

BACKGROUND

Environmental exposure to heavy metals have affected human health. Several studies have suggested that lead increase oxidative stress and induce mitochondrial dysfunction. The objective was to determine whether there was an association between blood lead level and impaired fasting glucose(IFG) in middle-aged population.

METHODS

This study was based on the data from the Korean National Health and Nutrition Examination Survey (KNHANES), conducted by the Korean Ministry of Health and Welfare in 2008-2011. Of 37,753 participants, data for 2,366 adults ≥ 40 years of age without diabetes were included in the analysis. Subjects were subdivided according to quartile of blood lead level. Multivariate logistic regression analyses were used to identify whether there was an independent association between blood lead level and IFG by adjusting for confounding factors.

Table 1. The characteristics of the study population

	Total	NGT	IFG	P value
N (%)	2,366	1,727(73)	639(27.0)	
Sex, male (%)	1060(46.2)	707(42.7)	353(55.8)	<0.001
Age (years)	54.28 \pm 0.31	53.75 \pm 0.38	55.70 \pm 0.63	0.012
BMI (kg/m ²)	23.97 \pm 0.10	23.61 \pm 0.10	24.91 \pm 0.18	<0.001
SBP (mmHg)	122.69 \pm 0.47	120.85 \pm 0.54	127.57 \pm 0.92	<0.001
DBP(mmHg)	78.65 \pm 0.32	77.90 \pm 0.34	80.63 \pm 0.67	<0.001
FPG (mg/dL)	94.79 \pm 0.28	90.25 \pm 0.17	106.82 \pm 0.32	<0.001
Smoking (%)				0.002
Never	56.1	58.8	49.1	
Past	22.3	20.5	27.0	
Current	21.6	20.7	23.9	
Alcohol drinking (%)				0.904
No	26.8	26.9	26.5	
Yes	73.2	73.1	73.5	
Family income ^a (%)				0.906
< 100	15.3	15.2	15.7	
100-199	17.0	16.5	18.1	
200-299	16.8	17.0	16.2	
≥ 300	50.9	51.3	50.0	
Less than high school education (%)	42.6	41.1	46.6	0.088
Residence in urban area (%)	67.6	67.5	67.9	0.910
Regular exercise ^b , yes (%)	7.9	8.3	6.7	0.356
Total energy intake (kcal)	2049.73 \pm 23.39	2022.62 \pm 26.58	2121.59 \pm 49.90	0.083
F/Hx of DM ^c , yes (%)	16.1	14.3	20.8	0.003
Known HTN (%)	23.0	20.1	30.9	<0.001
Known dyslipidemia (%)	9.8	8.6	13.0	0.021
Lead (μ g /dL)	2.577 \pm 0.331	2.522 \pm 0.384	2.723 \pm 0.565	0.002
Lead grade (%)				0.001
Quartile 1(≤ 1.845)	25.1	27.4	20.6	
Quartile 2(1.846-2.434)	25.1	26.3	21.6	
Quartile 3(2.435-3.091)	24.9	24.6	26.7	
Quartile 4(>3.091)	24.9	21.7	31.1	

Table 2. The characteristics of the study population according to serum lead level

	Lead(μ g /dL)				P value
	Quartile 1 (≤ 1.835)	Quartile 2 (1.836-2.434)	Quartile 3 (2.435-3.091)	Quartile 4 (>3.091)	
N (%)	593(25.1)	594(25.1)	590(24.9)	589(24.9)	
Sex, male (%)	105(17.1)	222(41.4)	307(54.2)	426(73.7)	<0.001
Age (years)	53.67 \pm 0.73	52.48 \pm 0.50	55.90 \pm 0.70	55.12 \pm 0.59	<0.001
BMI (kg/m ²)	23.93 \pm 0.19	23.93 \pm 0.17	24.06 \pm 0.17	23.95 \pm 0.15	0.934
SBP (mmHg)	120.09 \pm 0.85	119.80 \pm 0.95	123.99 \pm 0.96	127.07 \pm 0.94	<0.001
DBP(mmHg)	75.95 \pm 0.51	77.66 \pm 0.64	79.07 \pm 0.69	82.07 \pm 0.59	<0.001
FPG (mg/dL)	93.12 \pm 0.53	94.48 \pm 0.49	95.40 \pm 0.52	96.24 \pm 0.52	<0.001
Smoking (%)					<0.001
Never	80.2	61.3	50.4	31.4	
Past	14.4	18.5	24.3	32.3	
Current	5.4	20.2	25.3	36.3	
Alcohol drinking (%)					<0.001
No	40.0	25.4	25.8	15.3	
Yes	60.0	74.6	74.2	84.7	
Family income ^a (%)					0.070
< 100	15.3	10.0	19.2	16.8	
100-199	17.0	17.3	15.3	18.3	
200-299	18.1	15.4	14.8	18.8	
≥ 300	49.6	57.3	50.7	46.1	
Less than high school education (%)	39.2	36.3	46.6	48.4	0.003
Residence in urban area (%)	70.2	66.6	70.7	2.9	0.128
Regular exercise ^b , yes (%)	7.3	8.1	8.3	7.8	0.957
Total energy intake (kcal)	1854.33 \pm 42.60	2003.72 \pm 45.77	2054.56 \pm 49.92	2297.91 \pm 42.68	<0.001
F/Hx of DM ^c , yes (%)	21.8	12.5	14.6	15.4	0.007
Known HTN(%)	23.9	19.3	25.5	23.5	0.295
Known dyslipidemia (%)	10.8	12.5	7.8	7.9	0.099
IFG (%)	20.6	21.6	26.7	31.1	0.001

Data are expressed as the mean \pm SD for continuous variables and as weighted percentages for categorical variables. NGT, normal glucose tolerance; IFG, impaired fasting glucose; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; FPG, fasting plasma glucose.

^a Unit is thousand Korean wons/month. ^b Regular exercise was indicated as 'yes' when the subject did moderate exercise on a regular basis (for more than 30 min at a time and more than 5 times a week). ^c Family history of diabetes limited 1st degree relatives.

Table 3. Odds ratio (95% CI) for impaired fasting glucose according to quartiles of lead

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Model 1	1	1.093(0.751-1.589)	1.439(1.005-2.060) *	1.906(1.369-2.654) *
Model 2	1	1.073(0.728-1.583)	1.202(0.826-1.751)	1.484(1.010-2.180) *
Model 3	1	1.077(0.729-1.591)	1.209(0.833-1.754)	1.491(1.004-2.214) *

Model 1: unadjusted.

Model 2: adjusted for age, sex, and diabetes risk factors (known HTN, known dyslipidemia, F/Hx of DM, SBP, DBP, and BMI)

Model 3: model 2 plus lifestyle behaviors (smoking status, alcohol drinking, regular exercise, and total energy intake) and sociodemographic factors (residential area, family income, and education).

*P < 0.05

CONCLUSION

Blood lead level was independently associated with IFG in Korean middle-aged population. We propose that the lead may contribute to increasing glucose level and risk of prediabetes.

