

Model of adipocyte size dynamics under variable energy balance

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Adipocytes serve as an energy reservoir for the body thanks to their capacity to store and release lipids by adapting their size. Under energy surplus conditions, adipocytes store excess calories in the form of triglycerides through lipogenesis [3]. When existing cells reach storage capacity, new cells are recruited via pre-adipocyte differentiation [1]. During periods of energy deficit, adipocytes release the needed energy through lipolysis [3]. We propose a model incorporating transitions between two processes : lipogenesis and lipolysis, as well as cell recruitment, depending on energy balance.

We present a population dynamics model structured by the lipid content of the cell, formalized as an advection-diffusion partial differential equation, with non-local nonlinearities on the velocity term and on the boundary condition. The non-local term reflects the energy balance at a given moment. It determines whether cells increase or decrease their lipid content, and its value determines the rate of both processes. Further, it governs the recruitment of new cells.

We investigate model well-posedness in the general formulation and present its theoretical properties, as developed in [4]. We then numerically explore the model, predicting the evolution of the adipose tissue cell size in response to a given diet. We show that, with appropriate term selection, model predictions qualitatively agree with the measured data in rats [2].

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