Associations between Arsenic in Drinking Water and the Occurrence of End-Stage Renal Disease with Modifications by Comorbidities: A Nationwide Population-Based Cohort Study in Taiwan

Ya-Yun Cheng*, Department of Environmental and Occupational Health, College of Medical, National Cheng Kung University, Tainan, Taiwan, b507092063@tmu.edu.tw
Chang-Chih Tsai, Department of Emergency Medicine, Chi-Mei Medical Center, Tainan, Taiwan, sandwich2004@gmail.com
Yu-Tzu Chang, Department of Internal Medicine, National Cheng Kung University Hospital, Tainan, Taiwan, kangxiemperor@gmail.com
Junne-Ming Sung, Department of Internal Medicine, National Cheng Kung University Hospital, Tainan, Taiwan, jmsung@mail.ncku.edu.tw
How-Ran Guo, Department of Environmental and Occupational Health, College of Medical, National Cheng Kung University, Tainan, Taiwan, hrguo@mail.ncku.edu.tw

Background/Aim
Arsenic may affect the function of proximal convoluted tubules and glomerulus, but epidemiological data in the association between arsenic ingestion and end-stage renal disease (ESRD) are limited. Our objective is to study the associations between exposure to arsenic from drinking water and the occurrence of ESRD in Taiwan, where the prevalence and incidence of ESRD are among the highest in the world.

Methods
Using data extracted from the Longitudinal Health Insurance Database (LHID2000) of the National Health Insurance in Taiwan, we constructed a cohort with age ≥40 years and identified patients of ESRD newly diagnosed between January 1, 1998 and December 31, 2010. Arsenic levels were assessed on the basis of a nationwide census survey conducted by the government, of which measurement reports were available for 311 townships, covering almost 85% of the townships in Taiwan. We performed multivariate Cox proportional hazard regressions to identify risk factors of ESRD and evaluate their effects. In addition, we studied the potential effect modification by comorbidities, including hypertension, hyperlipidemia, diabetes mellitus, stroke, cardiovascular diseases, and anemia.

Results
In the univariate analyses, we found residents of areas with arsenic levels ≥50 μg/L in the drinking water had a hazard ratio (HR) = 1.14 (95% confidence interval [CI]: 1.08-1.21) for ESRD. After adjusting for sex, age, income, urbanization level, and comorbidities, the increased risk was still statistically significant, with an adjusted HR (AHR) = 1.12 (95%CI: 1.05-1.18). The effect was modified by comorbidities, with more prominent effects on patients with less than three comorbidities.

Conclusions
We found that a high arsenic level in the drinking water was a risk factor for developing ESRD, independent of most documented risk factors, and observed effect modification by comorbidities. Intervention programs should be implemented in endemic areas of arsenic exposure to reduce the occurrence of ESRD.

Keywords: arsenic, drinking water, end-stage renal disease (ESRD), National Health Insurance Research Database (NHIRD), Taiwan