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The Modification Effect of Ambient Temperatures on the Associations between PM2.5 Components and Hospitalizations for Chronic Kidney Disease: a Nationwide Space-time-stratified Case-crossover Study in China

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Objectives : Epidemiological evidence concerning whether fine particulate matter ($PM_{2.5}$) components were associated with elevating risk of hospitalizations for chronic kidney disease (CKD) remains insufficient. Moreover, the potential modification effect of ambient temperatures on $PM_{2.5}$ component impacts is still unknown.
Methods : In the present study, we collected a nationwide sample of 2,259,240 hospitalization records for CKD in 260 Chinese cities from 2015 to 2018 using a national inpatient database. The space-time-stratified case-crossover design combined with a conditional quasi-Poisson regression model was applied to determine the associations. We further calculated the effects of $PM_{2.5}$ components in three temperature strata [i.e., lowest (<25th), medium (25-75th), and highest (>75th)].
Results : The results showed significant and monotonic associations between exposure to black carbon (BC), sulfate (SO_4^{2-}), nitrate (NO_3^-), ammonium (NH_4^+), and organic matter (OM) and risk of CKD hospitalizations. Along with an interquartile range increment in BC (1.24 μg/m^3), SO_4^{2-} (5.45 μg/m^3), NO_3^- (8.60 μg/m^3), NH_4^+ (5.43 μg/m^3), and OM (6.87 μg/m^3) at lag 0-4 days, the relative risks (RR) were 1.012 (95% confidence interval [CI]:1.009–1.015), 1.016 (95%CI:1.012–1.019), 1.016 (95%CI:1.012–1.020), 1.014 (95%CI:1.010–1.018), and 1.011 (95%CI:1.008–1.014), respectively. Stronger associations were observed among males, older patients, and those living in northern China. Higher ambient temperature significantly modified the estimated effects of $PM_{2.5}$ components on CKD hospitalizations. For instance, the RR of CKD hospitalization associated with exposure to BC was higher (1.024, 95%CI:1.019–1.029) at the highest temperature level compared to the lowest and medium levels (P for interaction<0.001).
Conclusions : This study found ambient temperatures could modify the association of $PM_{2.5}$ components with hospitalizations for CKD and provided an insight into the joint kidney health effects of air pollution and climate change. These findings highlight the necessity of protection measures against specific $PM_{2.5}$ components and high temperatures for the vulnerable populations.