Understanding Sex Differences Through the Lens of Biological Networks



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Abstract

Biological sex significantly influences disease risk, progression, and treatment response, yet it is still rarely incorporated explicitly into how we design studies, analyze data, or develop therapies. In this talk, I will show how biologic networks can reveal sex-specific mechanisms that are not found in traditional single-gene analyses. By integrating multi-omic data and gene regulatory networks, we demonstrate how genes can be wired differently in males and females across health and disease. I will highlight examples in lung cancer where sex differences in gene regulation help explain disparities in incidence, progression, and response to therapy, and demonstrate how network methods can identify sex-specific therapeutic candidates and reveal why certain treatments may be more effective in one sex than the other. I will also present emerging work on the role of the X chromosome, dosage compensation, and epigenetic regulation in shaping sex-specific gene regulation in chronic lung disease. Throughout the talk, I will emphasize methodological considerations for building and interpreting sex-specific networks and for translating these insights into sex-aware interventions. Together, these results illustrate how network medicine can move us beyond simply "adjusting for sex" toward leveraging sex differences as a source of biological insight and therapeutic opportunity.

Short bio

Camila Lopes-Ramos is an Instructor in the Channing Division of Network Medicine at Brigham and Women's Hospital and Harvard Medical School, and in the Department of Biostatistics at the Harvard T.H. Chan School of Public Health in Boston, USA. Her research integrates multi-omics, systems biology, and network medicine to understand how sex-specific gene regulation drives disease development and treatment response, particularly in lung cancer and chronic lung disease. Dr. Lopes-Ramos' work identifies gene regulatory mechanisms underlying sex differences in disease risk and clinical outcomes, with the goal of advancing sex-aware precision medicine. She holds a PhD in Oncology from AC Camargo Cancer Center in Brazil and completed a postdoctoral fellowship at Dana-Farber Cancer Institute and Harvard University.

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