Universitat Pompeu Fabra Barcelona

Master in Bioinformatics for Health Sciences

Master project 2024-2025

Personal Information

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Project

Computational systems biology

Project Title:

Associations between the Maternal Exposome and Metabolome during Pregnancy

Keywords:

Metabolomics, Exposome, Pregnancy, Birth cohorts, Environment and health

Summary:

Pregnancy is a critical period for maternal and offspring health. The developing fetus and the pregnant mother are both especially susceptible to exposure to environmental chemicals. Many chemicals can pass through the placenta into the fetus. Exposures during pregnancy may lead to adverse outcomes in both mother and fetus that manifest both early and much later in life. Most studies of the impact of prenatal exposure have examined a small number of specific chemicals. There is growing interest in examining a larger range of exposures at once. This has led to the concept of measuring the chemical exposome to take a comprehensive and agnostic approach toward assessment of chemical exposures. Environmental epidemiological studies have identified many associations between exposure to individual chemicals during pregnancy and maternal and offspring health outcomes, but the underlying mechanisms remain largely unknown. Metabolomics systematically profiles metabolites, which are the endogenous small molecule substrates, intermediates, and products of cell metabolism in a biological sample. This comprehensive approach can identify metabolic signatures of chemical exposures that could play a role in disease etiology. Notably, metabolomics has been recognized as an omics technology that may be most closely relevant to disease phenotypes. For example, metabolomic platforms assess clinically applicable indicators, such as steroid hormones and cholesterol. Moreover, the small molecules interrogated by metabolomics approaches include nutrients and their metabolites that are involved in disease pathogenesis in humans and animals. Dramatic metabolic changes take place in pregnancy, including increased protein synthesis from amino acids to enable fetal growth and steroid hormone synthesis to support maintenance of the pregnancy. Therefore, metabolomics is of increasing interest in understanding both the normal physiology and pathology of pregnancy. In genetic studies, metabolomics has been used to suggest mechanisms that may underlie associations with health outcomes in humans. Application of exposomic and metabolomic technologies together in pregnancy could identify metabolomic signatures of a broad range of exposures that could shed light on potential health effects of these exposure, as well as their underlying mechanisms. This project will use a unique dataset available through the European Project ATHLETE (https://athleteproject.eu/), led by ISGlobal (campus Mar – PRBB https://www.isglobal.org/en/child-health?inheritRedirect=true), pioneers' researchers in the field of exposome research (https://www.isglobal.org/exposome-hub). The dataset consists of 1300 mother-child pairs with metabolomics and exposomics data at different time points throughout pregnancy and childhood. The metabolomics data are composed of 1000s of untargeted metabolite features. Project objectives: 1- Develop a bioinformatic pipeline in R to extract metabolomic features from the raw high-resolution liquid-chromatography dataset 2- Prepare an analysis protocol for the association between metabolomics and exposomic data 3- Prepare a scientific manuscript The student will learn: - How to conduct an epidemiological analysis with advanced statistical tools - To work with metabolomics and exposome data, which are highly promising new omics technologies in the post-genomic era in the health sector - Write a scientific manuscript The student will fully integrate the regular team meetings and seminars with opportunities to present their work and get training in epidemiology and statistics.

References:

https://ehp.niehs.nih.gov/doi/10.1289/EHP9745?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed

https://pubmed.ncbi.nlm.nih.gov/30285427/
https://journals.lww.com/environepidem/Fulltext/2021/10000/Advancing_tools_for_human_early_lifecourse.5.aspx

Expected skills:

R programming, Statistics, Analytical chemistry (basic knowledge appreciated)

Possibility of funding:

To be discussed

Possible continuity with PhD:

To be discussed

Comments:

possibility of remote work