Blood Mercury and Insulin Resistance in Nondiabetic Koreans (KNHANES 2008–2010)

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Purpose: Blood mercury levels are associated with inflammation, and chronic low-grade inflammation is a cause of insulin resistance. This study aimed to investigate the association between serum mercury and insulin resistance.

Materials and Methods: Subjects from the 2008–2010 Korean National Health and Nutrition Examination Survey were selected (n=29235) and the relevant data of 5388 subjects (2643 males and 2745 females) were analyzed cross-sectionally. Homeostasis Model Assessment for Insulin Resistance (HOMA-IR) was compared according to blood mercury quartiles, and the odds ratio (OR) of having the highest quartile of HOMA-IR according to blood mercury quartiles was calculated.

Results: Blood mercury levels in men and women were 29.4 nmol/L and 20.5 nmol/L, respectively, and fasting blood sugar (FBS), insulin, and HOMA-IR were significantly correlated with blood mercury levels. The correlation was stronger in men than in women. In men, FBS and HOMA-IR showed step-wise increases as the quartiles of blood mercury increased; only HOMA-IR differed significantly in the third and fourth blood mercury quartiles, compared to the first quartile. In women, however, both FBS and HOMA-IR differed significantly in the third and fourth blood mercury quartiles, compared to the first quartile. Among men, the OR of being in the highest HOMA-IR quartile was greatest for the highest blood mercury quartile (OR=1.720, 95% CI; 1.172–2.526), compared with the lowest quartile. Conclusion: In this large population-based study, blood mercury levels were weakly correlated with HOMA-IR and may be a risk factor for insulin resistance in nondiabetic Koreans.

Key Words: Mercury, insulin resistance, environment, inflammation, Korean

INTRODUCTION

Chronic inflammation affects several pathologic processes in type 2 diabetes, cardiovascular disease, and metabolic syndrome. In particular, chronic low-grade inflammation has been identified as an integral part of the pathogenesis of vascular diseases, such as hypertension, and vascular inflammation has been shown to play a crucial role in the development of hypertension through endothelial dysfunction mediated by a reduced availability of nitric oxide and increased activity of the rennin-angiotensin system. Dysfunctional insulin action, insulin resistance, and meta-
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bolic syndrome are noted causes of type 2 diabetes: meta-

bolic syndrome increased the risk for diabetes in Framing-

ham Offspring Study subjects, and obesity was the most
important risk factor for insulin resistance, independent of

sex, age, or race in adolescents in a study conducted in the

United States. In Asians, body mass index (BMI) was also
revealed to be an independent risk factor for metabolic syn-

drome and insulin resistance in Chinese subjects, while

waist circumference (WC), triglyceride (TG), and glucose
were independent risk factors for Homeostasis Model As-

sessment for Insulin Resistance (HOMA-IR) in non-diabetic

Taiwanese subjects.

Humans are typically exposed to organic mercurial com-

pounds, especially methyl mercury, via consumption of ma-

rine mammals and fish, which is increasingly emerging as

an environmental source of potential mercury toxicity. Methyl

mercury is produced environmentally by biomethyl-

ation of the inorganic mercury present in aquatic sediments.

In particular, consumption of contaminated fish can lead to
the accumulation of mercury in the human body. This bio-

accumulation may be associated with chronic inflammation
and many clinical diseases, such as hypertension, cardio-

vascular disease, and stroke, as well as insulin resistance,

mainly due to mercury-induced mitochondrial dysfunction,

oxidative stress, and lipid peroxidation.

HOMA-IR is widely used to represent insulin resistance,
and the respective cutoff value for HOMA-IR in Korean

non-diabetic adults has been reported as 2.34 (sensitivity
62.8%, specificity 65.7%). Meanwhile, few studies have
evaluated the relationships between blood mercury levels
and insulin resistance according to HOMA-IR in Korean
nondiabetic subjects. Accordingly, the aim of this study was
to demonstrate the impact on blood mercury levels on insu-
lin resistance by HOMA-IR in a nondiabetic Korean popu-
lation using data from the Korean National Health and Nu-

trition Examination Survey (KNHANES).

MATERIALS AND METHODS

Study population and data source

The KNHANES, conducted periodically by the Korea Cen-
ters for Disease Control and Prevention since 1998, pro-

vides comprehensive information on health status, health
behavior, nutritional status, socio-demographics, and bio-

markers of environmental exposure for 600 national dis-

tricts across Korea. The health interview component in

KNHANES is conducted through face-to-face interviews at
the participants’ homes by trained interviewers. Blood mer-
ccury data from the fourth (IV-2, 3, 2008, 2009) and fifth (V-
1, 2010) KNHANES data samplings were utilized in this
cross-sectional analysis. From an initial total of 29235 men
and women, 23847 subjects were excluded for missing data
of blood mercury (22883 subjects), age under 20 years (397
subjects), type 2 diabetes (515 subjects), current cancers (42
subjects), chronic renal failure (nine subjects), and blood
mercury >498.5 nmol/L (one subject). Diabetes was defined
as a fasting glucose level ≥126 mg/dL (6.99 mmol/L), cur-
rent use of antidiabetic medications, or a self-reported phy-

sician diagnosis of diabetes. For the exclusion of current
cancers and chronic renal failure, we used personal medical
history recorded at the initial KNHANES interview. A final
total of 5388 subjects (2643 males and 2745 females) were
included for analysis in this study (Fig. 1). Although we suf-
fered from a loss of much of the population data, blood mer-
ccury data remained evenly distributed for three years stud-
inied (33.9% in 2008, 33.9% in 2009, 32.1% in 2010), sug-

Fig. 1. Flow chart of study subjects. KNHANES, Korean National Health and
Nutrition Examination Survey; DM, type 2 diabetes; YO, years old.
ing without shoes to the nearest 0.1 kg and 0.1 cm, respectively. WC was measured at the narrowest point between the lower border of the rib cage and the iliac crest. BMI was calculated as the ratio of weight/height² (kg/m²). Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured in the right arm using a Baumanometer standard mercury sphygmomanometer (Baum, Copiague, NY, USA). The average of two SBP and DBP readings recorded at a 5-min interval was used for analysis. Blood samples were collected year round after an 8 h fast. They were immediately processed, refrigerated, and transported in cold storage to the NeoDin Medical Institute (Seoul, Korea) for analysis within 24 h. Total cholesterol (TC), TG, and high density lipoprotein cholesterol (HDLC) levels were measured using a model 7600-110 chemistry analyzer (Hitachi, Tokyo, Japan). Fasting blood glucose concentrations were measured using a Pureauto S GLU automated analyzer with an enzymatic assay (Hiauchi, Tokyo, Japan), and serum insulin concentrations were measured using an INS-Irma gamma counter with an immunoradiometric assay (Biosource, Nivelles, Belgium). Insulin resistance was estimated using HOMA-IR calculated as: [fasting insulin (mU/L)×fasting glucose (mmol/L)]/22.5. Blood mercury was measured by the Gold-Amalgam method using a DMA-80 apparatus (Milestone, Italy); the inter-assay coefficients of variation were 0.47–6.08%. Physical examinations were performed by trained investigators following a standardized procedure. Current smokers were defined as those who had smoked more than five packs of cigarettes during their life and were currently smoking; past-smokers included smokers who had smoked in the past but had quit; and non-smokers had no history of smoking. Regular alcohol drinkers comprised those who drank alcohol currently more than one time per month, while nondrinkers included all others.

**Statistical analyses**

Complex sample analysis was used for the KNHANES data to weight all values, as recommended by the Korea Centers for Disease Control and Prevention. At first, clinical characteristics for all study subjects, including age, BMI, WC, blood pressure, metabolic markers including fasting blood glucose, insulin, TC, HDLC, TG, and blood mercury level were analyzed by a simple descriptive method after data weighting. Smoking status and alcohol consumption were evaluated by the χ² test. To determine correlations between blood mercury level and other metabolic parameters, Pearson correlation coefficients were generated after log transformation of blood mercury concentrations to create a normal distribution. To elucidate the relationships between blood mercury levels and HOMA-IR, as well as other metabolic parameters, blood mercury levels were divided into quartiles, and HOMA-IR, as well as the other metabolic parameters (as dependent variables), and blood mercury quartiles (as a fixed factor) were compared by ANCOVA test. In addition, to evaluate further correlations between blood mercury and HOMA-IR, linear regression analysis was conducted. Finally, the odds ratio (OR) of having the highest quartile of HOMA-IR according to blood mercury quartiles was calculated by logistic regression analysis after dividing HOMA-IR into quartiles with adjustment for age, TC, and TG. P for trend was used to assess the significance of all analyses. Data were analyzed using SPSS 19.0 (SPSS Inc., Chicago, IL, USA) to account for the complex sampling design.

### RESULTS

The clinical characteristics of all study subjects are presented in Table 1. A total of 5388 subjects, including 2643 men and 2745 women, were evaluated in this cross-sectional study. The mean ages of the men and women were 39.7 years and 41.2 years, respectively. Mean BMI and WC were 24.0 kg/m² and 83.5 cm, respectively, in men and 22.8 kg/m² and 76.5 cm in women. Other respective values in men and women comprised average fasting blood sugar (FBS; 5.15 and 5.04 mmol/L), insulin (10.0 and 10.0 mU/L), HOMA-IR (2.32 and 2.27), TC (4.80 and 4.80 mmol/L), HDLC (1.29 and 1.47 mmol/L), and TG (1.69 and 1.18 mmol/L). Blood mercury levels in men (29.4 nmol/L) were higher than those in women (20.5 nmol/L). As expected, current smokers and regular alcohol consumption were higher in men than in women.

In the analysis of correlations between log-transformed blood mercury and metabolic parameters, all metabolic parameters showed significant differences, except for HDLC in men and TG in women. The overall number of correlations between blood mercury and metabolic parameters was greater in men than in women. Among metabolic parameters, blood mercury showed relatively good correlation with BMI (r=0.207, p<0.001 in men and r=0.134, p<0.001 in women) and WC (r=0.206, p<0.001 in men and r=0.151, p<0.001 in women). Markers of glycemic control such as FBS, insulin, and HOMA-IR showed significant correlations with blood mercury, which were also greater in men than in women (Table 2). Blood mercury levels were divid-
Table 1. Clinical Characteristics of the 5388 Study Subjects

| Variables       | Men (n=2643) | Women (n=2745) | p value |
|-----------------|-------------|---------------|---------|
| Age (yrs)       | 39.7 (0.3)  | 41.2 (0.3)    | <0.001 |
| BMI (kg/m²)     | 24.0 (1.1)  | 22.8 (0.1)    | <0.001 |
| WC (cm)         | 83.5 (0.2)  | 76.5 (0.2)    | <0.001 |
| SBP (mm Hg)     | 116.4 (0.4) | 110.6 (0.4)   | <0.001 |
| DBP (mm Hg)     | 77.1 (0.3)  | 71.7 (0.2)    | <0.001 |
| FBS (mmol/L)    | 5.15 (0.01) | 5.04 (0.01)   | <0.001 |
| Insulin (mU/L)  | 10.0 (0.1)  | 10.0 (0.1)    | 0.952  |
| HOMA-IR         | 2.32 (0.04) | 2.27 (0.03)   | 0.227  |
| TC (mmol/L)     | 4.80 (0.02) | 4.80 (0.03)   | 0.992  |
| HDLc (mmol/L)   | 1.29 (0.01) | 1.47 (0.01)   | <0.001 |
| TG (mmol/L)     | 1.69 (0.04) | 1.18 (0.02)   | <0.001 |
| Cholesterol (mg/dL) | 294.0 (0.55) | 205.5 (0.35) | <0.001 |
| Smoking, † n (%) | 1207 (45.9) | 164 (6.0)     | <0.001 |
| Past and none   | 1423 (54.1) | 2573 (94.0)   |        |
| Alcohol, † n (%) | 2005 (76.4) | 1576 (57.7)   | <0.001 |
| None            | 618 (23.6)  | 1156 (42.3)   |        |

BMI, body mass index; WC, waist circumference; SBP, systolic blood pressure; DBP, diastolic blood pressure; FBS, fasting blood sugar; TC, total cholesterol; HDLc, high density lipoprotein cholesterol; TG, triglyceride; Mercury, blood Mercury; HOMA-IR, Homeostasis Model Assessment for Insulin Resistance.

Data represent mean (standard error) after weighting in complex sample analysis. p values were from a general linear model without adjustment.

†Missing data were not included.

‡Percentage of total study subjects.

*Missing data were not included.

DISCUSSION

In this cross-sectional study of the associations of blood mercury levels with insulin resistance, blood mercury concentrations showed a weak but positive association with insulin resistance. In particular, blood mercury concentration showed a greater effect on insulin resistance in men than in women. Even though blood mercury levels were not an independent or strong risk factor for insulin resistance and their correlation with HOMA-IR was weak, their use as a...
Table 3. Comparison of Clinical Characteristics of Study Subjects According to Quartiles of Blood Mercury

| Mercury (median, range, nmol/L) | Q1 (n=660) | Q2 (n=661) | Q3 (n=661) | Q4 (n=661) | p value | Q1 (n=685) | Q2 (n=687) | Q3 (n=687) | Q4 (n=686) | p value |
|--------------------------------|------------|------------|------------|------------|---------|------------|------------|------------|------------|---------|
| Age (yrs)                      | 35.8 (6.6) | 38.9 (6.6) | 40.8 (6.6) | 44.4 (6.6) | <0.001  | 39.7 (6.6) | 39.7 (6.6) | 41.3 (6.6) | 44.2 (6.6) | <0.001  |
| BMI (kg/m²)                    | 23.2 (0.2) | 23.9 (0.1) | 24.1 (0.2) | 24.9 (0.2) | <0.001  | 22.4 (0.1) | 22.6 (0.2) | 23.0 (0.2) | 23.4 (0.2) | <0.001  |
| WC (cm)                        | 81.2 (0.5) | 83.3 (0.4) | 83.7 (0.4) | 86.2 (0.5) | <0.001  | 74.9 (0.4) | 75.7 (0.7) | 77.1 (0.5) | 78.3 (0.5) | <0.001  |
| SBP (mm Hg)                    | 114.2 (0.7)| 116.8 (0.7)| 116.3 (0.8)| 118.9 (0.7)| <0.001  | 110.2 (0.8)| 109.4 (0.7)| 111.1 (0.7)| 111.9 (0.7)| 0.086   |
| DBP (mm Hg)                    | 75.0 (0.5) | 77.5 (0.6) | 77.2 (0.6) | 77.9 (0.5) | <0.001  | 70.9 (0.5) | 71.2 (0.5) | 72.1 (0.4) | 72.8 (0.5) | 0.034   |
| FBS (mmol/L)                   | 5.05 (0.03)| 5.13 (0.03)| 5.18 (0.03)| 5.26 (0.03)| <0.001  | 5.00 (0.02)| 5.00 (0.02)| 5.07 (0.02)| 5.09 (0.03)| 0.002   |
| Insulin (mU/L)                 | 9.7 (0.2)  | 9.8 (0.2)  | 10.3 (0.3) | 10.3 (0.3) | 0.185    | 9.7 (0.2)  | 9.8 (0.2)  | 10.3 (0.2) | 10.2 (0.2) | 0.099   |
| HOMA-IR                        | 2.20 (0.05)| 2.24 (0.05)| 2.42 (0.09)| 2.44 (0.08)| 0.038    | 2.17 (0.05)| 2.21 (0.05)| 2.35 (0.06)| 2.33 (0.06)| 0.022   |
| TC (mmol/L)                    | 4.60 (0.04)| 4.81 (0.04)| 4.87 (0.05)| 4.97 (0.05)| <0.001  | 4.73 (0.05)| 4.69 (0.04)| 4.84 (0.04)| 4.95 (0.04)| <0.001  |
| HDLC (mmol/L)                  | 1.29 (0.02)| 1.28 (0.02)| 1.31 (0.02)| 1.29 (0.02)| 0.583    | 1.46 (0.02)| 1.46 (0.02)| 1.48 (0.02)| 1.49 (0.02)| 0.323   |
| TG (mmol/L)                    | 1.51 (0.06)| 1.69 (0.06)| 1.66 (0.06)| 1.96 (0.11)| <0.002  | 1.21 (0.05)| 1.16 (0.04)| 1.13 (0.03)| 1.22 (0.04)| 0.253   |

BMI, body mass index; WC, waist circumference; SBP, systolic blood pressure; DBP, diastolic blood pressure; FBS, fasting blood sugar; HOMA-IR, Homeostasis Model Assessment for Insulin Resistance; TC, total cholesterol; HDLC, high density lipoprotein cholesterol; TG, triglyceride; Mercury, blood Mercury; SE, standard error.

Data represent mean (SE). Each Q represents quartiles of blood mercury concentrations. p values are p for trend from a general linear model after data weighting in complex sample analysis without adjustment.

*Represent p < 0.05 by ANCOVA test after adjustments with job, education, smoking, alcohol intake, and moderate physical activity and history of hypertension.
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In a population, the geometric mean of blood mercury levels (3.08 μg/L, 15.4 nmol/L) was more prevalent in subjects over 40 years of age than in those younger than 40 years, higher in those who consumed alcohol, and increased with more frequent fish consumption.

As a blood mercury level of 3.08 μg/L (15.4 nmol/L) is not particularly toxic, we cannot conclude a causal effect thereof on general health including insulin resistance. However, in view of our results, we can cautiously presume a possible effect on vascular inflammation or insulin resistance. Even though blood mercury levels did not display a strong linear relationship with HO-MA-IR, compared with BMI, WC, TC, TG, and C-reactive protein (not analyzed in our study), HOMA-IR increased as blood mercury levels increased, and subjects with blood mercury levels higher than the geometric mean showed HOMA-IR values significantly greater than the cutoff value of HOMA-IR for insulin resistance in Koreans. This may indicate that blood mercury is an important risk factor for insulin resistance. In addition to insulin resistance, several cross-sectional studies have shown positive links between methylmercury exposure and higher blood pressure or prevalent hypertension, mainly due to vascular inflammation. These results may also support the notion of blood mercury as a risk factor for insulin resistance in the general population and provide further evidence of the risk of environmental exposure to mercury.

There were several limitations in this study. This was a cross-sectional study, which has a limitation in demonstrating the causality of insulin resistance and blood mercury. Second, study data were based on the KNHANES, which included data from the United States (0.94 μg/L, 4.69 nmol/L), Germany (0.58 μg/L, 2.89 nmol/L), and Canada (0.69 μg/L, 3.44 nmol/L). In a biomonitoring study of lead, cadmium, and mercury in the blood of New York city adults, the geometric mean blood mercury concentration was 2.73 μg/L (13.6 nmol/L) and more than three times that at the national level. Interestingly, blood mercury levels were elevated 39% in the highest income group relative to the lowest, and concentrations in adults who reported consuming fish or shellfish 20 times or more in the last 30 days were 3.7 times higher than that in those who reported no consumption of fish and shellfish.19 In the Korean population, the geometric mean of blood mercury levels (3.08 μg/L, 15.4 nmol/L) was more prevalent in subjects over 40 years of age than in those younger than 40 years, higher in those who consumed alcohol, and increased with more frequent fish consumption.20 As a blood mercury level of 3.08 μg/L (15.4 nmol/L) is not particularly toxic, we cannot conclude a causal effect thereof on general health including insulin resistance. However, in view of our results, we can cautiously presume a possible effect on vascular inflammation or insulin resistance. Even though blood mercury levels did not display a strong linear relationship with HO-MA-IR, compared with BMI, WC, TC, TG, and C-reactive protein (not analyzed in our study), HOMA-IR increased as blood mercury levels increased, and subjects with blood mercury levels higher than the geometric mean showed HOMA-IR values significantly greater than the cutoff value of HOMA-IR for insulin resistance in Koreans. This may indicate that blood mercury is an important risk factor for insulin resistance. In addition to insulin resistance, several cross-sectional studies have shown positive links between methylmercury exposure and higher blood pressure or prevalent hypertension, mainly due to vascular inflammation. These results may also support the notion of blood mercury as a risk factor for insulin resistance in the general population and provide further evidence of the risk of environmental exposure to mercury.

Table 4. Linear Regression Analysis of the Relationship between HOMA-IR and Clinical Parameters

|            | β   | SE  | 95% CI     | t   | R²  | p value |
|------------|-----|-----|------------|-----|-----|---------|
| Men (n=2643) |     |     |            |     |     |         |
| Age (yrs)  | 0.000 | 0.002 | -0.004-0.005 | 0.181 | 0.000 | 0.856   |
| BMI (kg/m²) | 0.162 | 0.019 | 0.126-0.198 | 8.748 | 0.147 | <0.001  |
| WC (cm)    | 0.057 | 0.07 | 0.044-0.070 | 8.580 | 0.014 | <0.001  |
| TC (mmol/L) | 0.004 | 0.001 | 0.002-0.006 | 3.376 | 0.011 | 0.001   |
| TG (mmol/L) | 0.002 | 0.001 | 0.001-0.004 | 3.155 | 0.058 | 0.002   |
| sMercury (nmol/L) | 0.021 | 0.008 | 0.006-0.036 | 2.811 | 0.005 | 0.005   |
| Women (n=2745) |     |     |            |     |     |         |
| Age (yrs)  | 0.008 | 0.002 | 0.004-0.012 | 3.899 | 0.010 | <0.001  |
| BMI (kg/m²) | 0.131 | 0.010 | 0.112-0.150 | 13.584 | 0.150 | <0.001  |
| WC (cm)    | 0.046 | 0.003 | 0.039-0.052 | 13.790 | 0.147 | <0.001  |
| TC (mmol/L) | 0.004 | 0.001 | 0.002-0.005 | 5.107 | 0.014 | <0.001  |
| TG (mmol/L) | 0.003 | 0.000 | 0.003-0.004 | 7.879 | 0.052 | <0.001  |
| sMercury (nmol/L) | 0.021 | 0.010 | 0.002-0.040 | 2.214 | 0.002 | 0.027   |

BMI, body mass index; WC, waist circumference; TC, total cholesterol; TG, triglyceride; Mercury, blood Mercury; HOMA-IR, Homeostasis Model Assessment for Insulin Resistance; SE, standard error; CI, confidence interval.

Table 5. Logistic Regression Analysis of Having the Highest Quartile of HOMA-IR According to Blood Mercury Quartile

|       | OR (95% CI) | Unadjusted | Adjusted |
|-------|-------------|------------|----------|
| Men   |             |            |          |
| Q1    | 1.00        | 1.00       |          |
| Q2    | 1.013 (0.690–1.487) | 0.947 (0.642–1.398) |          |
| Q3    | 1.425 (0.948–2.143) | 1.402 (0.919–2.140) |          |
| Q4    | 1.842 (1.257–2.700) | 1.720 (1.172–2.526) |          |
| Women |             |            |          |
| Q1    | 1.00        | 1.00       |          |
| Q2    | 0.926 (0.639–1.342) | 0.971 (0.660–1.430) |          |
| Q3    | 1.167 (0.792–1.720) | 1.265 (0.842–1.900) |          |
| Q4    | 1.178 (0.806–1.720) | 1.213 (0.814–1.805) |          |

HOMA-IR, Homeostasis Model Assessment for Insulin Resistance.
Data represent odds ratio (OR) of being in the highest quartile of HOMA-IR with 95% confidence interval (CI) by logistic regression analysis before (unadjusted) and after adjustments for age, total cholesterol, and triglyceride, job, education, smoking, alcohol intake, and moderate physical activity.

An analysis of the relationship between HOMA-IR and clinical parameters showed significant associations with age, BMI, WC, TC, TG, and sMercury. The geometric mean of blood mercury levels (3.08 μg/L, 15.4 nmol/L) was more prevalent in subjects over 40 years of age than in those younger than 40 years, higher in those who consumed alcohol, and increased with more frequent fish consumption. However, in view of our results, we can cautiously presume a possible effect on vascular inflammation or insulin resistance. Even though blood mercury levels did not display a strong linear relationship with HO-MA-IR, compared with BMI, WC, TC, TG, and C-reactive protein (not analyzed in our study), HOMA-IR increased as blood mercury levels increased, and subjects with blood mercury levels higher than the geometric mean showed HOMA-IR values significantly greater than the cutoff value of HOMA-IR for insulin resistance in Koreans. This may indicate that blood mercury is an important risk factor for insulin resistance. In addition to insulin resistance, several cross-sectional studies have shown positive links between methylmercury exposure and higher blood pressure or prevalent hypertension, mainly due to vascular inflammation. These results may also support the notion of blood mercury as a risk factor for insulin resistance in the general population and provide further evidence of the risk of environmental exposure to mercury.
volves one nation and ethnicity; the results cannot be generalized globally. However, the data provide an important reference for studies conducted in other nations and with other ethnicities. Third, we could not adjust for all possible confounders that may affect insulin resistance or HOMA-IR, such as hormones\(^2\) or lower BMI.\(^4\) We only adjusted for age, TC, and TG to evaluate the OR of being in the highest quartile of HOMA-IR according to quartiles of blood mercury, because BMI and WC had stronger correlations with HOMA-IR than blood mercury concentration. Despite these limitations, this is the first study to demonstrate an association between blood mercury concentration and HOMA-IR in a large population-based data.

In conclusion, blood mercury showed a weak but significant association with HOMA-IR and may be a potential risk factor for insulin resistance in Koreans. Careful consideration of blood mercury levels in relation to insulin resistance is warranted.

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