The utility of standardizing or crude weight measures in modeling of postnatal growth trajectories: are there differences?

Child growth trajectories are a frequently used metric in life course epidemiology. Z-scores, of weight, length or a combination of the two, are measures typically used when modeling growth trajectories. In terms of parsimony, advantages of Z-scores on a cross-sectional basis include linear scale properties and the ability to combine genders in one model without additional covariates. As a result, Z-scores are frequently used in modeling infant growth, but their properties relative to crude measurements have not been fully explored. We undertook a series of simulations to compare tests of differences in infant weight change across time (growth velocity) across two exposure groups with a referent model including crude weight as an outcome and time as a continuous measure. Models with weight Z-score or weight percentile outcomes were then compared to the referent model using data from three different countries (Portugal, Chile and Italy). To assess differences between the models we calculated power, type I error, and median estimates. Simulation results demonstrate lower power when using Z-scores as an outcome. Also, evidence supports situations in which the crude weight model velocity differences between exposed and unexposed are in the opposite direction of those estimated in the Z-score or percentile model. These contradictory estimates occur when there are group differences in weight at baseline. The Z-score standards were developed for cross-sectional use, and a within-child increase in crude weight over time may not translate to an increase in Z-score or vice versa. This characteristic can help explain the discrepancies in velocity differences across outcome measures. We conclude that infant growth models calculated using Z-scores and percentiles can produce inference contradicting results from models using crude weight measures. These results emphasize the need for careful consideration of the appropriate scale when modeling infant growth trajectories.