**Appendix Table 1.** Spearman correlation coefficients for urine creatinine and kidney outcome measures in 684 lead workers

 Calc. Creat. MDRD Meas. Creat. Cystatin CYS CYS Combined Urine

**Kidney Outcome** Clearance eGFR Clearance C eGFRs eGFRm eGFRc NAG Creatinine

Serum Creatinine, mg/dL -0.38# -0.72# -0.17# 0.37# -0.37# -0.18# -0.58# -0.22# 0.14#

Calculated Creatinine Clearance, mL/min 0.69# 0.62# -0.37# 0.37# 0.47# 0.69# -0.11\*\* 0.15#

MDRD eGFR, mL/min/1.73 m2 0.49# -0.48# 0.48# 0.51# 0.91# 0.001 0.04

Measured Creatinine Clearance, mL/min -0.28# 0.28# 0.38# 0.51# -0.20# 0.33#

Serum Cystatin C, mg/L -1.0# -0.93# -0.76\* 0.06 0.07

Single variable CysCeGFRs, mL/min/1.73 m2 0.93# 0.76# -0.06 -0.07

Multi-variable CysCeGFRm, mL/min/1.73 m2 0.80# -0.18# 0.01

Combined eGFRc, mL/min/1.73 m2 -0.08\* 0.03

Ln-NAG, μmol/h/g creatinine -0.12\*\*

\* p-value < 0.05; \*\* p-value < 0.01; # p-value < 0.001

**Appendix Table 2.** Associations between urine metals (µg/g creatinine) and kidney outcomes in 684 lead workers

 **Model 1** **Model 2** **Model3**  **Model 4**

**Kidney Outcome** **β coeff (95 % CI)) β coeff (95 % CI)) β coeff (95 % CI)) β coeff (95 % CI))**

**MDRD eGFR, mL/min/1.73 m2**

Ln-Urine Antimony 1.5 (0.5, 2.5)\*\* 0.9 (-0.03, 1.9) 0.8 (-0.2, 1.7)

Ln- Urine Thallium 6.3 (3.5, 9.0)# 5.8 (3.1, 8.6)# 4.6 (1.8, 7.4)\*\*

Ln-Urine Cadmium 6.6 (3.5, 9.8)#

**Calculated Creatinine Clearance, mL/min**

Ln-Urine Antimony 0.8 (-0.1, 1.6) 0.5 (-0.3, 1.4) 0.5 (-0.4, 1.3)

Ln- Urine Thallium 3.8 (1.3, 6.2)\*\* 3.5 (1.1, 5.9)\*\* 2.8 (0.4, 5.2)\*

Ln-Urine Cadmium 3.3 (0.5, 6.1)\*

**Measured Creatinine Clearance, mL/min**

Ln-Urine Antimony -0.7 (-2.2, 0.9) -0.8 (-2.3, 0.7) -0.6 (-2.1, 0.9)

Ln- Urine Thallium 0.8 (-3.4, 5.0) 1.2 (-3.1, 5.4) 1.9 (-2.4, 6.2)

Ln-Urine Cadmium -4.7 (-9.6, 0.2)

**Serum Creatinine, mg/dL**

Ln-Urine Antimony -0.010 (-0.018,-0.003)\*\* -0.006 (-0.013, 0.001) -0.005 (-0.01, 0.002)

Ln- Urine Thallium -0.05 (-0.07, -0.03)# -0.05 (-0.07, -0.03)# -0.04 (-0.06, -0.02)#

Ln-Urine Cadmium -0.05 (-0.07, -0.03)#

**CYSeGFRm, mL/min/1.73 m2**

Ln-Urine Antimony -0.2 (-1.0, 0.7) -0.5 (-1.3, 0.3) -0.4 (-1.3, 0.4)

Ln-Urine Thallium 4.9 (2.7, 7.2)# 5.2 (2.9, 7.4)# 5.5 (3.2, 7.8)#

Ln- Urine Cadmium - - -1.9 (-4.5, 0.8)

**CYSeGFRs, mL/min/1.73 m2**

Ln-Urine Antimony -0.1 (-1.0, 0.8) -0.5 (-1.4, 0.3) -0.5 (-1.3, 0.4)

Ln-Urine Thallium 4.9 (2.6, 7.2)# 5.1 (2.8, 7.4)# 5.5 (3.1, 7.9)#

Ln- Urine Cadmium - - -2.1 (-4.8, 0.6)

**Combined eGFRc, mL/min/1.73 m2**

Ln-Urine Antimony 0.9 (-0.01, 1.7) 0.4 (-0.5, 1.2) 0.3 (-0.5, 1.1)

Ln-Urine Thallium 6.3 (3.9, 8.6)# 6.1 (3.7, 8.5)# 5.5 (3.1, 7.9)#

Ln- Urine Cadmium - - 3.1 (0.4, 5.8)\*

**Serum Cystatin C, mg/L**

Ln-Urine Antimony 0.0003 (-0.004, 0.005) 0.002 (-0.002, 0.007) 0.002 (-0.002, 0.006)

Ln-Urine Thallium -0.032 (-0.045, -0.020)# -0.033 (-0.046, -0.021)# -0.036 (-0.049, -0.024)#

Ln- Urine Cadmium 0.014 (-0.0002, 0.028)

**Ln-NAG, μmoL/h/g creatinine**

Ln-Urine Antimony 0.03 (0.004, 0.06)\* 0.03 (-0.001, 0.06) 0.02 (-0.01, 0.05)

Ln-Urine Thallium 0.11 (0.03, 0.19)\* 0.09 (0.01, 0.18)\* 0.05 (-0.03, 0.13)

Ln- Urine Cadmium - - 0.23 (0.14, 0.32)#

Multiple linear regression models also adjusted for age, gender, BMI, employment status (current vs. former lead worker), study status (phase I vs. II study entry), annual income (10, 10-20, 20-30, 30-40, and > 40 million won), education (< middle school graduate, < high school graduate, high school graduate, > high school), alcohol consumption (never, former, current), smoking dose [(cigarettes per day × years of smoking) in quartiles for current smokers and ex-smoker status], diastolic blood pressure, blood lead, and tibia lead. Model 1 also adjusted for lead job duration

\*p-value < 0.05; \*\*p-value < 0.01; #p-value < 0.001

**Appendix Table 3.** Associations between urine antimony and thallium and kidney outcomes with and without urine cadmium adjustment in 684 lead workers

**Kidney Outcome** **Antimony Model 1** **Antimony Model 2** **Thallium Model 1** **Thallium Model 2**

  **β coeff (95 % CI)) β coeff (95 % CI)) β coeff (95 % CI)) β coeff (95 % CI))**

**MDRD eGFR, mL/min/1.73 m2**

Ln-Urine Metal µg/L 1.5 (0.5, 2.5)\*\* 1.2 (0.2, 2.2)\* 6.8 (4.1, 9.6)# 5.5 (2.8, 8.3)#

Ln- Urine Cadmium µg/L - 7.8 (4.6, 11.0)# - 6.9 (3.8, 10.1)#

**Calculated Creatinine Clearance, mL/min**

Ln-Urine Metal µg/L 0.8 (-0.1, 1.6) 0.6 (-0.2, 1.5) 4.0 (1.5, 6.5)\*\* 3.2 (0.8, 5.6)\*\*

Ln- Urine Cadmium µg/L - 4.2 (1.4, 6.9)\*\* - 3.6 (0.9, 6.4)\*

**Measured Creatinine Clearance, mL/min**

Ln-Urine Metal µg/L -0.6 (-2.1, 0.9) -0.4 (-1.9, 1.0) 2.7 (-1.4, 6.8) 3.3 (-0.9, 7.4)

Ln- Urine Cadmium µg/L - -2.6 (-7.3, 2.1) - -3.5 (-8.3, 1.2)

**Serum Creatinine, mg/dL**

Ln-Urine Metal µg/L -0.01 (-0.02,-0.003)\*\* -0.01 (-0.02, 0.0004)\* -0.05 (-0.07, -0.03)# -0.04 (-0.06, -0.02)#

Ln- Urine Cadmium µg/L - -0.06 (-0.08, -0.03)# - -0.05 (-0.07, -0.03)#

**CYSeGFRm, mL/min/1.73 m2**

Ln-Urine Metal µg/L -0.2 (-1.0, 0.7) -0.1 (-1.0, 0.7) 4.9 (2.6, 7.2)# 5.3 (2.9, 7.6)#

Ln- Urine Cadmium µg/L - -0.8 (-3.4, 1.9) - -2.1 (-4.7, 0.6)

**CYSeGFRs, mL/min/1.73 m2**

Ln-Urine Metal µg/L -0.1 (-1.0, 0.7) -0.1 (-1.0, 0.8) 5.3 (2.9, 7.7)# 5.7 (3.3, 8.1)#

Ln- Urine Cadmium µg/L - -0.7 (-3.5, 2.0) - -2.1 (-4.8, 0.6)

**Combined eGFRc, mL/min/1.73 m2**

Ln-Urine Metal µg/L 0.9 (-0.01, 1.7) 0.7 (-0.2, 1.5) 6.3 (3.9, 8.6)# 5.7 (3.3, 8.1)#

Ln- Urine Cadmium µg/L - 4.3 (1.5, 7.0)\*\* - 3.2 (0.5, 5.9)\*

**Serum Cystatin C, mg/L**

Ln-Urine Metal µg/L 0.0004 (-0.004, 0.005) 0.0001 (-.005, 0.005)-0.032 (-0.045, -0.02)# -0.035 (-0.048, -0.022)#

Ln- Urine Cadmium µg/L - 0.008 (-0.007, 0.022) - 0.016 (0.001, 0.03)\*

**Ln-NAG, μmol/h/g creatinine**

Ln-Urine Metal µg/L 0.03 (0.004, 0.06)\* 0.02 (-0.01, 0.05) 0.10 (0.01, 0.18)\* 0.05 (-0.03, 0.14)

Ln- Urine Cadmium µg/L - 0.24 (0.14, 0.33)# - 0.23 (0.14, 0.33)#

Multiple linear regression models also adjusted for age, sex, BMI, employment status (current vs. former lead worker), study status (phase I vs. II study entry), annual income (10, 10-20, 20-30, 30-40, and > 40 million won), education (< middle school graduate, < high school graduate, high school graduate, > high school), alcohol consumption (never, former, current), smoking dose [(cigarettes per day × years of smoking) in quartiles for current smokers and ex-smoker status], diastolic blood pressure, blood lead, tibia lead, and lead job duration (in antimony models only)

\*p-value < 0.05; \*\*p-value < 0.01; #p-value < 0.001

**Appendix Table 4.** Associations between urine metals and kidney outcomes without urine creatinine adjustment in 684 lead workers

**Kidney Outcome** **β coeff (95 % CI))**

**MDRD eGFR, mL/min/1.73 m2**

Ln-Urine Antimony, µg/L 0.5 (-0.5, 1.5)

Ln- Urine Thallium, µg/L 1.6 (-1.0, 4.1)

Ln-Urine Cadmium, µg/L 1.3 (-1.3, 3.9)

**Calculated Creatinine Clearance, mL/min**

Ln-Urine Antimony, µg/L 0.3 (-0.5, 1.2)

Ln- Urine Thallium, µg/L 1.4 (-0.8, 3.5)

Ln-Urine Cadmium, µg/L 0.9 (-1.3, 3.2)

**Measured Creatinine Clearance, mL/min**

Ln-Urine Antimony, µg/L -0.5 (-1.9, 1.0)

Ln- Urine Thallium, µg/L 7.0 (3.2, 10.8)#

Ln-Urine Cadmium, µg/L 1.9 (-2.0, 5.8)

**Serum Creatinine, mg/dL**

Ln-Urine Antimony, µg/L -0.003 (-0.010, 0.004)

Ln- Urine Thallium, µg/L -0.013 (-0.032, 0.006)

Ln-Urine Cadmium, µg/L -0.008 (-0.027, 0.012)

**CYSeGFRm, mL/min/1.73 m2**

Ln-Urine Antimony, µg/L -0.5 (-1.3, 0.3)

Ln-Urine Thallium, µg/L 4.4 (2.3, 6.4)#

Ln- Urine Cadmium, µg/L -3.5 (-5.7, -1.4)\*\*

**CYSeGFRs, mL/min/1.73 m2**

Ln-Urine Antimony, µg/L -0.5 (-1.3, 0.4)

Ln-Urine Thallium, µg/L 4.7 (2.5, 6.8)#

Ln- Urine Cadmium, µg/L -3.7 (-5.9, -1.5)\*\*

**Combined eGFRc, mL/min/1.73 m2**

Ln-Urine Antimony, µg/L 0.1 (-0.7, 1.0)

Ln-Urine Thallium, µg/L 2.8 (0.6, 5.0)\*

Ln- Urine Cadmium, µg/L -0.9 (-3.2, 1.3)

**Serum Cystatin C, mg/L**

Ln-Urine Antimony, µg/L 0.002 (-0.002, 0.007)

Ln-Urine Thallium, µg/L -0.029 (-0.040, -0.018)#

Ln- Urine Cadmium, µg/L 0.025 (0.013, 0.037)#

**Ln-NAG, μmoL/h/g creatinine**

Ln-Urine Antimony, µg/L 0.016 (-0.014, 0.045)

Ln-Urine Thallium, µg/L -0.061 (-0.136, 0.015)

Ln- Urine Cadmium, µg/L 0.070 (-0.007, 0.148)

Multiple linear regression models also adjusted for age, sex, BMI, employment status (current vs. former lead worker), study status (phase I vs. II study entry), annual income (10, 10-20, 20-30, 30-40, and > 40 million won), education (< middle school graduate, < high school graduate, high school graduate, > high school), alcohol consumption (never, former, current), smoking dose [(cigarettes per day × years of smoking) in quartiles for current smokers and ex-smoker status], diastolic blood pressure, and blood and tibia lead.

\*p-value < 0.05; \*\*p-value < 0.01; #p-value < 0.001