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Differential impact of per- and polyfluoroalkyl substances exposure on hypertension risk based on kidney function

Yaerim Kim¹, Inae Lee², Jeonghwan Lee³, Jin Hyuk Paek¹, Kyubok Jin², Seungyeup Han¹, Younglim Kho⁴, Kyungho Choi⁵, Jung Pyo Lee³

¹Department of Internal Medicine-Nephrology, Keimyung University Dongsan Medical Center, Korea, Republic of

²Department of School of Public Health, Keimyung University, Korea, Republic of

³Department of Internal Medicine-Nephrology, Seoul National University Boramae Medical Center, Korea, Republic of

⁴Department of Environment and Safety, Eulji University, Korea, Republic of

⁵Department of School of Public Health, Seoul National University, Korea, Republic of

Objectives : Per- and polyfluoroalkyl substances (PFAS) are persistent environmental contaminants widely detected in human populations. Emerging evidence suggests an association between PFAS exposure and hypertension, yet the role of kidney function in modifying this relationship remains unclear. This study investigates the differential effect of PFAS exposure on hypertension risk based on kidney function, while also assessing the modifying influences of obesity and sex.

Methods : We analyzed data from the 2018–2020 Korean National Environmental Health Survey (KoNEHS), including adults with available blood PFAS measurements, blood pressure assessments, and kidney function parameters. Multivariable logistic regression models were used to evaluate the association between PFAS exposure and hypertension, with interaction analyses stratified by kidney function, obesity, and sex.

Results : PFOS and PFNA were significantly associated with an increased risk of hypertension in the total population (adjusted odds ratio [aOR] for highest vs. lowest quartile: 1.79, 95% confidence interval [CI]: 1.22–2.62 for PFOS; aOR: 1.53, 95% CI: 1.13–2.08 for PFNA). However, these associations were primarily observed in individuals with preserved kidney function (eGFR \geq 90), where the effect sizes were stronger and statistically significant. Among those with reduced kidney function (eGFR < 90), the associations between PFAS exposure and hypertension were generally weaker and non-significant. Additionally, obesity modified the relationship, with obese individuals exhibiting stronger associations between PFAS and hypertension. Sex-stratified analyses revealed that PFAS exposure had a more pronounced hypertensive effect in men compared to women.

Conclusions : This study highlights the potential role of kidney function in modifying PFAS-associated hypertension risk. The findings suggest that individuals with normal kidney function may be more susceptible to the hypertensive effects of PFAS, whereas those with impaired renal clearance may experience attenuated associations due to altered PFAS toxicokinetics. Future research should explore longitudinal effects and mechanistic pathways underlying these relationships.