1653 | 1006.77 | 935.64 | 1083.30 |  |
| TTCA | ng/g creatinine | 33 | 20104.20 | 13615.55 | 29685.09 | † | 13 | 12440.64 | 9777.08 | 15829.84 | † | 1369 | 20661.03 | 18340.40 | 23275.30 |  |

† Estimate should be interpreted with caution because it has low precision. It is based on a sample size of less than 50, or the coefficient of variation of the estimate is larger than 30 percent. (i.e. RSE > 30% or n <50)

‡ Estimates were flagged due to more than 40% of the samples below LOD in the tobacco user group. The percentage of samples below LOD are in quotes.

Table S6. Urinary BOEs of Metals in PATH Study Wave 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Exclusive Current Est. Cig Users Daily** | | | | | **Exclusive Current Est. Cig Users Nondaily** | | | | | **Exclusive Current Est. SLT Users Daily** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| Cadmium | ug/g creatinine | 1982 | 0.311 | 0.291 | 0.331 |  | 437 | 0.146 | 0.124 | 0.172 |  | 351 | 0.134 | 0.122 | 0.147 |  |
| Lead | ug/g creatinine | 1982 | 0.494 | 0.474 | 0.516 |  | 437 | 0.378 | 0.333 | 0.430 |  | 351 | 0.412 | 0.375 | 0.452 |  |
| Beryllium | ug/g creatinine | 1982 | 0.012 | 0.011 | 0.013 | ‡ (93.9%) | 437 | 0.011 | 0.010 | 0.012 | ‡ (93.1%) | 351 | 0.011 | 0.010 | 0.012 | ‡ (92.0%) |
| Cobalt | ug/g creatinine | 1982 | 0.545 | 0.526 | 0.564 |  | 437 | 0.501 | 0.452 | 0.555 |  | 351 | 0.457 | 0.430 | 0.485 |  |
| Manganese | ug/g creatinine | 1981 | 0.139 | 0.132 | 0.147 | ‡ (56.0%) | 437 | 0.114 | 0.101 | 0.130 | ‡ (60.0%) | 350 | 0.128 | 0.116 | 0.142 | ‡ (57.0%) |
| Strontium | ug/g creatinine | 1980 | 113.354 | 106.811 | 120.297 |  | 436 | 111.097 | 99.279 | 124.321 |  | 351 | 115.031 | 104.595 | 126.508 |  |
| Thallium | ug/g creatinine | 1982 | 0.153 | 0.147 | 0.158 |  | 437 | 0.162 | 0.152 | 0.173 |  | 351 | 0.140 | 0.131 | 0.150 |  |
| Uranium | ug/g creatinine | 1982 | 0.007 | 0.007 | 0.008 |  | 437 | 0.006 | 0.004 | 0.007 |  | 351 | 0.005 | 0.005 | 0.006 |  |
|  |  | **Exclusive Current Est. SLT Users Nondaily** | | | | | **Daily CIG+Daily SLT** | | | | | **Daily CIG+Nondaily SLT** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| Cadmium | ug/g creatinine | 97 | 0.098 | 0.084 | 0.114 |  | 33 | 0.226 | 0.153 | 0.333 | † | 56 | 0.161 | 0.121 | 0.216 |  |
| Lead | ug/g creatinine | 97 | 0.364 | 0.311 | 0.427 |  | 33 | 0.485 | 0.386 | 0.610 | † | 56 | 0.443 | 0.383 | 0.512 |  |
| Beryllium | ug/g creatinine | 97 | 0.013 | 0.010 | 0.015 | ‡ (93.8%) | 33 | 0.015 | 0.011 | 0.022 | †, ‡ (87.9%) | 56 | 0.010 | 0.009 | 0.012 | ‡ (96.4%) |
| Cobalt | ug/g creatinine | 97 | 0.417 | 0.356 | 0.488 |  | 33 | 0.492 | 0.419 | 0.576 | † | 55 | 0.461 | 0.403 | 0.527 |  |
| Manganese | ug/g creatinine | 97 | 0.146 | 0.113 | 0.189 | ‡ (63.9%) | 33 | 0.152 | 0.127 | 0.183 | †. ‡ (69.7%) | 56 | 0.124 | 0.105 | 0.146 | ‡ (55.4%) |
| Strontium | ug/g creatinine | 97 | 103.854 | 89.147 | 120.988 |  | 33 | 123.534 | 95.486 | 159.820 | † | 56 | 118.800 | 96.123 | 146.827 |  |
| Thallium | ug/g creatinine | 97 | 0.137 | 0.123 | 0.151 |  | 33 | 0.138 | 0.113 | 0.168 | † | 56 | 0.124 | 0.108 | 0.141 |  |
| Uranium | ug/g creatinine | 97 | 0.007 | 0.005 | 0.009 |  | 33 | 0.006 | 0.005 | 0.007 | † | 56 | 0.008 | 0.006 | 0.010 |  |
|  |  | **Nondaily CIG+Daily SLT** | | | | | **Nondaily CIG+ Nondaily SLT** | | | | | **Never Tobacco Users** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| Cadmium | ug/g creatinine | 35 | 0.093 | 0.063 | 0.137 | † | 16 | 0.061 | 0.042 | 0.087 | † | 1652 | 0.149 | 0.140 | 0.159 |  |
| Lead | ug/g creatinine | 35 | 0.326 | 0.266 | 0.398 | † | 16 | 0.346 | 0.244 | 0.492 | † | 1653 | 0.351 | 0.330 | 0.373 |  |
| Beryllium | ug/g creatinine | 35 | 0.009 | 0.007 | 0.012 | †, ‡ (91.4%) | 16 | 0.009 | 0.007 | 0.011 | †, ‡ (93.8%) | 1653 | 0.011 | 0.010 | 0.011 | ‡ (96.5%) |
| Cobalt | ug/g creatinine | 35 | 0.426 | 0.369 | 0.491 | † | 16 | 0.383 | 0.315 | 0.467 | † | 1653 | 0.564 | 0.537 | 0.591 |  |
| Manganese | ug/g creatinine | 35 | 0.096 | 0.072 | 0.129 | †, ‡ (60%) | 15 | 0.108 | 0.080 | 0.147 | †, ‡ (43.8%) | 1652 | 0.131 | 0.124 | 0.138 | ‡ (49.5%) |
| Strontium | ug/g creatinine | 35 | 133.363 | 106.922 | 166.342 | † | 16 | 93.445 | 69.070 | 126.423 | † | 1653 | 112.710 | 106.776 | 118.973 |  |
| Thallium | ug/g creatinine | 35 | 0.148 | 0.127 | 0.171 | † | 16 | 0.172 | 0.151 | 0.196 | † | 1652 | 0.172 | 0.164 | 0.180 |  |
| Uranium | ug/g creatinine | 35 | 0.007 | 0.005 | 0.009 | † | 16 | 0.008 | 0.004 | 0.017 | † | 1653 | 0.005 | 0.005 | 0.006 |  |

† Estimate should be interpreted with caution because it has low precision. It is based on a sample size of less than 50, or the coefficient of variation of the estimate is larger than 30 percent. (i.e. RSE > 30% or n <50)

‡ Estimates were flagged due to more than 40% of the samples below LOD in the tobacco user group. The percentage of samples below LOD are in quotes.

Table S7. Urinary BOEs of Arsenic in PATH Study Wave 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Exclusive Current Est. Cig Users Daily** | | | | | **Exclusive Current Est. Cig Users Nondaily** | | | | | **Exclusive Current Est. SLT Users Daily** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| Arsenite | ug/g creatinine | 1988 | 0.330 | 0.305 | 0.356 |  | 437 | 0.352 | 0.293 | 0.423 |  | 351 | 0.343 | 0.304 | 0.387 |  |
| Arsenate | ug/g creatinine | 1988 | 0.605 | 0.574 | 0.636 | ‡ (95.9%) | 437 | 0.528 | 0.481 | 0.581 | ‡ (94.1%) | 351 | 0.595 | 0.542 | 0.654 | ‡ (90.3%) |
| Dimethylarsinic acid | ug/g creatinine | 1988 | 3.022 | 2.898 | 3.152 |  | 437 | 3.513 | 3.196 | 3.861 |  | 351 | 2.806 | 2.597 | 3.032 |  |
| Monomethylarsonic acid | ug/g creatinine | 1988 | 0.422 | 0.399 | 0.448 |  | 437 | 0.407 | 0.362 | 0.457 |  | 351 | 0.427 | 0.383 | 0.475 |  |
| Total arsenic | ug/g creatinine | 1988 | 4.658 | 4.471 | 4.853 |  | 437 | 5.122 | 4.705 | 5.577 |  | 351 | 4.463 | 4.154 | 4.795 |  |
|  |  | **Exclusive Current Est. SLT Users Nondaily** | | | | | **Daily CIG+Daily SLT** | | | | | **Daily CIG+Nondaily SLT** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| Arsenite | ug/g creatinine | 97 | 0.411 | 0.331 | 0.509 |  | 33 | 0.472 | 0.342 | 0.650 | † | 56 | 0.404 | 0.317 | 0.516 |  |
| Arsenate | ug/g creatinine | 97 | 0.675 | 0.570 | 0.800 | ‡ (89.7%) | 33 | 0.736 | 0.529 | 1.024 | †, ‡ (93.9%) | 56 | 0.543 | 0.468 | 0.630 | ‡ (89.3%) |
| Dimethylarsinic acid | ug/g creatinine | 97 | 3.062 | 2.660 | 3.524 |  | 33 | 3.027 | 2.177 | 4.209 | †, ‡ (42.4%) | 56 | 2.673 | 2.327 | 3.071 |  |
| Monomethylarsonic acid | ug/g creatinine | 97 | 0.416 | 0.347 | 0.499 |  | 33 | 0.427 | 0.311 | 0.587 | †, ‡ (42.4%) | 56 | 0.430 | 0.363 | 0.509 |  |
| Total arsenic | ug/g creatinine | 97 | 4.874 | 4.271 | 5.562 |  | 33 | 4.939 | 3.666 | 6.654 | † | 56 | 4.313 | 3.868 | 4.810 |  |
|  |  | **Nondaily CIG+Daily SLT** | | | | | **Nondaily CIG+ Nondaily SLT** | | | | | **Never Tobacco Users** | | | | |
| Analyte | Unit | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag | N | Geometric Mean | Lower Bound of 95% CI | Upper Bound of 95% CI | flag |
| Arsenite | ug/g creatinine | 35 | 0.413 | 0.317 | 0.537 | † | 16 | 0.349 | 0.249 | 0.490 | † | 1653 | 0.332 | 0.307 | 0.359 |  |
| Arsenate | ug/g creatinine | 35 | 0.462 | 0.349 | 0.612 | †, ‡ (85.7%) | 16 | 0.428 | 0.337 | 0.543 | †, ‡ (100%) | 1653 | 0.535 | 0.505 | 0.565 | ‡ (96.2%) |
| Dimethylarsinic acid | ug/g creatinine | 35 | 3.183 | 2.463 | 4.114 | † | 16 | 2.460 | 1.776 | 3.407 | † | 1653 | 3.691 | 3.478 | 3.916 |  |
| Monomethylarsonic acid | ug/g creatinine | 35 | 0.483 | 0.388 | 0.602 | † | 16 | 0.504 | 0.338 | 0.753 | † | 1653 | 0.482 | 0.448 | 0.518 |  |
| Total arsenic | ug/g creatinine | 35 | 4.768 | 3.765 | 6.039 | † | 16 | 3.962 | 3.008 | 5.220 | † | 1653 | 5.360 | 5.078 | 5.658 |  |

† Estimate should be interpreted with caution because it has low precision. It is based on a sample size of less than 50, or the coefficient of variation of the estimate is larger than 30 percent. (i.e. RSE > 30% or n <50)

‡ Estimates were flagged due to more than 40% of the samples below LOD in the tobacco user group. The percentage of samples below LOD are in quotes.

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