

Gaige Hunter Kerr. **COVID-19 Pandemic Reveals Persistent Disparities in Nitrogen Dioxide Pollution.**

**\*Background\*** Nitrogen dioxide (NO<sub>2</sub>) pollution in urban areas is primarily caused by light-duty vehicles (passenger cars) and heavy-duty trucking emissions. In addition to causing significant adverse health effects, NO<sub>2</sub> pollution is also an environmental justice issue as higher concentrations have been documented in racially and ethnically diverse and low socioeconomic status communities. Here we investigate how the unprecedented drop in NO<sub>2</sub> during COVID-19 lockdowns, largely due to reduced passenger vehicle emissions, impacts NO<sub>2</sub> disparities in the United States (U.S.).

**\*Methods.\*** We obtained space-based observations of tropospheric NO<sub>2</sub> from the TROPospheric Monitoring Instrument (TROPOMI) over the U.S. for a baseline period (13 March - 13 June 2019) and lockdown period (13 March-13 June 2020). TROPOMI observations for these periods were averaged to a high resolution grid of ~1 km x 1 km and thereafter aggregated over individual census tracts. Tract-averaged NO<sub>2</sub> levels were harmonized with demographic information (race, ethnicity, income, and educational attainment) from the U.S. Census Bureau's American Community Survey.

**\*Results.\*** Prior to the pandemic, NO<sub>2</sub> levels in the least white census tracts were approximately double NO<sub>2</sub> levels in the most white tracts. Similar results hold on the basis of ethnicity, income, and educational attainment. During lockdowns, the largest NO<sub>2</sub> reductions occurred in urban neighborhoods that have 2.0 times more non-white residents and 2.1 times more Hispanic residents than neighborhoods with the smallest reductions. We link these large decreases to the disproportionate number of major highways and interstates located in racially and ethnically diverse neighborhoods. Although the largest reductions in NO<sub>2</sub> occurred in marginalized neighborhoods, significant ethnoracial and socioeconomic disparities persisted during the pandemic-related lockdowns. Marginalized neighborhoods in many major metropolitan areas had higher NO<sub>2</sub> levels during the lockdowns than predominantly white neighborhoods experienced prior to the lockdowns.

**\*Conclusions.\*** While the lockdowns associated with the COVID-19 pandemic purportedly cleaned the air, our study showed persistent, significant disparities in NO<sub>2</sub> levels in the U.S. despite a dramatic decrease in human activity and emissions. Simply reducing the number of passenger vehicles, as was unintentionally done during the pandemic, or reducing the emissions from passenger vehicles (e.g., increasing fuel efficiency, improving vehicle emission controls) is unlikely to eliminate these NO<sub>2</sub> disparities. In addition, concerted efforts to reduce emissions from other sectors such as heavy-duty trucking, electricity generation, and industry, which are largely located in marginalized communities, are urgently needed to protect public health and advance environmental justice. "