HOW CLEAN IS THE AIR ON BICYCLE ROUTES?

A NITC research project evaluates cyclists' exposure to air pollution along distinct types of bicycle facilities.

The Issue

Active transportation modes such as walking and bicycling can offer health benefits from increased physical activity. However, active commuters also risk an increased intake (amount of air and pollutants) and uptake (absorption of pollutants by the body) of traffic-related air pollution. The risk is increased for cyclists due to exertion; cyclists' breathing rates and volumes tend to be higher than for other modes. Drivers in particular are less affected by pollution because air-tight vehicles provide a significant shielding effect.

Pollution exposure for urban bicyclists is not well understood due to a lack of on-road measurements. Existing literature on bicyclists' uptake of pollution suffers from a lack of direct measurements and insufficient analysis of the determinants of exposure. As a result, pollution-conscious planning, design, and analysis for bicycle facilities are hindered by limited quantitative guidance. A NITC study led by Portland State University professors James Pankow and Miguel Figliozzi addresses this research gap.

The Research

Investigators focused on two research questions. First, they sought to understand how urban bicyclists' intake

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THE ISSUE

A better understanding of urban bicyclists' exposure to air pollution would benefit planners and communities.

THE RESEARCH

This study measured:

- Ambient air quality on different bicycle routes in Portland, Oregon;
- Cyclists' intake and uptake of potentially harmful air pollution;
- Roadway characteristics' impact on air quality.

IMPLICATIONS

This research provides general guidance for bikeway design that aims to minimize air pollution risks, as well as providing Portland cyclists with information about air quality on their routes.

Photo: Springwater Corridor, an off-street bicycle path in southeast Portland, Oregon with the highest detected pollution levels of any bicycle route in the city

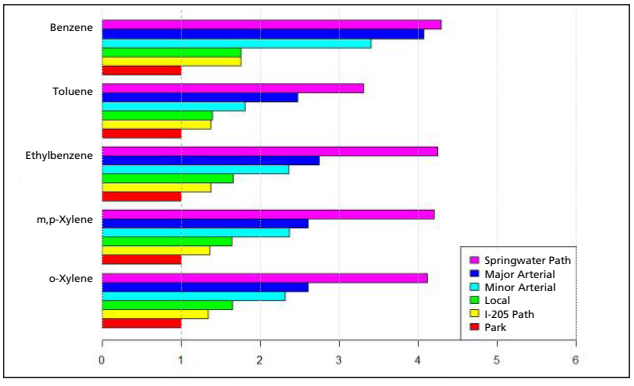
and uptake of air pollution vary with roadway and travel characteristics. Second, they wanted to find ways to reduce this exposure with transportation strategies.

Breath biomarkers were used to study absorbed doses of volatile organic compounds (VOCs) during riding. This research is the first application of breath biomarkers to travelers and the first uptake measurements of any pollutant to include roadway-level and atmospheric covariates. Carbon monoxide (CO), particulate matter (PM), and total volatile organic compounds (VOC) were measured using an instrumented bicycle. Three research subjects rode a variety of routes including bicycle lanes on arterials, bicycle boulevards, off-street paths and mixed-use roadways. Research subjects were instructed to ride at a pace and exertion level typical for utilitarian travel, and they rode a bicycle equipped with instruments to collect breath samples as well as high-resolution bicycle, rider, traffic, and environmental data.

Implications

Research results have important implications for bikeway design that aims to minimize air pollution risks. The results can also benefit active travelers who want to make more informed route and travel choices.

Separated bicycle facilities, low-traffic routes, and off-peak travel can significantly reduce exposure concentrations. These are potential "win-win" strategies because bicyclists already prefer low-traffic routes and bicycle-specific facilities. It was found that cyclists could significantly reduce their pollution exposure by making even minor, one- to two-block detours from major arterials to parallel low-volume streets. Cycle tracks are useful to reduce bicyclist exposure concentrations by increasing the separation between bicyclists and motorized traffic, but cycle tracks are not as effective as parallel off-street paths. Although off-street facilities generally have low concentrations, off-street facilities near industrial land uses should be avoided because they can have significantly higher air pollution concentrations than mixed used roadways in downtown areas or neighborhoods.



Average ambient concentrations by location

This graph shows concentrations of VOCs, normalized to the park location. Due to adjacent industrial land use, the Springwater off-street trail has the highest concentrations of these compounds.

PROJECT INFORMATION

TITLE: Evaluation of Bicyclists Exposure to Traffic-Related Air Pollution along Distinct Facility Types

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