New Study Designs and Methods to Evaluate Gene and Environmental Chemical Interaction Data

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Evaluating mixtures of environmental chemicals and genes separately is a challenging undertaking due to the large number of often highly correlated covariates. Evaluating possible interactions between these two complex groups is difficult, and standard design and estimation methods are ill suited for it. Advancements in study design and estimation procedures will improve our ability to quantify potential interactions between genes and environmental chemicals significantly.

We will develop state of the art study design and estimation approaches to evaluate the impact of gene and environmental chemical interactions on human health using non-parametric and parametric approaches. One such aim would be to use redaction techniques accounting for interactions with the goal of avoiding population stratification bias. Marginal structural models to test for interactions will be developed. Other causal inference techniques will be employed to disentangle these complex relations while minimizing the effect of multiple comparisons. These techniques will be suited to environmental mixtures and gene data that are subject to impediments from intricate laboratory measurement constraints, such as limits of detection and measurement error. Upon completion of the work, we will prepare peer reviewed scientific manuscripts. These papers are expected to document the epidemiological and statistical issues, offer statistical approaches for obtaining valid parameter estimates along with confidence intervals, and empirically demonstrate the utility of the proposed methodology. The panel of pre-doctoral and post-doctoral fellows has yet been selected.

Implications: This study will offer DESPR investigators and external consultants an opportunity to create new and innovative study design and estimation techniques for interaction between highly correlated chemical exposures and multiple genes. These techniques will minimize difficulties common to these types of data, such as high cost of sample procurement and measurement while searching for small effect sizes. New designs and estimation techniques will be suitable for biomonitoring and to improve population safety while conducting informative and efficient investigation of chemical exposures, genes, and potential human health risks. These new designs and analysis techniques will grant researchers the ability to seek small effect sizes associated with potential interactions between complex chemical exposures and gene profiles. These methods will also account for the complexity and costly nature of measuring such data, allowing for ground breaking research of potential interactions that investigators were once unable to study.

Start and end date: January 2009 − December 2010

Presentation(s): None to date.

Peer-reviewed publication(s): None to date.

Other publication(s): None to date.

Sponsors in addition to the LRI: Intramural Research Program, *Eunice Kennedy Shriver* National Institute of Child Health and Human Development.

Abstract creation date: March 2009