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

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Introduction

Analyses of growth trajectories are expanding in tandem with the growing interest in life course epidemiology. Z-scores are a frequent choice when modeling weight growth trajectories to standardize the sample to usually what is the CDC reference or WHO standard populations. When used for cross-sectional data, Z-scores have advantages including linear sex- and age-independent measures of weight outcomes. However, there is no appropriate rationale to use Z-scores, or an equivalent such as percentiles, when studying weight change in infancy.

Samples

Growth trajectory parameters for baseline exposure correspond to published estimates for three samples: Italy, Portugal and Chile.

C. Pizzi et al. "Prenatal Influences on Size, Velocity and Tempo of Infant Growth: Findings from Three Contemporary Cohorts". In: *PLoS ONE* 9.2 (Feb. 27, 2014). Ed. by G. Wang, e90291. DOI: 10.1371/journal.pone.0090291

Aim

Use simulations to assess differences in power, type I error measures, and coefficient estimates of weight change differences across three different outcome measures in child anthropometric measures: weight, weight Z-score and weight percentiles.

Method

We simulated infant growth data using a Reed first order parametric model:

$$y = \beta_0 + \beta_1 \cdot t + \beta_2 \cdot \ln(t) + \frac{\beta_3}{t}$$

After simulating data, three models were run on the data:

Model 1

$$y_{ij} = \beta_0 + \beta_1 \cdot t + \beta_2 \cdot \mathrm{group} + \beta_3 \cdot t \cdot \mathrm{group} + e_{ij}$$

Model 2

$$y_{ij} = \beta_0 + \beta_1 \cdot t + \beta_2 \cdot \mathrm{group} + \beta_3 \cdot t \cdot \mathrm{group} + \beta_4 \cdot t^2 + e_{ij}$$

Model 3

$$y_{ij} = \beta_0 + \beta_1 \cdot \mathrm{month.6} + \beta_2 \cdot \mathrm{group} + \beta_3 \cdot \mathrm{month.6} \cdot \mathrm{group} + e_{ij}$$

Model Terms

- y_{ij}: the outcome: weight, Z-score or percentile
- **group**: a binary exposure factor
- **month.6**: a binary variable for time with 1=month 6 and 0=month 0
- e_{ij}: error term with a autocorrelation structure, ρ=0.5 and σ=0.75

Results

Figure 1: Simulated growth curves: weight, Z-score, and percentile outcomes using Chilean growth parameters

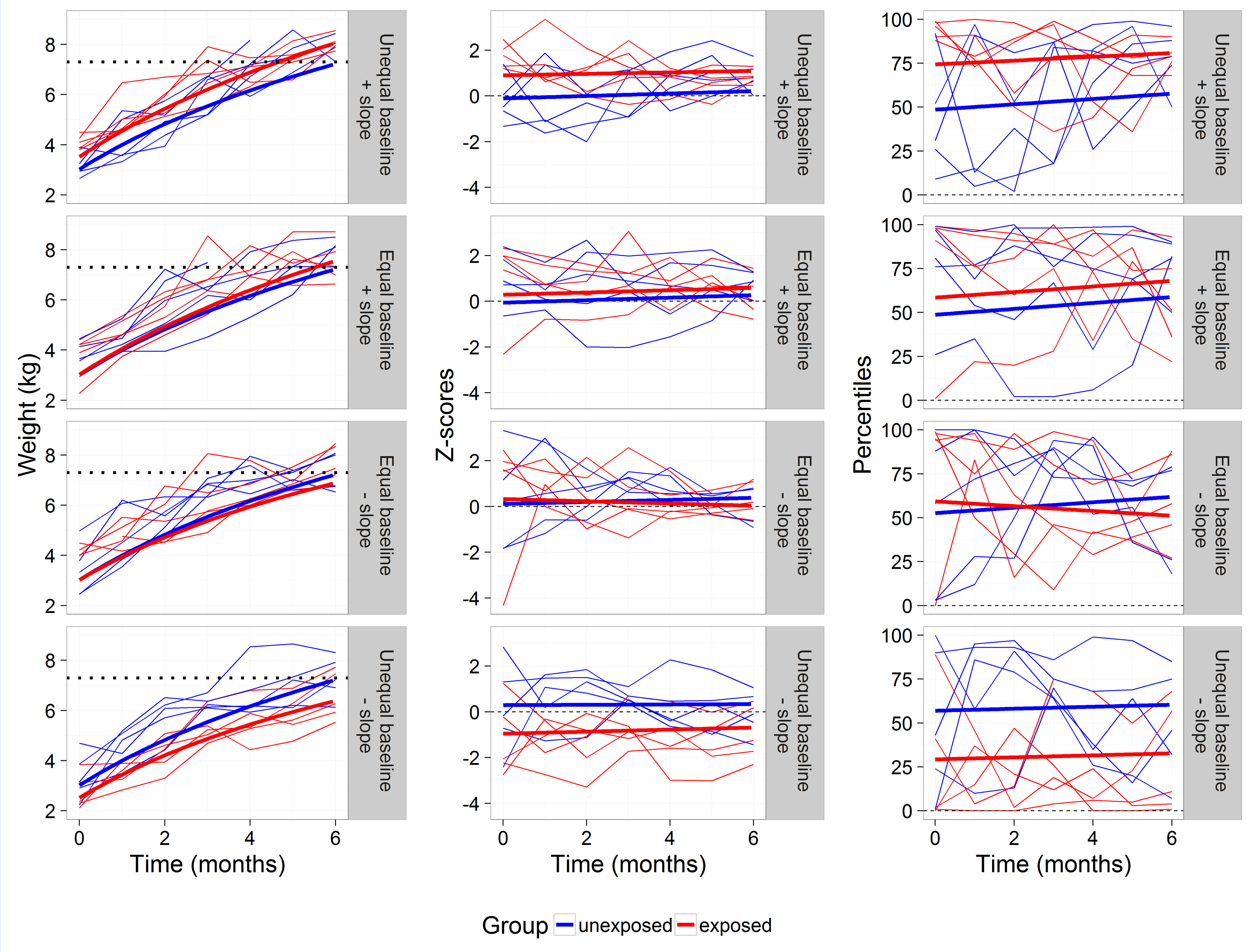
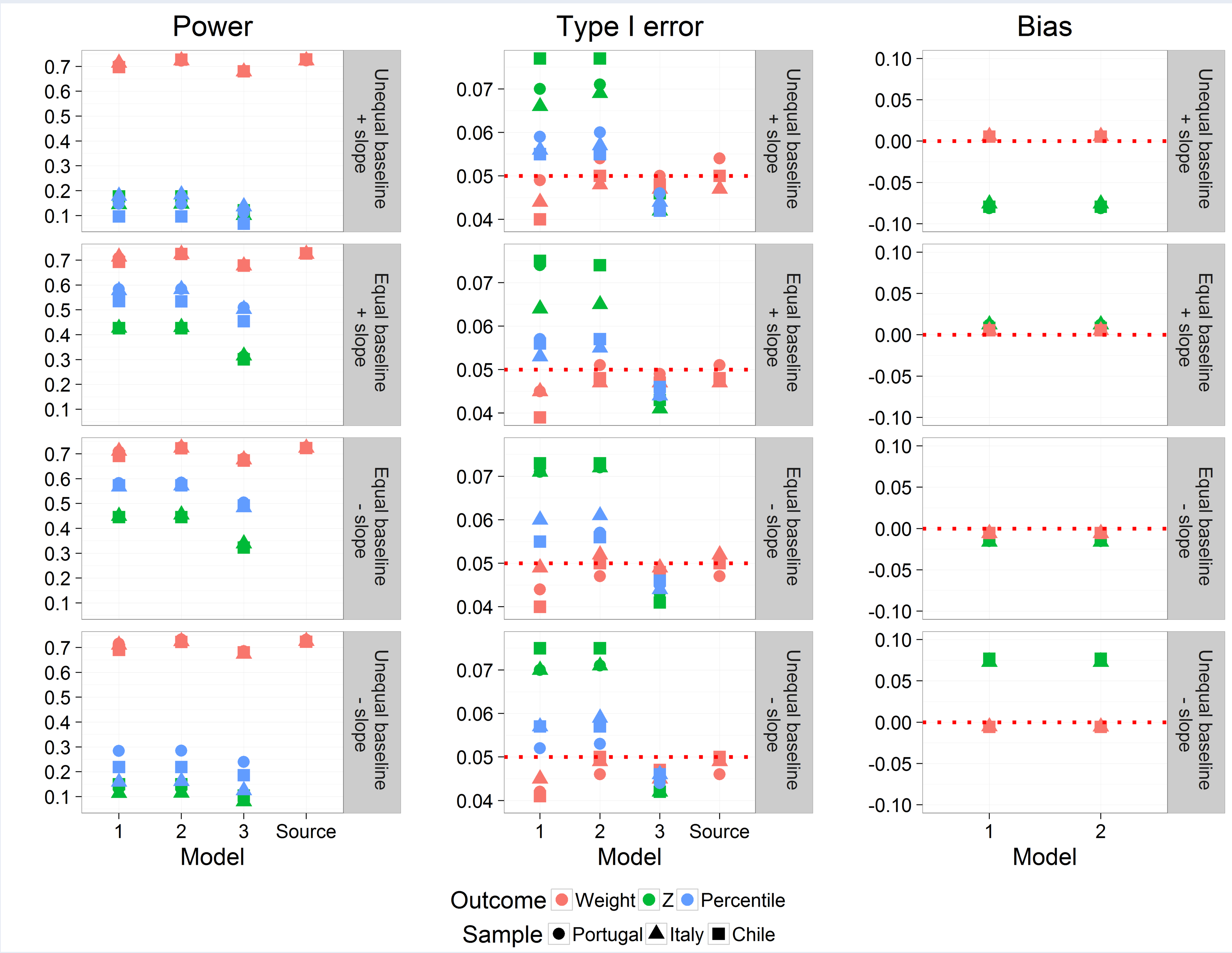


Figure 2: Comparison of power, type-I error and bias for product term for time and exposure effect, β_3.



Summary

Power Greater with original weight value.

- Weight difference at baseline creates larger differential.

Type I error Closest to nominal level with original weight value.

- Z-scores most likely to be less conservative.

Bias Direction of effect in opposite direction for Z-score outcomes when groups have weight difference at baseline.

- With no weight differences at baseline, estimates between Z-score and original weight value similar.

Future Efforts

Put future efforts here.