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Development of a mathematical model of the effects of gastrointestinal disease and dietary nutrition on infant body composition in order to improve outcomes in those suffering from malnutrition

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Malnutrition in infants in low- to middle-income countries is a complex problem caused, in part, by underfeeding and an increased prevalence of gastrointestinal (GI) disease. To understand and separate the effects of nutrition and disease on infant growth, a physiologically-based mathematical model was developed describing fat mass (FM) and fat-free mass (FFM) from birth to 2 years. This effort was based on a published model describing growth dynamics, expanded to include effects of infection and nutritional status on nutrient absorption in the gut. Model calibration used published data to quantify the physiology of healthy and non-healthy GI function and resulting physical growth, including: Macronutrient absorption efficiencies, deposition of metabolizable energy into FM and FFM, total energy expenditure, dynamics of severe bacterial and viral infections, effects of malnutrition on GI/immune function, recovery from malnutrition. The model was validated using individual data from different geographical locations representing various phenotypes, dietary intakes, disease susceptibilities and child rearing patterns. One important insight from this work resulted from the differential FM and FFM composition of weight loss during infection and weight gain during recovery, dependent on the degree of malnutrition and individual phenotype. For example, an interesting phenotype has been seen in infants at risk of malnutrition whereby FM is increased despite energy intakes smaller than age-appropriate requirements. The model was able to mechanistically recapitulate this phenotype by imposing repeated cycles of weight loss/gain due to infections or underfeeding, indicating the potentially large impact of non-dietary factors on infant growth outcomes.

Biography

Rena Eudy-Byrne, PhD has over 5 years of experience developing physiolgical systems models and other modeling and simulation applications for drug devel-opent. Her training is in Biomedical Engineering.

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