Big Data, Big Opportunities - Systems Biology Approaches for Understanding Our "Second Genome" in Health and Disease

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Abstract

In recent years, human microbiome, our "second genome", found to play a crucial role in the regulation of host physiology. For example, human microbiome found to be strong determinants of metabolic status more than host genetics, its dysbiosis associated with many types of chronic diseases, including diabetes, cancers, and neurodegenerative diseases. Based on such findings, many researchers claimed that microbiota should be a part of "hallmark of aging", being associated with accelerated aging process and the onset of aging-associated diseases. Therefore, the modulation of "unhealthy" human gut microbiota can prevent many chronic diseases, for example, insulin resistance and cardiovascular diseases.

Currently, there are many promising technology and computational methods developed to identify the composition of human microbiome and associated metabolome. For example, next-generation sequencing (NGS) and mass spectrometry have enabled the in-depth molecular profiling of patients with chronic diseases, including transcriptome, epigenome, proteome, metabolome, and metagenome (Mardinoglu *et al.*, 2017, Cell Metabolism; Brian D. Piening *et al.*, 2018, Cell Systems; Nathan Price et al., 2017, Nature Biotechnology). Applying systems biology approaches with multi-omics data, complex biological phenomena can be simplified into understandable formulae. For instance, based on multi-omics studies, decreased uptake of D-mannose in liver tissue has been found among insulin resistant subjects, which could explain the how the decreased glycosylation of hepatic insulin receptors can promote insulin resistance (Sunjae Lee *et al.*, 2016, Cell Metabolism). Therefore, application of systems biology for the understanding of human microbiome, our "second genome" will advance the prevention and treatment of many chronic diseases associated with microbial dysbiosis.

Furthermore, many systems biologists designed the precision diet based on the AI models of human microbiome profiles, so that AI-guided diets can improve postprandial blood glucose response. Recent findings holds promises of regulation of glucose metabolism by systems biology approaches based on human microbiome modulations. In this lecture, the speaker will present recent systems biology approaches for the understanding of human microbiome and future perspective of precision medicine will be proposed in regard to personal multi-omics data clouds, beyond human microbiome data.