

The HERCULES Exposome Research Center develops new tools and technologies to study the exposome.

The Exposome

The exposome is the concept that **environmental exposures** play a role in our **health** over a lifetime. These exposures include what we eat and drink, the air we breathe, our behaviors and lifestyles, and where we work, live and play. Metabolomics is one approach that HERCULES uses to study the exposome.



Metabolomics identifies environmental contaminants in our body in addition to quantifying how these contaminants alter biological processes. It is the measurement of all the **metabolites** (small molecules) that result from metabolism in the body.

These metabolites result from chemicals that are naturally produced by our bodies (**endogenous metabolites**) or from the metabolism of food, drugs, and pollutants that enter our bodies (**exogenous metabolites**).



Metabolomics is one part of the **'-omics of exposure'** approach which is used to analyze our body's interactions with thousands of different environmental chemicals at the molecular level.

Tools and Methods

Biological samples are analyzed for metabolites using:

- Chromatography (gas or liquid), which separates the metabolites
- High-resolution mass spectrometry, which detects metabolic features based on chemical properties such as size and behavior.

The results are used to:

• Identify the individual chemical compounds in the body

Biological Samples can include:

- blood
- urine
- saliva
- tissues
- hair
- exhaled breath condensatefecal samples
- Examine relationships between exposure, internal dose and the effect on biological processes at a molecular level.

Metabolomics is a valuable scientific method that allows us to detect alterations in biological function at a molecular level and intervene before a person may show signs or symptoms of disease

What questions can data science answer?

- What classes of contaminants have entered our bodies?
- What biological functions have changed in relation to environmental exposures?

Metabolomics in Action

Traffic-related air pollution and asthma



Traffic-related air pollution (TRAP) can affect heart and lung health. In asthmatics, TRAP exposure has been linked to worsened asthma symptoms in addition to hospitalizations. **This study used metabolomics to measure how TRAP exposure changes the metabolites in blood samples in asthmatics and non-asthmatics.**

Methods









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participants drove a scripted route during morning rush hour in Atlanta

TRAP chemicals

were monitored and measured inside the vehicles during the commute

Blood samples

were collected before and after the commute

Metabolites

were analyzed in the blood and compared to invehicle TRAP exposure

Results

In all commuters, TRAP exposure altered metabolite levels in the blood samples. In asthmatics, TRAP exposure more heavily altered metabolites associated with **inflammation** and an **overly reactive airway response**.

This study shows how HERCULES uses metabolomics to identify metobolites and biological functions that are altered due to a environmental exposure.

How can I learn more?



For more information about HERCULES: https://emory.hercules.com/

For more information about metabolomics at HERCULES: https://emoryhercules.com/facility-cores/metabolomics/

To read more about the Metabolics in Action study:

https://doi.org/10.1007/s11869-017-0530-8

Golan, R., Ladva, C., Greenwald, R. *et al.* Acute pulmonary and inflammatory response in young adults following a scripted car commute. *Air Qual Atmos Health* **11**, 123–136 (2018).



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