The escalating prevalence of obesity and its associated complications, including type 2 diabetes (T2D), poses a growing concern, especially among children. Recent research has elucidated the role of gut bacteria in fermenting non-digestible dietary fiber, resulting in the production of short-chain fatty acids (SCFAs) such as acetate, propionate, and butyrate. Notably, groundbreaking discoveries in rodent models have underscored the profound impact of maternal nutrition and SCFAs on the proper development of the central and peripheral nervous systems, which in turn govern energy balance and glucose homeostasis during childhood and adulthood (1). However, further investigations are required to elucidate the underlying mechanisms and then establish the existence of similar connections in humans, particularly in relation to the prevention of obesity and T2D throughout pregnancy, childhood, and adulthood of the offspring. Building upon these remarkable findings, we will focus on unraveling the mechanisms underlying the communication between the gut and brain, particularly during critical stages of development, to identify potential strategies for preventing the onset of neurological and metabolic disorders. We will address the aims listed below:

Aim 1: to evaluate the expression and localization of SCFA receptors during embryonic and postnatal stages in rodents, in the presence or absence of maternal gut microbiota.

Aim 2: to assess the role of SCFAs on the pre- and postnatal development of central (CNS) and autonomic (ANS) nervous systems, and to determine the long-lasting effects of the lack of Free Fatty Acid Receptor (FFAR3) in neuronal tissue on energy balance and glucose homeostasis.

Aim 3: to utilize clinical data, most of them available, to evaluate the correlation between maternal fiber intake, and SCFA levels in pregnancy with metabolic parameters in children such as body weight and body fat at birth, age 2 and 12 months.

By combining our expertise in gut microbiota, neurodevelopment, and clinical data analysis, we aim to provide novel insights into the impact of nutrition and gut-brain communication on long-term health outcomes, laying the groundwork for targeted interventions, and improving overall health trajectories for individuals across their lifespan.