Thesis Portfolio

Systems Genetics Approaches to Compare Mechanisms of Smooth Muscle Cell Plasticity in Quiescent and Proliferative States in Coronary Artery Disease

(Technical Report)

The Politics of the Global Footprint Network Resistance to Changes to the Ecological Footprint Metric

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

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Spring, 2022

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Table of Contents

Sociotechnical Synthesis

Food inaccessibility is a growing concern around the world (Berlin et al., 2012). Agricultural production continues to increase to meet the growing demand for food (Spiertz, 2009). However, because of their environmental effects, many common agricultural practices are unsustainable. More sustainable agricultural techniques are needed to meet current and future demand for food. Sustainable means of improving food accessibility may also improve cardiovascular health as food insufficiency has been associated with risk factors for several cardiovascular diseases (CVDs) (Liu and Eicher-Miller, 2021; Vercammen et al., 2021). CVDs include coronary artery disease (CAD), the number-one cause of death worldwide (Khera & Kathiresan, 2017).

To understand more about CAD, the technical project presented in this thesis is about finding a novel and more robust way of investigating genetic disease, specifically CAD. In my case, I am investigating atherosclerosis which is the cause of CAD. By being able to research some of the genes related to CAD, we are able to understand the genetic factors of this disease, but not necessarily some of the environmental factors. Therefore, I wanted to investigate some of those factors as well. This led me to look at food accessibility and its relationship with coronary artery disease as well as sustainable practices. Being able to investigate environmental sustainability and how the Ecological Footprint metric is used to change environmental policy and how it has changed with new findings allowed me to understand more about an aspect of some of the environmental factors that may be contributing to CAD.

In my STS project, my thesis is that though the Ecological Footprint metric has been used by multiple communities to guide their environmental choices, it has received criticisms from various scientists for their lack of complexity in certain areas. Even when the criticism has come

from various sources, the GFN has not changed the EF according to the new scientific information aimed at improving it. Though GFN has not taken the criticism to re-work their metric, other scientists have used the new scientific insights to change said metric as discussed through the co-production lense first described by Sheila Jasanoff. The findings from this project are that even though the reason is not completely clear, the Global Footprint Network and its co-creator have not taken different scientific expertise into account to retroactively adjust their metric. However, others have used these new insights to adjust this metric and produce meaningful results of the Ecological Footprint.

On the other hand, my technical project's goal is to find a more robust computational method to determine whether and how a pathway of genes is perturbed between the atherogenic and healthy conditions of CAD. To do this, modules whose connectivity patterns are not preserved between conditions were studied. This study demonstrates the power of using network preservation statistics in identifying differences between two biological states. The results provide new evidence supporting the role of metabolism as a potential regulator of vascular smooth muscle cell (VSMC) plasticity. Further studies need to be conducted to discern whether dysregulated metabolism in VSMCs is a byproduct or a driving mechanism of phenotypic plasticity. Specifically, considering MPI in regulating mannose and glycolysis metabolism in VSMCs.

References

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