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Air Pollution, Exposure to Polycyclic Aromatic Hydrocarbons, and Early Cardiovascular Effects: A Natural Experiment Between Los Angeles and Beijing

Background. Ambient air pollution is a major contributor to population's exposure to polycyclic aromatic hydrocarbons (PAHs) and has been associated with cardiovascular mortality and morbidity. Yet it remains unclear to what extent a short-term visit to a location with severe air pollution could increase exposure to PAHs and the risk of cardiovascular disease development.

Methods. In this natural experiment among healthy young adults who traveled from less-polluted Los Angeles to more-polluted Beijing, we collected 418 urine samples from 55 participants in 2012-2017 and 72 blood samples from 26 participants in 2014-2015 before, during and after they spent ten weeks in Beijing. Urinary hydroxy-PAHs levels and a panel of circulating biomarkers indicative of lipid peroxidation and inflammation were assessed.

Results. Traveling from Los Angeles to Beijing led to 15% to 595% increases in urinary concentrations of five hydroxy-PAHs ($p < 0.05$), which returned to baseline levels when participants went back to Los Angeles. With the rapid improvement in air quality in China since the implementation of a national air pollution control policy in 2013, we observed significant decreases in the urinary concentrations of hydroxy-PAHs in Beijing ($p < 0.05$) from 2012 to 2017 but not in Los Angeles. Urinary hydroxy-PAHs concentrations were positively associated with ambient levels of nitrogen dioxide, fine particulate matter, and ozone ($p < 0.05$) at stationary monitors in Beijing but not in Los Angeles. Traveling from Los Angeles to Beijing also increased the level of six circulating biomarkers of lipid peroxidation, among which 5-, 12-, 15- hydroxyeicosatetraenoic, and 9-, 13-hydroxyoctadecadienoic acids reached statistical significance ($p < 0.05$), but not the 8-isoprostane (20.8%; 95%CI, -5.0% to 53.6%). The anti-oxidative activities of paraoxonase (-9.8%; 95%CI, -14.0% to -5.3%) and arylesterase (-14.5%; 95%CI, -22.3% to -5.8%) were lower, and pro-inflammatory C-reactive protein (101%; 95% CI, 3.3% to 291%) and fibrinogen (48.3%; 95% CI, 4.9% to 110%) were higher in Beijing. All changes in cardiovascular biomarkers were reversed, at least partially, after participants returned to Los Angeles. Changes in most cardiovascular biomarkers were associated with urinary hydroxy-PAHs levels ($p < 0.05$).

Conclusions. People might be exposed to higher exposure to PAHs, in associations with pro-oxidative and pro-inflammatory effects when traveled from a less-polluted to a more-polluted city.