Predicting Accelerated Weight Gain in Urban Infants and Toddlers

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Overview

- Pediatric Obesity and Overweight Trends and Definitions
- Risk Factors and Health Disparities
- Preliminary Findings from CANDLE Data set
- Discussion
- Questions

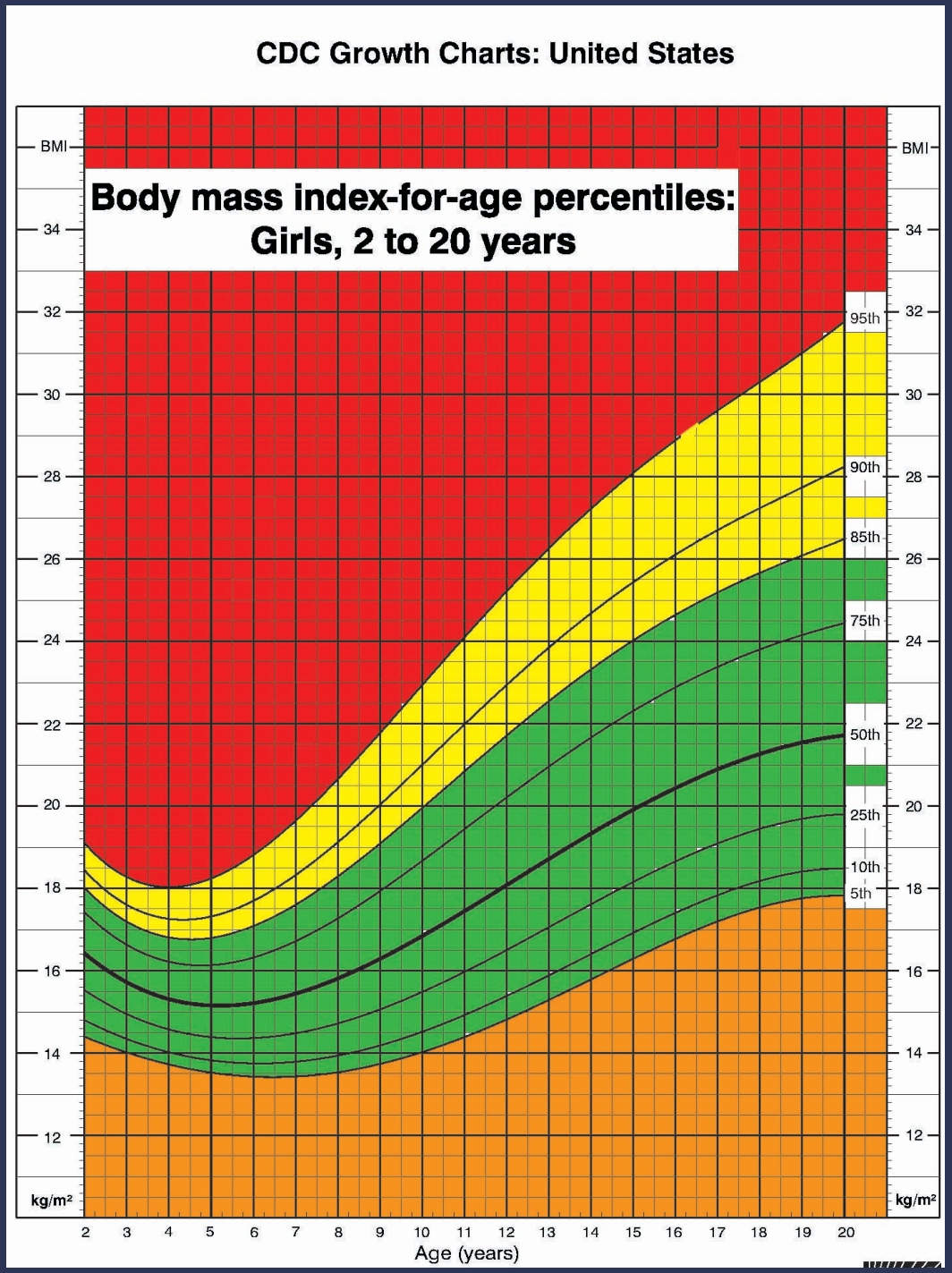
Background & Significance

- Pediatric obesity prevalence has increased dramatically in the past 30 years, more than doubling in children and tripling in adolescents[1]
- Age- and sex- specific Body Mass Index (BMI) percentiles are use with Children (2 to 19 years old) to define overweight and obesity[2]
  - BMI $= weight\,(kg)/height\hat{}2\,(m)$

1. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *Journal of the American Medical Association* 2012;307(5):483-490.
2. Barlow SE and the Expert Committee. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics* 2007;120 Supplement December 2007:S164—S192.

BMI-Based Weight Categories

Category	Percentile Range
Obese	≥ 95th
Overweight	85th < 95th
Healthy Weight	5th to < 85th
Underweight	< 5th



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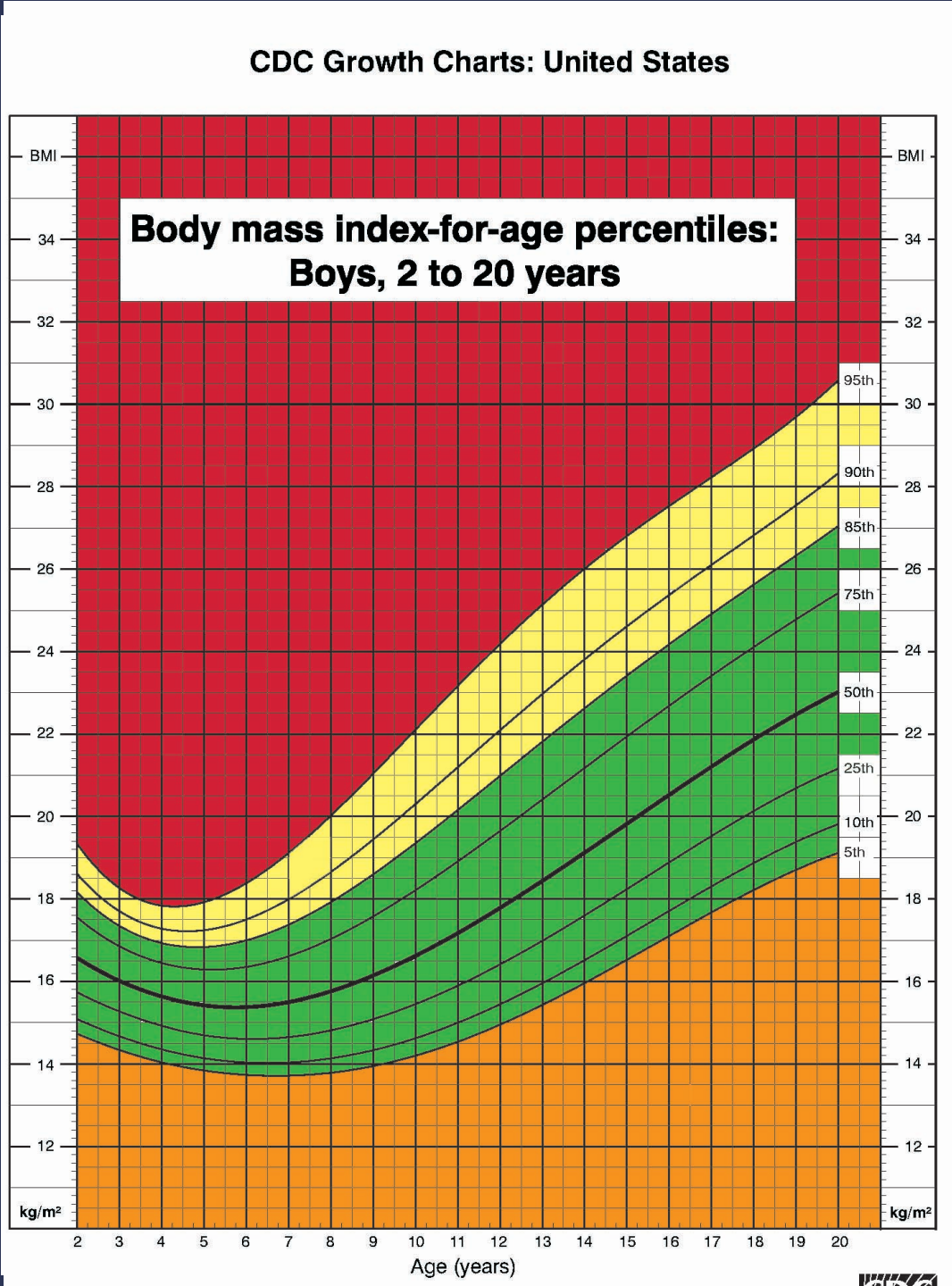

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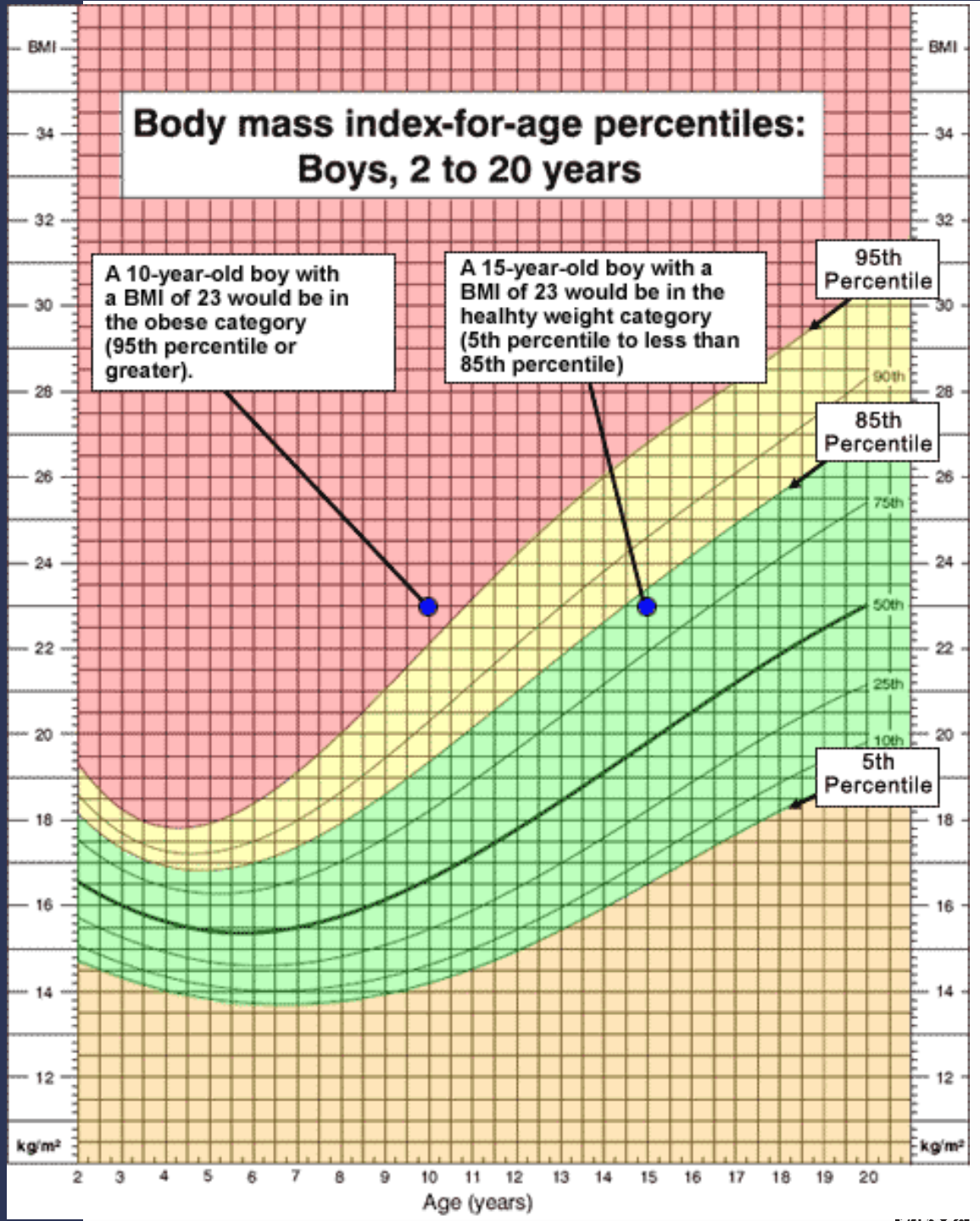


Birth to 24-36 months: Weight for Length ("Adiposity Z-scores")

Background & Significance

- Pediatric obesity “epidemic”
- Obesity and overweight place children at considerable risk for multitude of problems such as heart disease, type-2 diabetes, stroke, poor self-esteem, body dissatisfaction, and social stigmatization.[1-4]
- Obese children are more likely to become obese adults. [5-7]
- If children are overweight, obesity in adulthood is likely to be more severe[8].

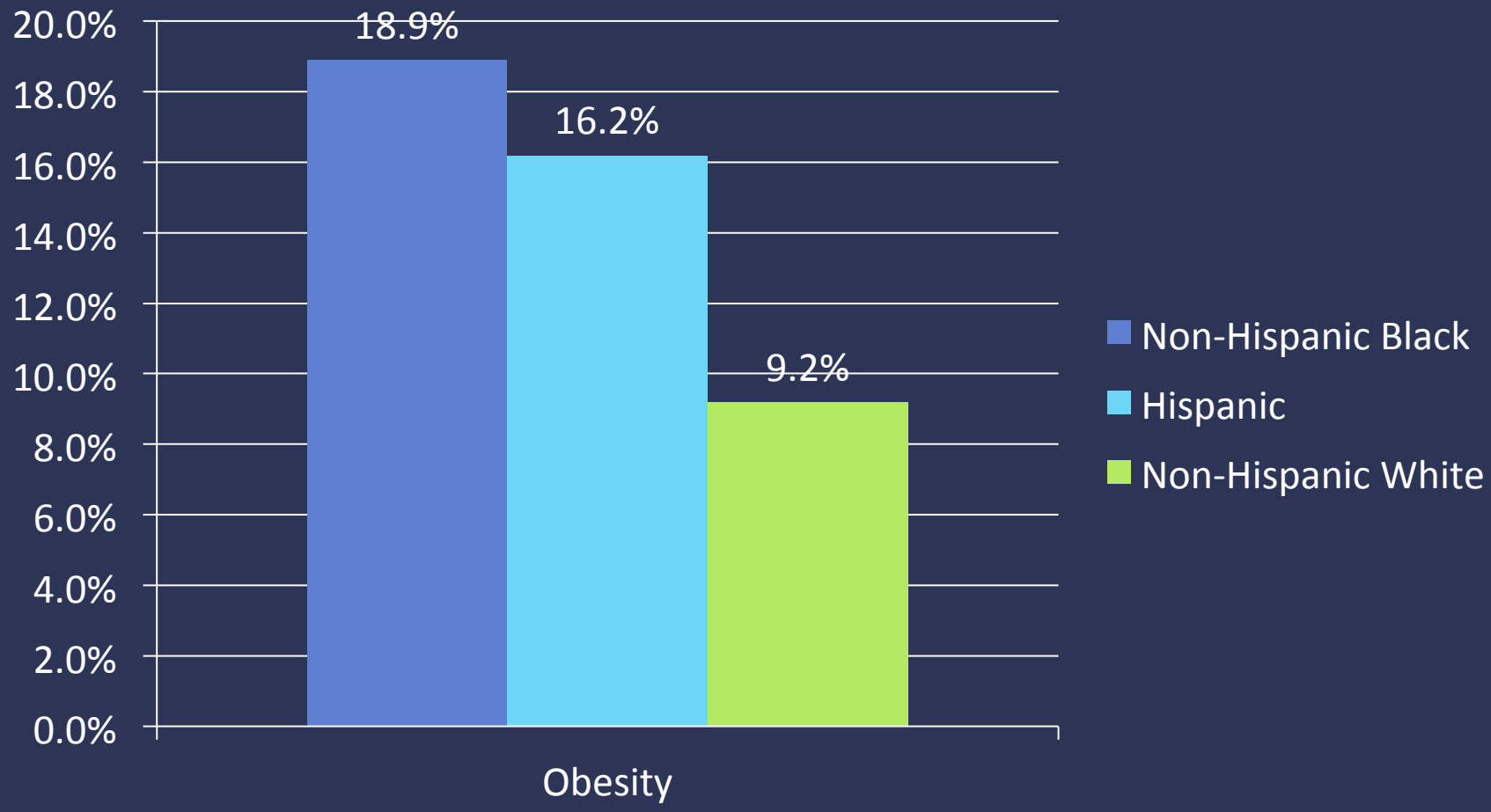
1. Davison, K. K., & Birch, L. L. (2001). Childhood overweight: a contextual model and recommendations for future research. *Obesity Review*, 159-171.
2. Davison KK, Markey CN, Birch LL. A longitudinal examination of patterns in girls' weight concerns and body dissatisfaction from ages 5 to 9 years. Int Journal Eat Disorder. 2003; 33:320–32.
3. Latner JD, Stunkard AJ. Getting worse: the stigmatization of obese children. Obes Res. 2003; 11:452–456.
4. U.S. Surgeon General. Overweight and Obesity: Health Consequences http://www.surgeongeneral.gov/topics/obesity/calltoaction/fact_consequences.htm. Published January 8, 2001. Accessed January, 15, 2010.
5. Biro FM, Wien M. Childhood obesity and adult morbidities. *Am J Clin Nutr.* May 2010;91(5):1499S—1505S.
6. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med* 1997;37(13):869—873.
7. Serdula MK, Ivery D, Coates RJ, Freedman DS. Williamson DF. Byers T. Do obese children become obese adults? A review of the literature. *Prev Med* 1993;22:167—177.
8. Freedman DS, Khan LK, Dietz WH, Srinivasan SR, Berenson GS. Relationship of childhood overweight to coronary heart disease risk factors in adulthood: The Bogalusa Heart Study. *Pediatrics* 2001;108:712—718.

Background & Significance

- Obesity is a serious health condition which can develop early in life and disproportionately affects young children from minority and low-income families.[3-5]

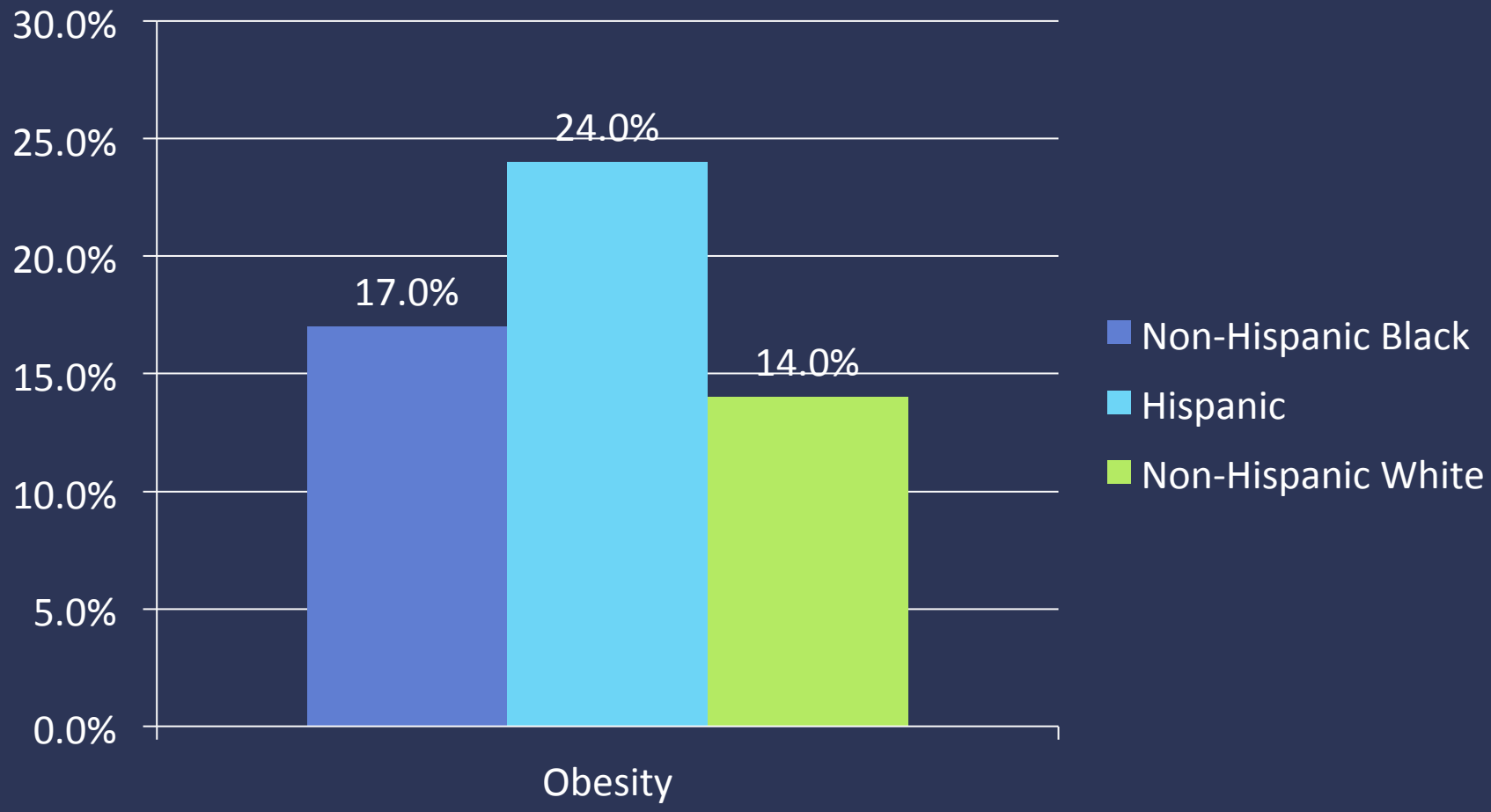
3. Ogden CL, Lamb MM, Carroll MD, Flegal KM. Obesity and socioeconomic status in children: United States 1988–1994 and 2005–2008. NCHS data brief no. 51.
4. Anderson SE, Whitaker RC. Prevalence of obesity among US preschool children in different racial and ethnic groups. *Arch Pediatr Adolesc Med*. 2009;163(4):344-348.
5. Centers for Disease Control and Prevention (CDC). Obesity prevalence among low-income, preschool-aged children - United States, 1998-2008. *MMWR Morb Mortal Wkly Rep*. 2009;58(28):769-773.

Health Disparities in Obesity Among U.S. Children 2-5 years old



Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *Journal of the American Medical Association*, 483-490.

Obesity Among 3 year old children from Low Income Urban Families



Kimbro RT, Brooks-Gunn J, McLanahan S. Racial and ethnic differentials in overweight and obesity among 3-year-old children. Am J Public Health. 2007;97(2):298-305.

Background & Significance

- Infants who are at the highest end of the distributions for weight or body mass index are more likely to be obese in both childhood and adolescence, relative to smaller infants[1,2]
- Children who exhibit abnormal accelerations in weight-for-age or weight-for-length (*i.e.*, rapid growth) during infancy are at 1.06 to 5.70 times the odds for later obesity, this jumps to 9.24 for Low-income minority children living in urban areas[3]

1. Baird J, Fisher D, Lucas P, Kleijnen J, Roberts H, Law C. Being big or growing fast: Systematic review of size and growth in infancy and later obesity. *BMJ*. 2005;331(7522):929.
2. Yu ZB, Han SP, Zhu GZ, et al. Birth weight and subsequent risk of obesity: A systematic review and meta-analysis. *Obes Rev*. 2011;12(7):525-54
3. Goodell LS, Wakefield DB, Ferris AM. Rapid weight gain during the first year of life predicts obesity in 2-3 year olds from a low-income, minority population. *J Community Health*. 2009;34(5):370-375.

The Candle Study

Conditions Affecting Neurocognitive Development and Learning in Early Childhood

Specific Aims

- Aim 1: Describe urban children's patterns of growth (length, weight, and weight for length) during the first three years of life and the relationship of growth to Adiposity Status at age three.

- Aim 2: Determine the influence of race, income, child gender, and maternal factors (depression, anxiety, BMI, and pregnancy weight gain) on urban children's birth weight-for-recumbent length z-score and rate of change in weight-for-recumbent length z-score from birth to 3 years.

- Aim 3: Determine whether differential weight for length trajectories exist among urban infants and toddlers the extent to which these subgroups vary in terms race, income, child gender, and maternal factors (depression, anxiety, current BMI, and pregnancy weight gain).

Specific Aims: Today

- **Aim 1:** Describe urban children's patterns of growth (length, weight, and weight for length) during the first three years of life

- **Aim 2:** Preliminary Analyses to determine the influence of race, income, child gender, and maternal factors (depression, anxiety, pre-pregnancy BMI) on urban children's birth weight-for-length z-score and rate of change in weight-for-length z-score from birth to 3 years.

Participants

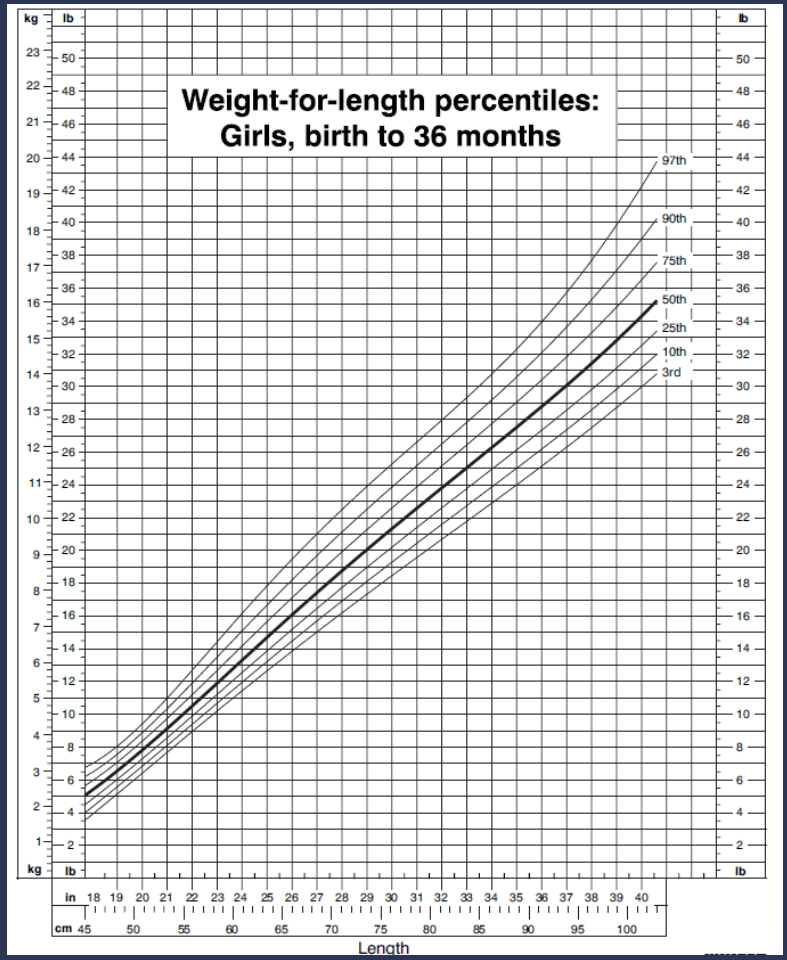
- N = 1,443, Mothers and Children participating in the CANDLE Study
  - Race: 65% African American/Black, 32% White/ Caucasian, 3% Other
  - Median Income was $25,000-34,999
- Child Data
  - 49% Girls (*n* = 711), 51% Boys (*n* = 724)

Measures

- Brief Symptom Inventory: depression and anxiety scales (during 3rd Trimester)
- Maternal Reports of
  - Smoking during pregnancy
  - Race
  - Income
  - Pre-Pregnancy Height and Weight

Measures

- Child Growth Measures (Z-score)
  - Weight-for-length/ stature
  - Weight for Age
  - Length for Age
- Time Points:
  - Birth, 12 months, 24 Months, and 36 Months



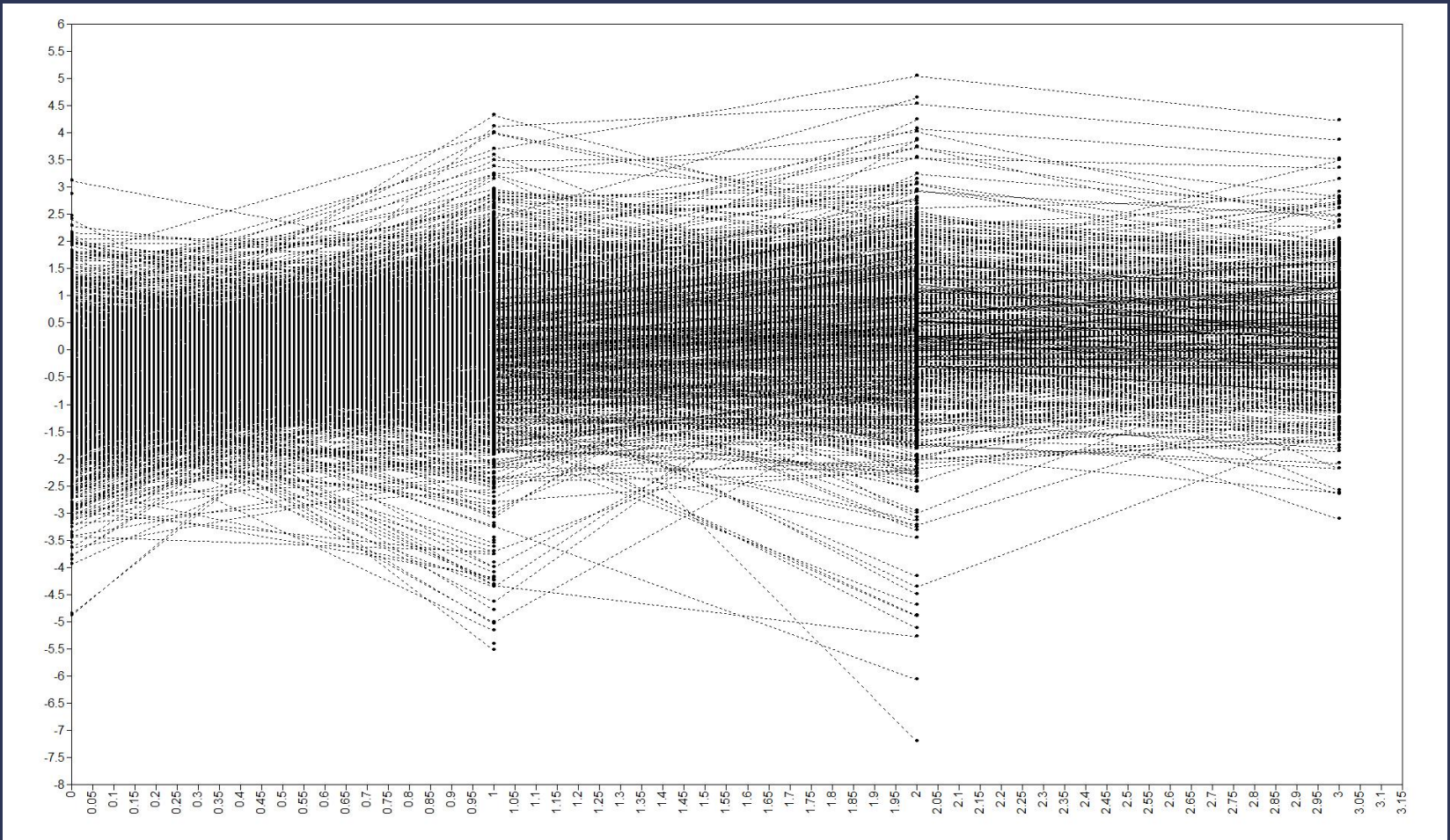
Method

- Data were analyzed using Latent Growth Curve Modeling and Structural Equation Modeling
  - Determine the best statistical model to characterize children's growth (linear, curvilinear, piecewise, etc.)
  - This approach allows for
    - individually varying baseline values (intercepts), and rates of change (slope)
    - Non-normal distributions
    - Multiple dependent variables

Results

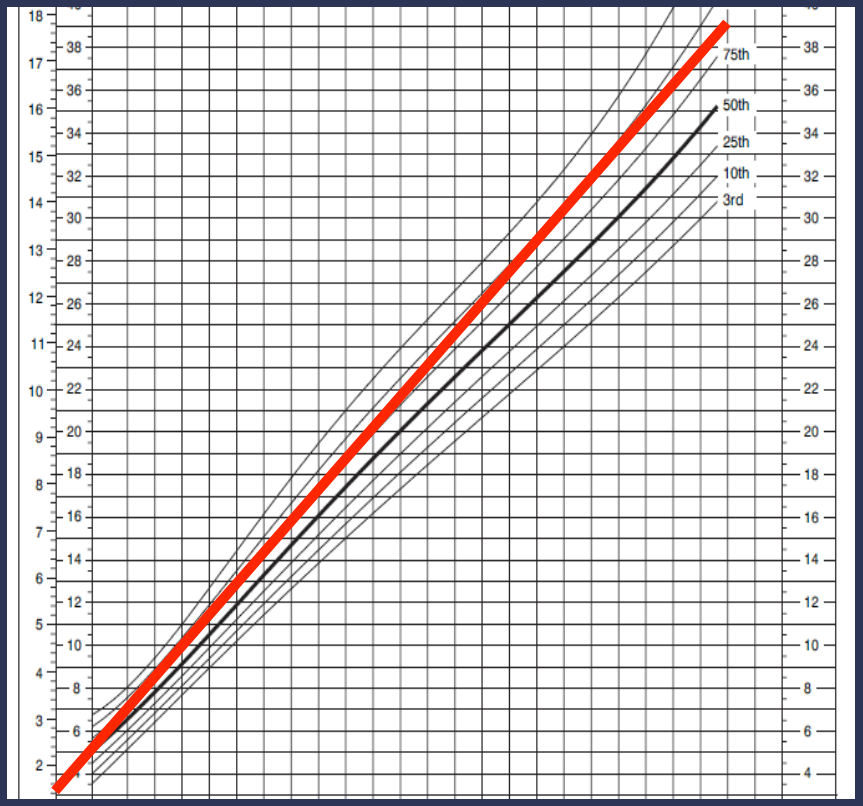
- Analytic Plan
  - Determine the best statistical model for growth
  - Determine whether there is significant variability in growth parameters
  - Determine predictors of growth

Growth: Weight for Length Z-score



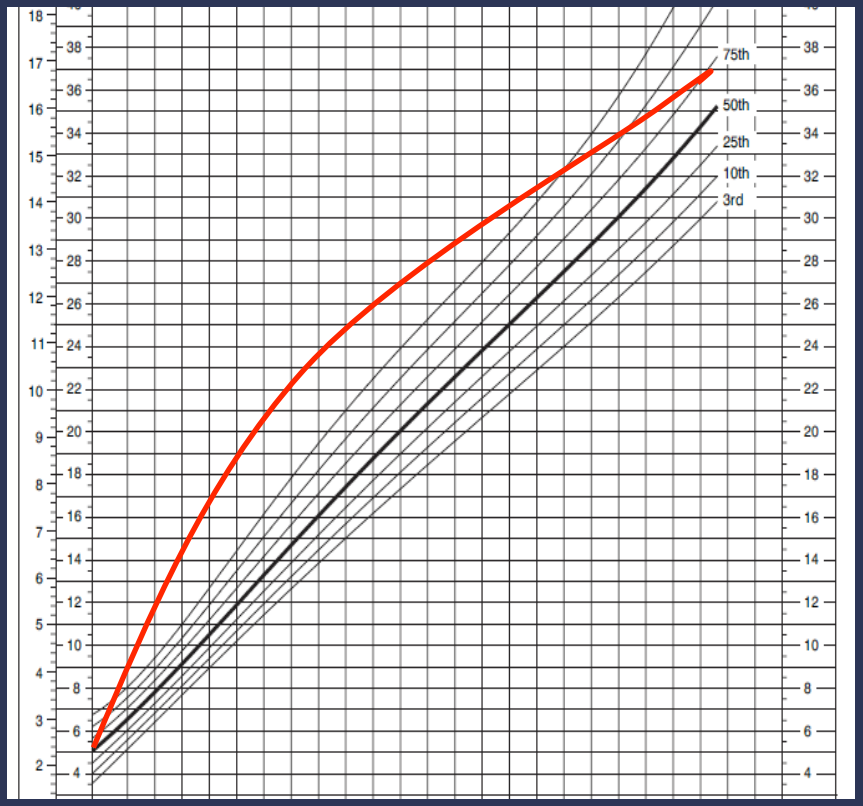
Best Model for Growth

- Statistically Compare
  - **Linear growth**



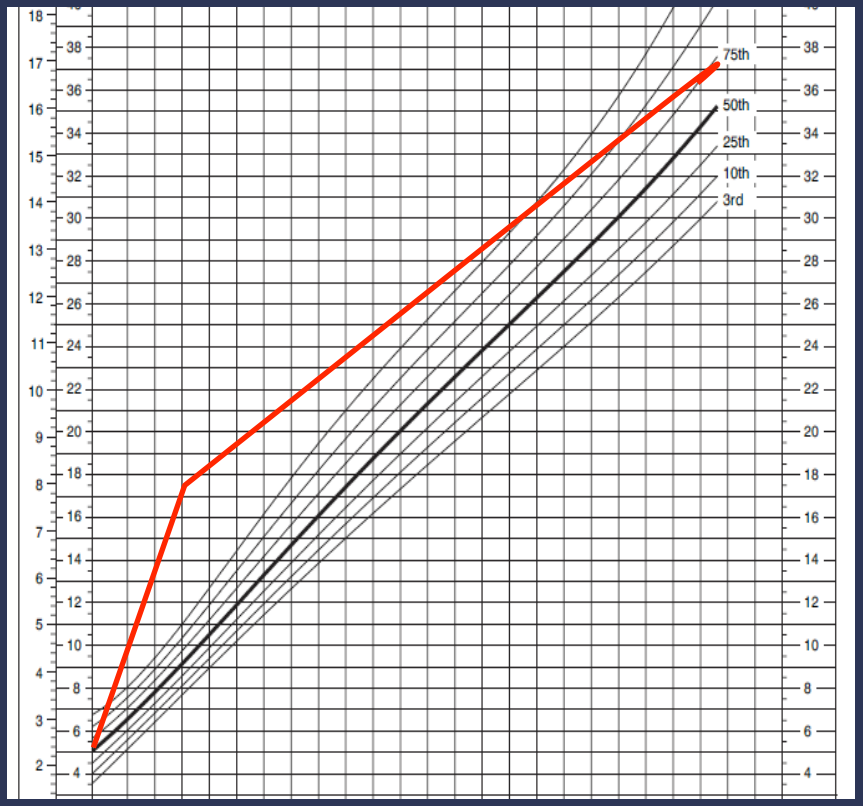
Best Model for Growth

- Statistically Compare
  - Linear growth
  - **Curvilinear (quadratic) growth**



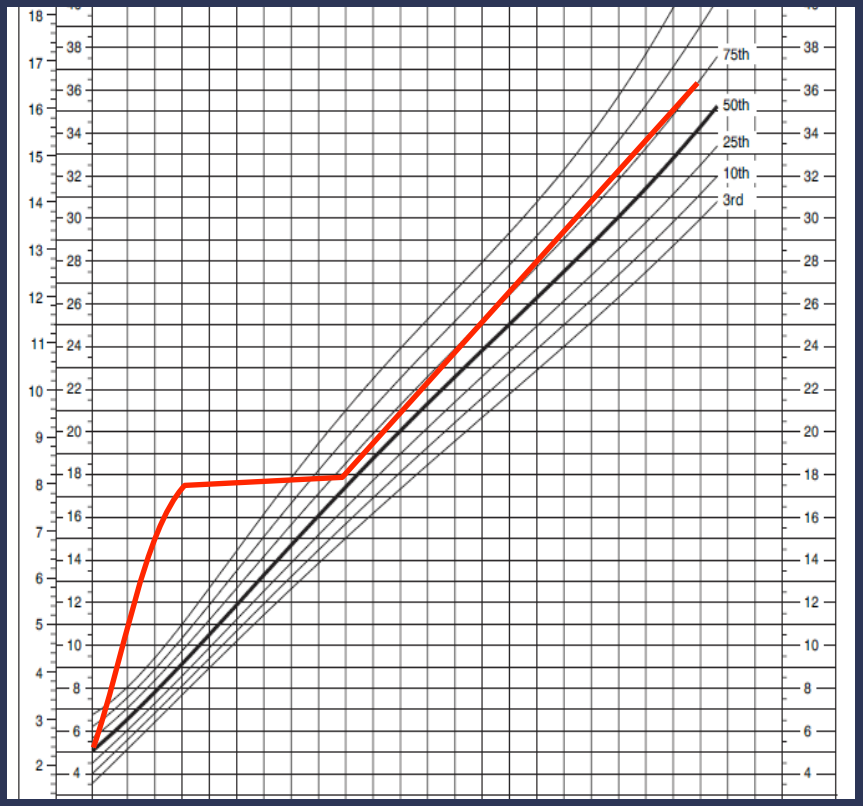
Best Model for Growth

- Statistically Compare
  - Linear growth
  - Curvilinear (quadratic) growth
  - **“Piecewise” or two-part growth**

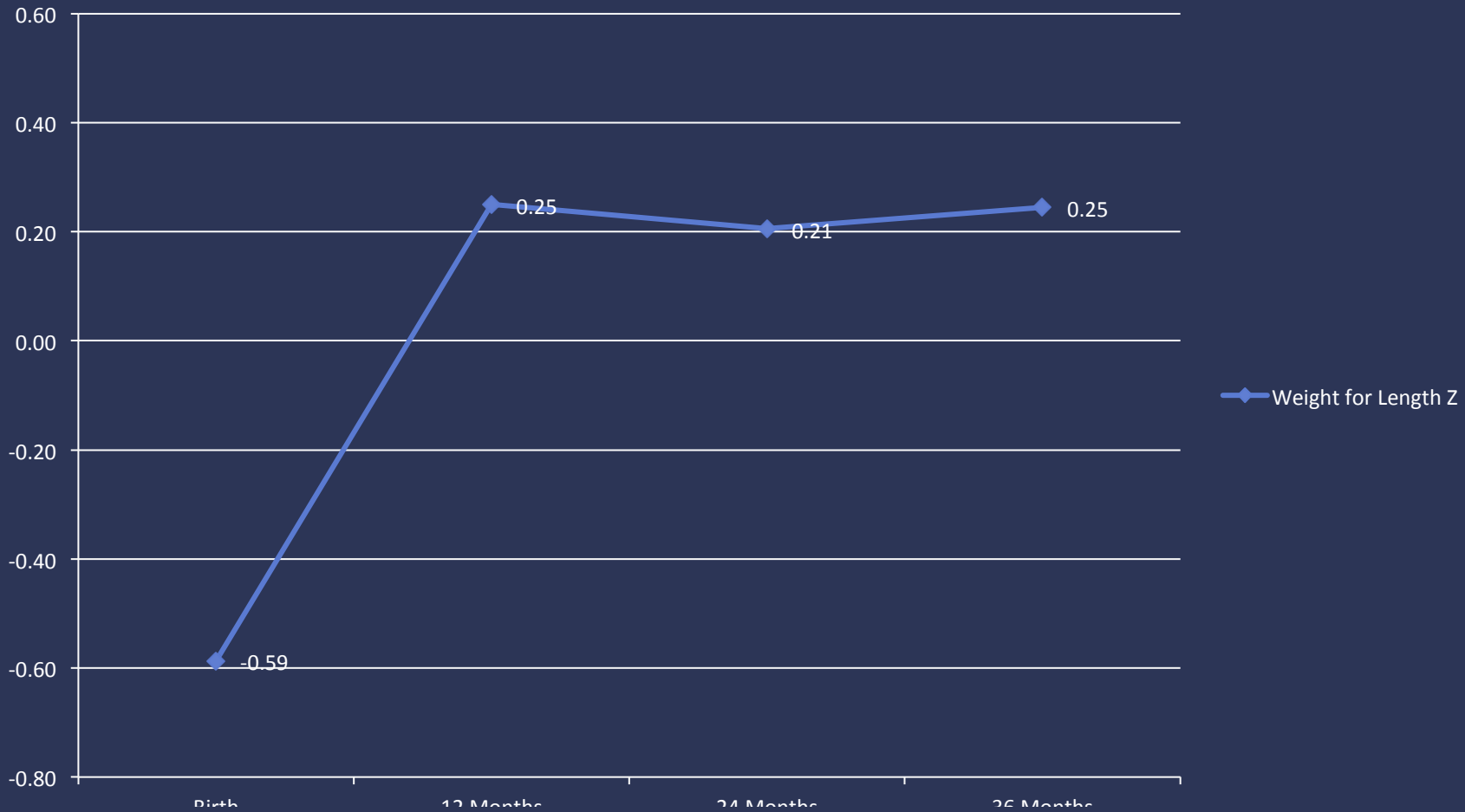


Best Model for Growth

- Statistically Compare
  - Linear growth
  - Curvilinear (quadratic) growth
  - Piecewise" or two-part growth
  - **"Freely Estimated" (Latent Basis) growth**



Growth: Weight for Length Z-score



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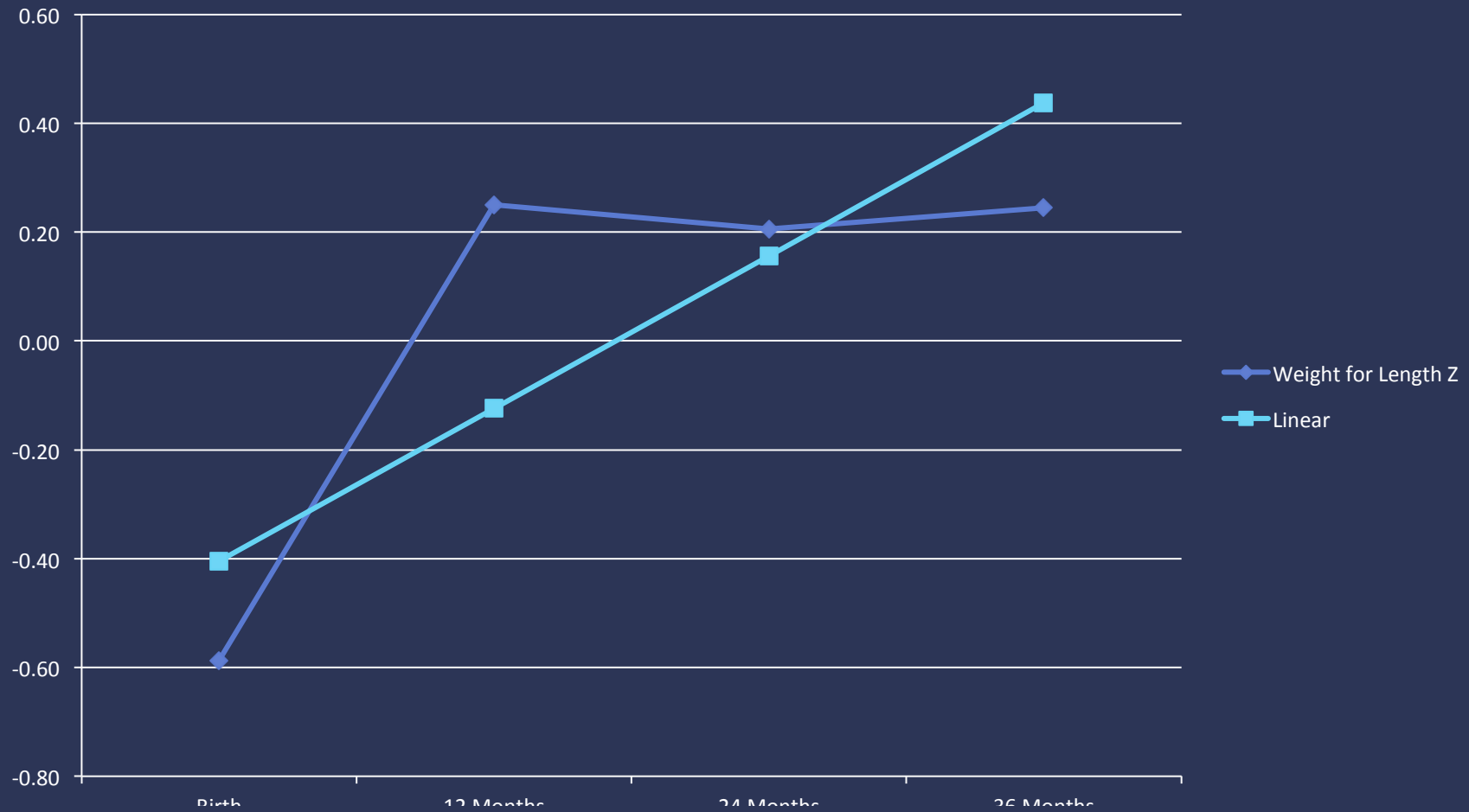

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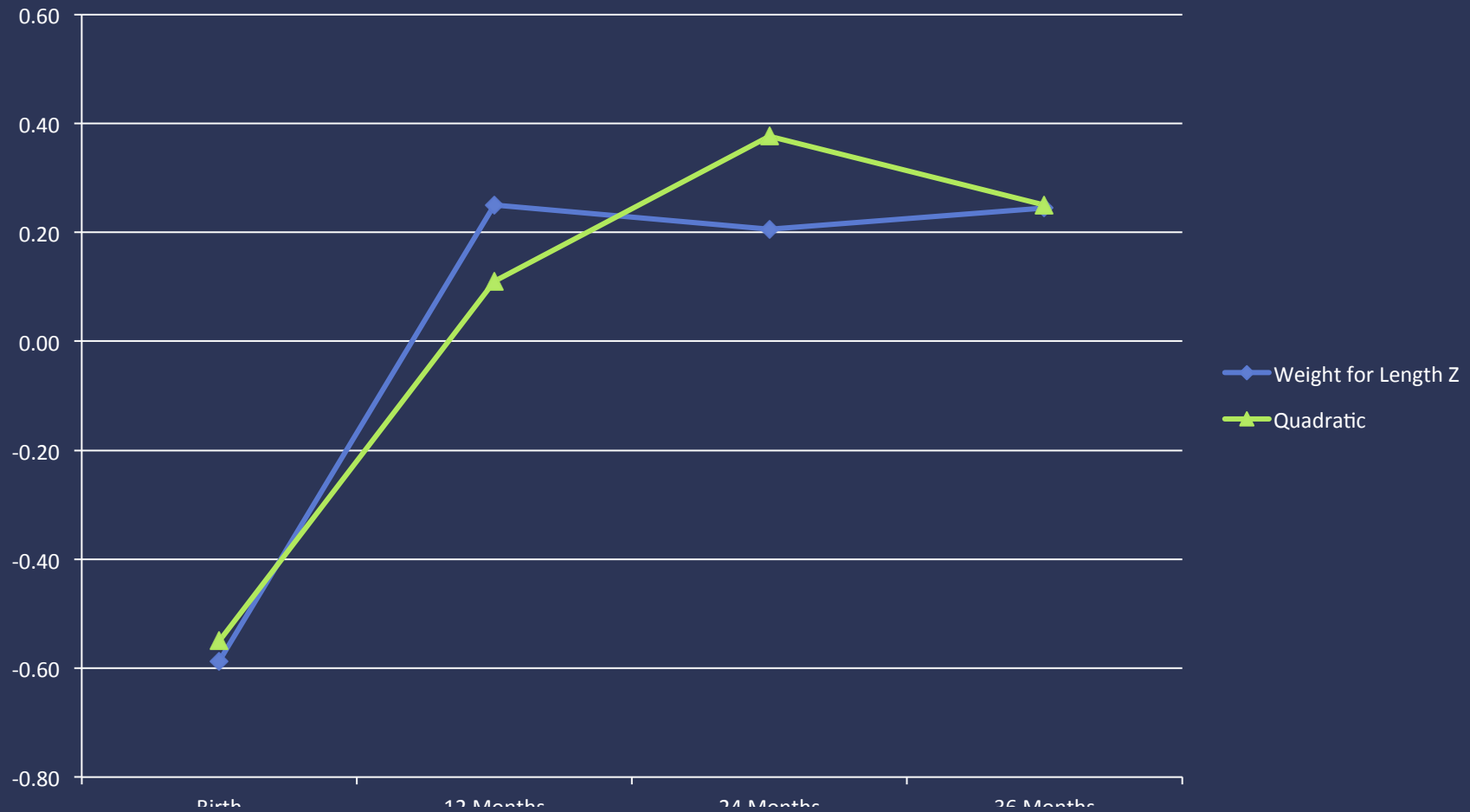

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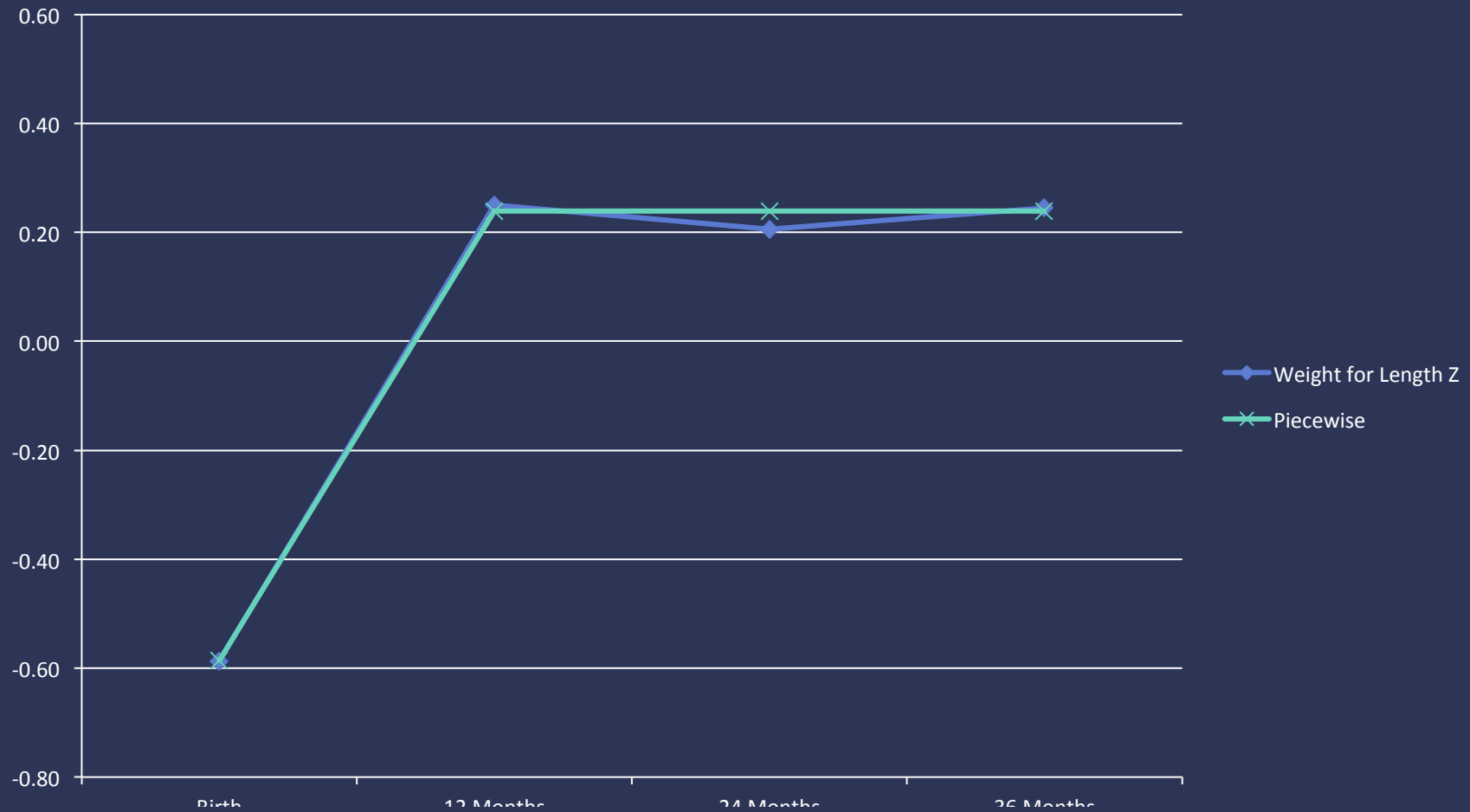

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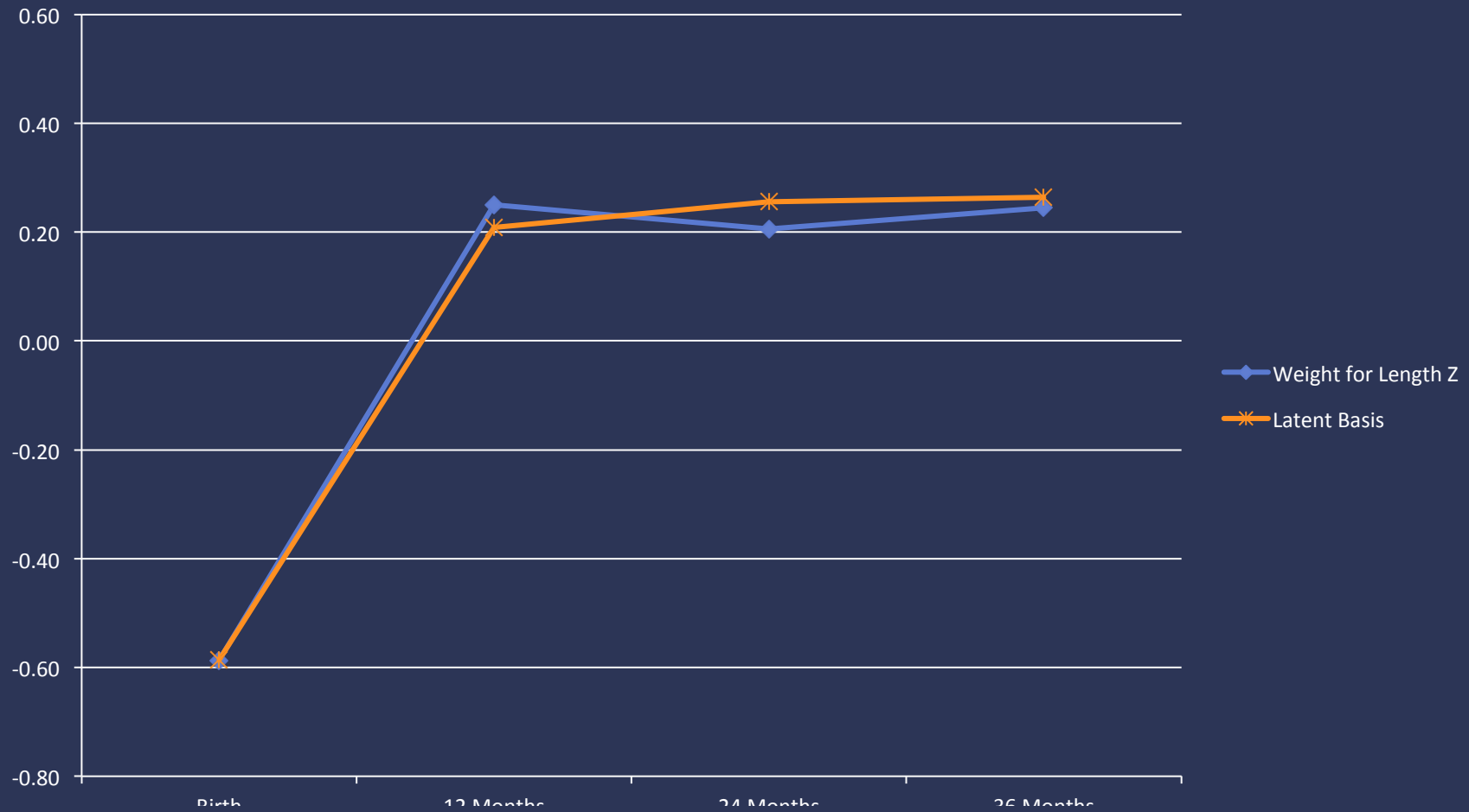

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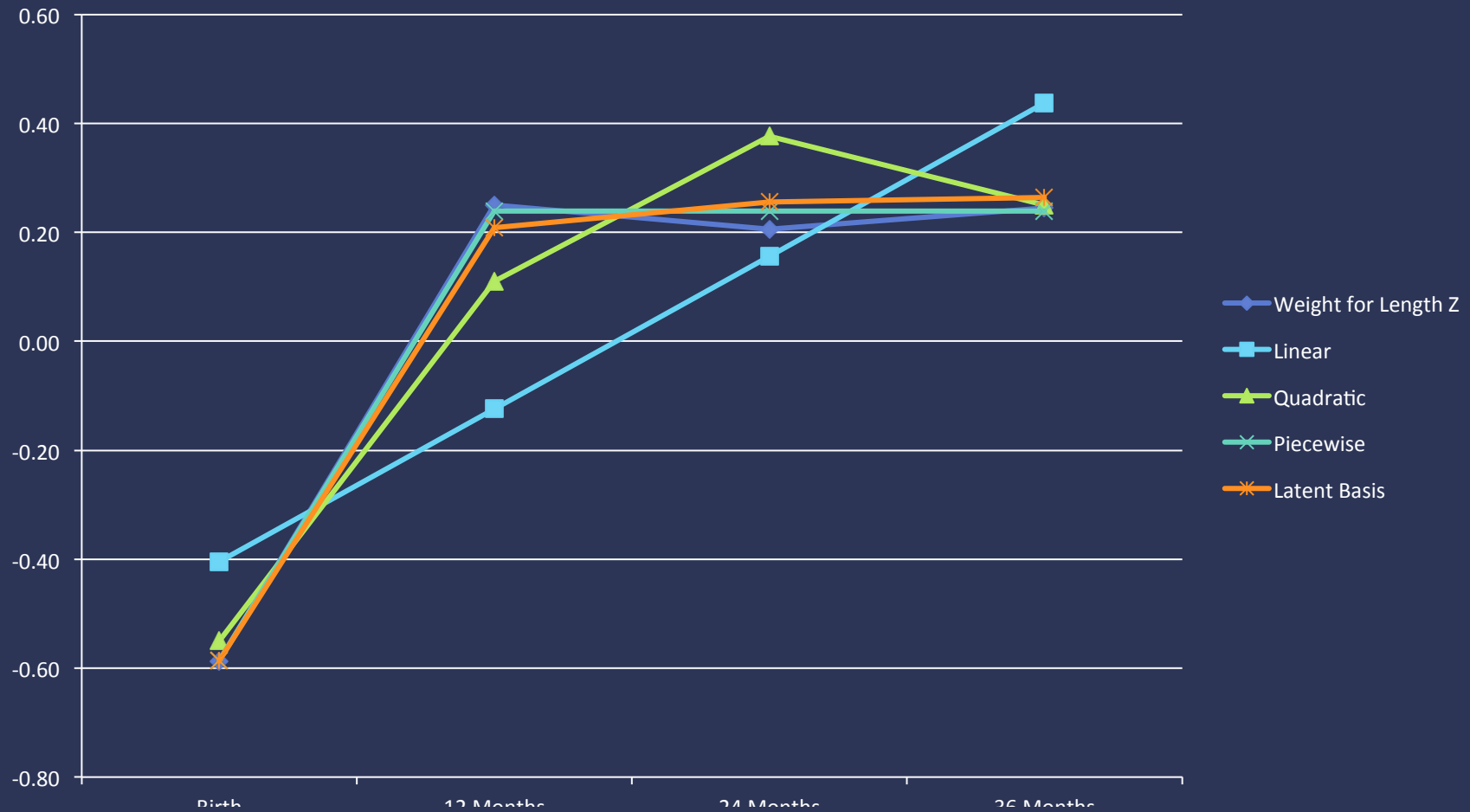


Fit Statistics

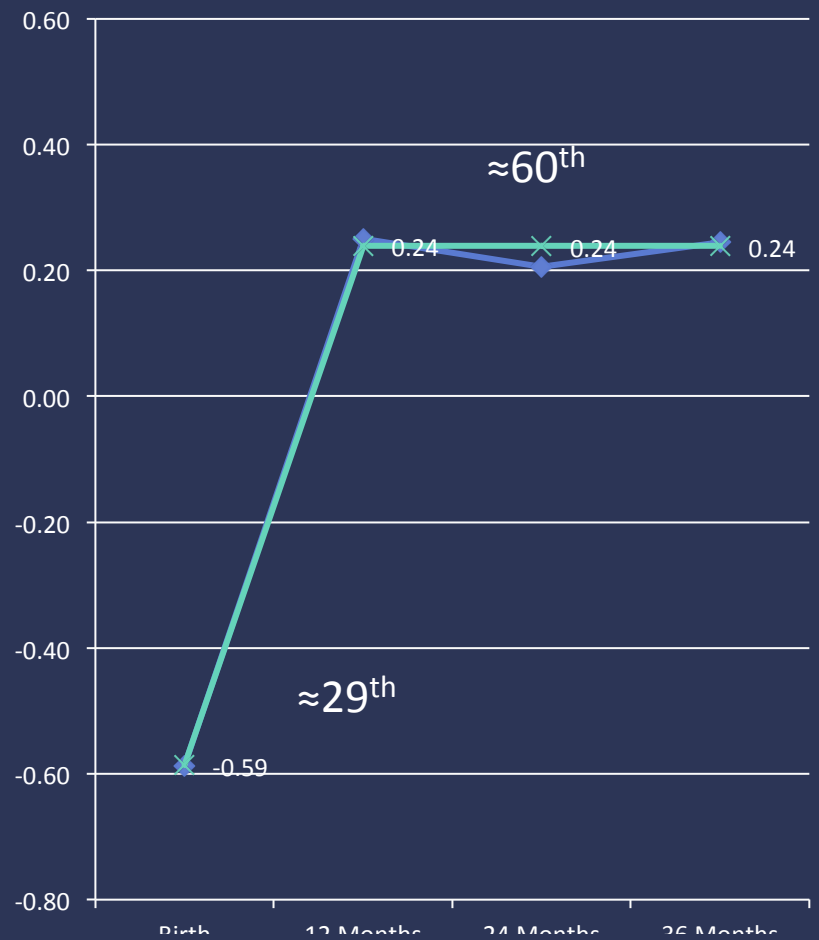
	Akaike (< better)	**x^2/df (< 2)**	**RMSEA (<0.05 to .08)**	**CFI (>0.95)**
Linear	11934.27	34.74	0.15	0.39
Quadratic	11615.8	18.97	0.11	0.92
Piecewise	**11558.48**	**0.54**	**0.00**	**1.00**
Latent Basis	11567.47	2.78	0.04	0.99

Fit Statistics

	Akaike (< better)	x^2/df (< 2)	RMSEA (<0.05 to .08)	CFI (>0.95)
Piecewise	11558.48	0.54	0.00	1.00

Growth: Weight for Length Z-score

Parameter	Mean	Variance
Baseline: Weight for Length	-0.59*	0.37*
Rate of Change: birth to 12 months	0.83*	0.99*
Rate of Change: 12 to 36 months	0.000	0.06*
		* $p < 0.05$



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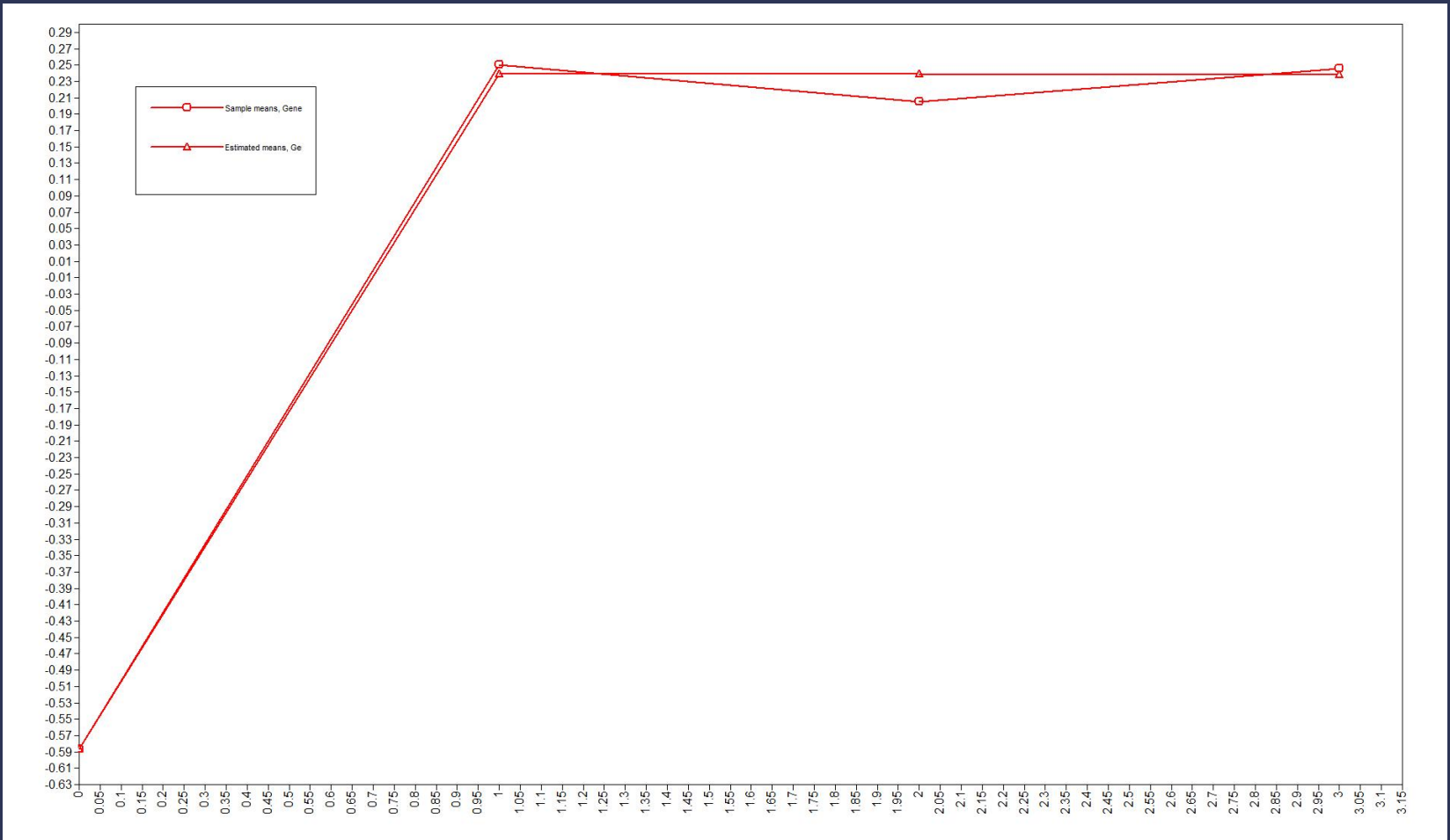

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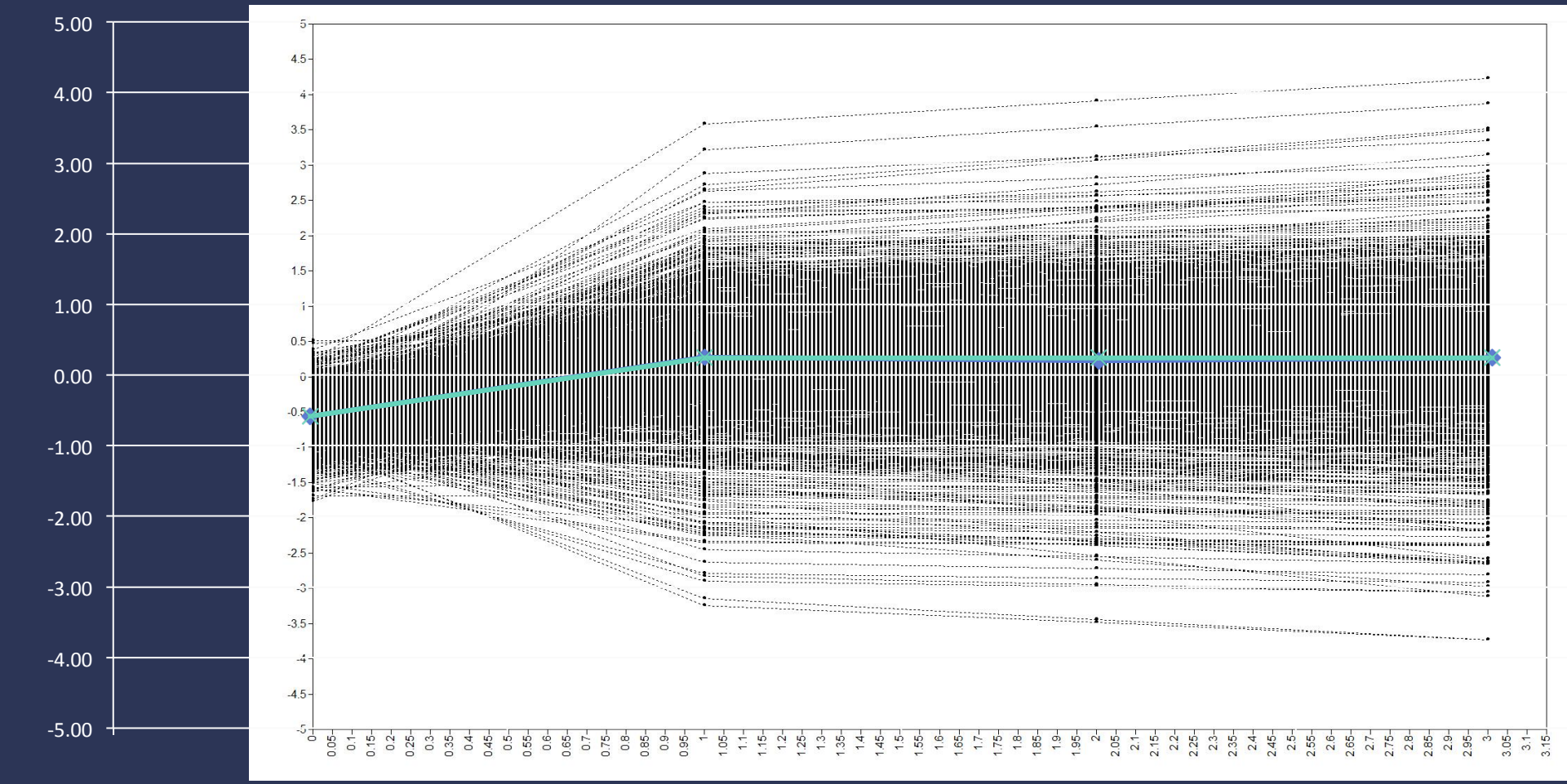
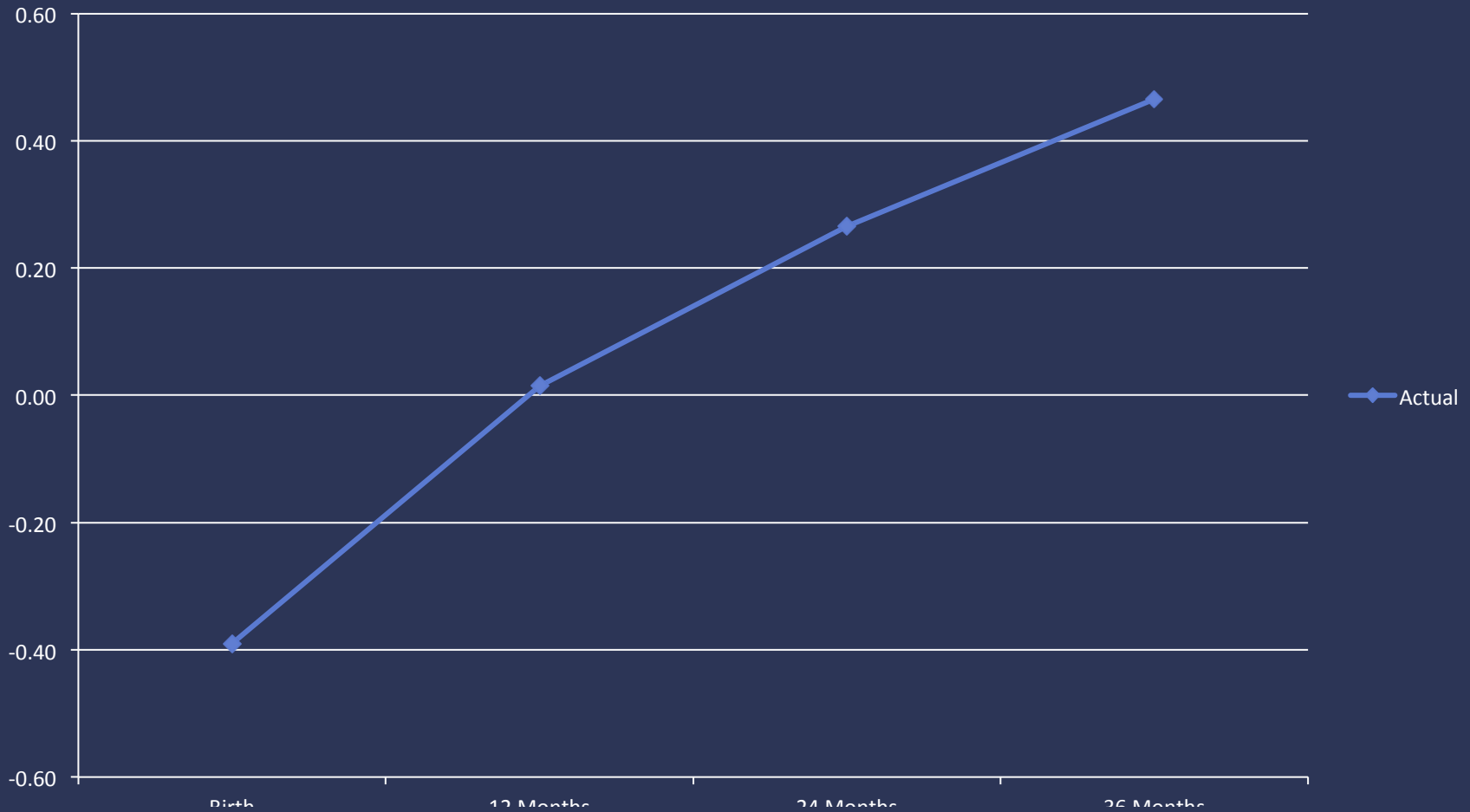


Weight for Age Z-score



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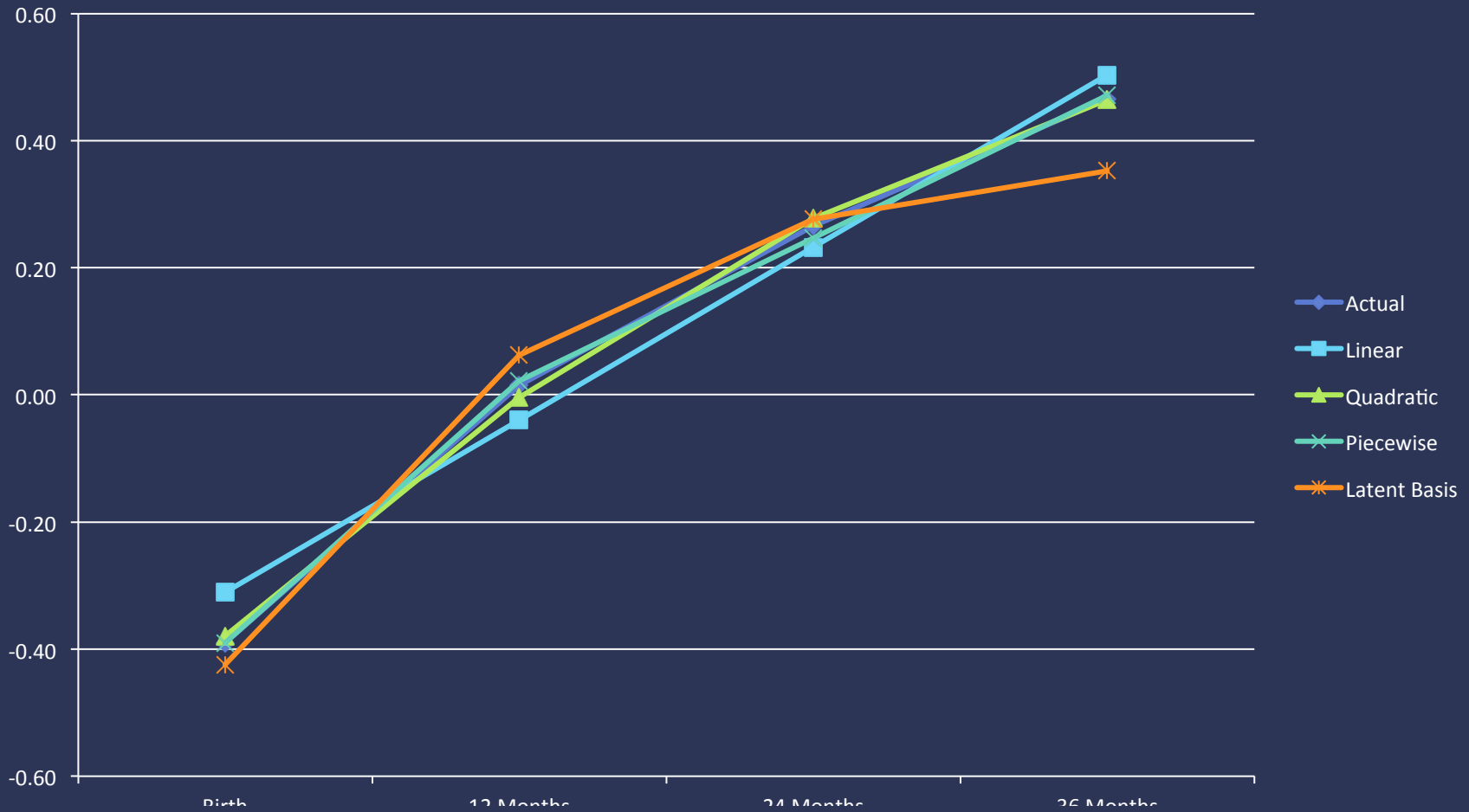

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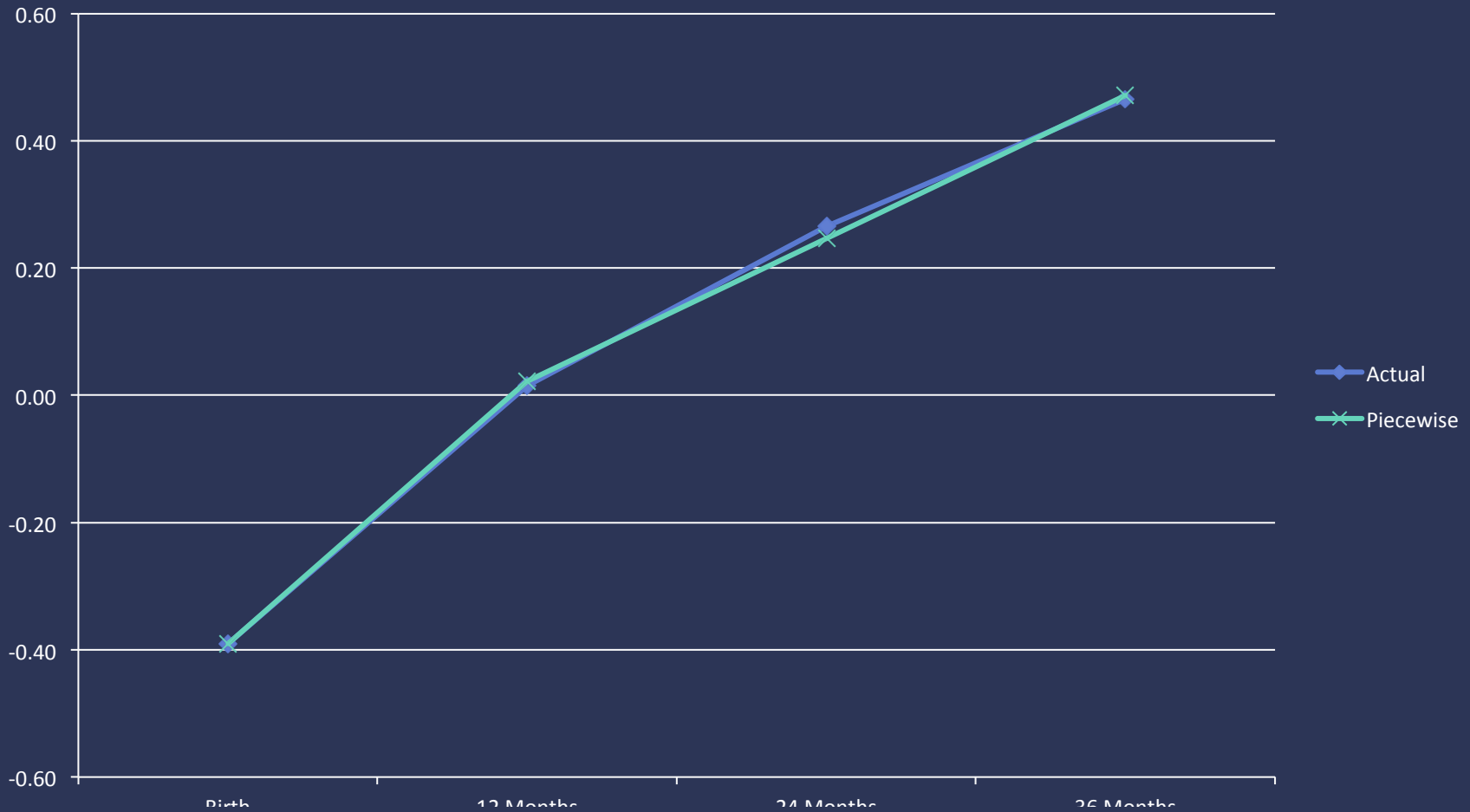
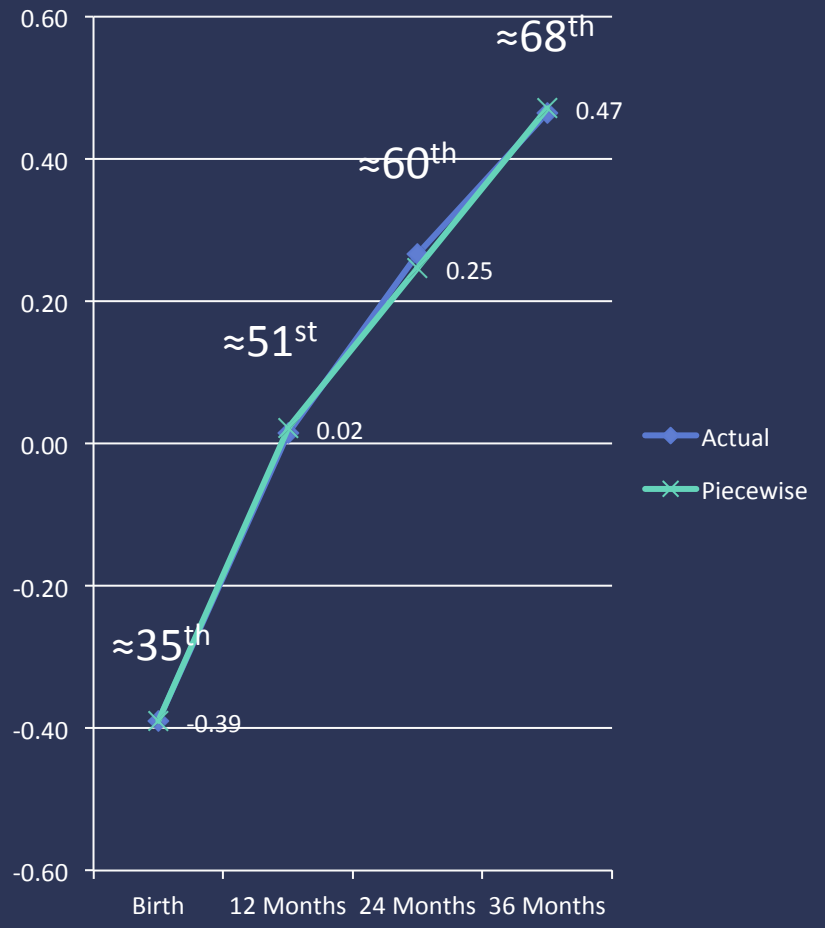
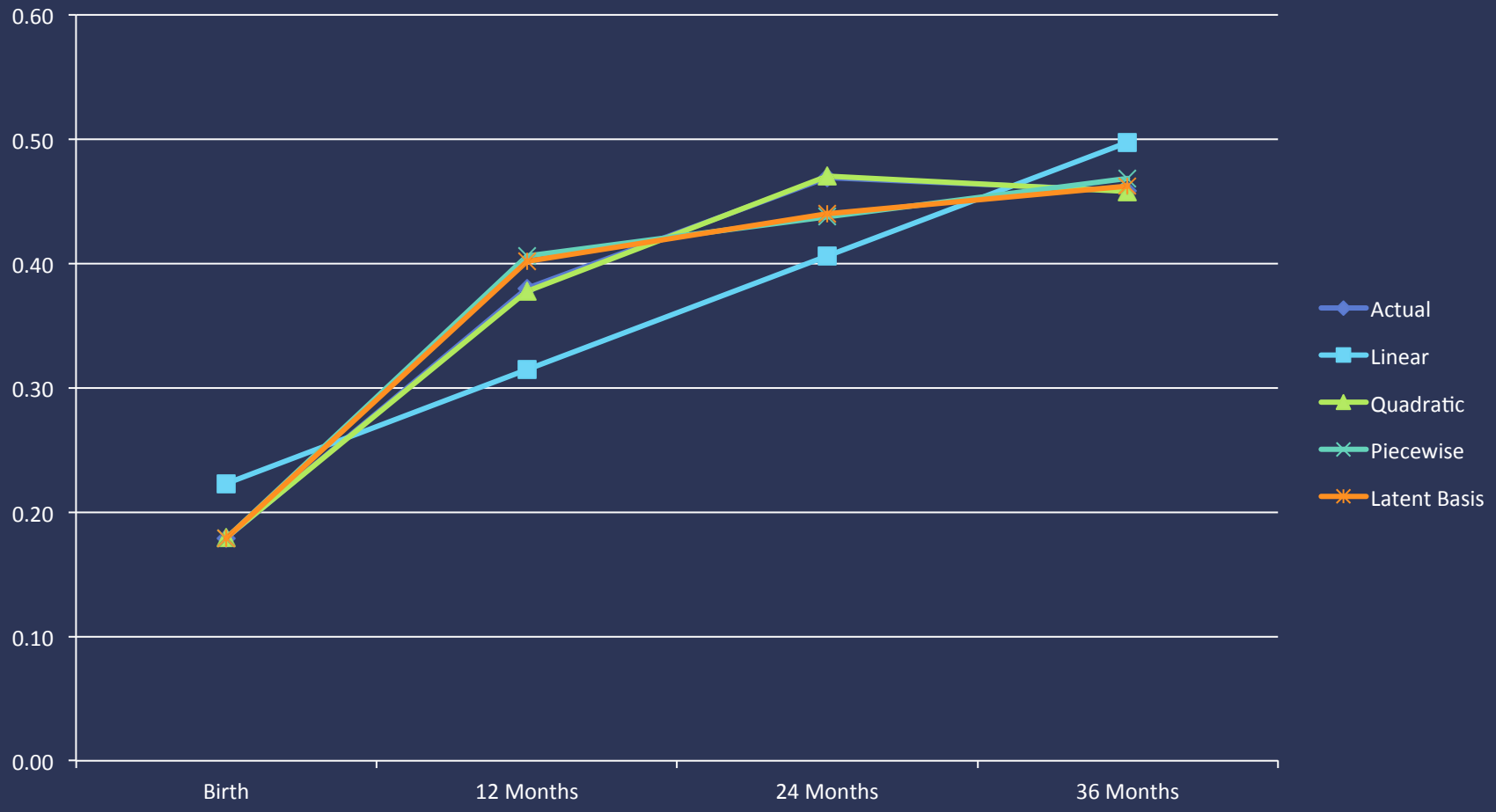


Growth: Weight for Age z-score

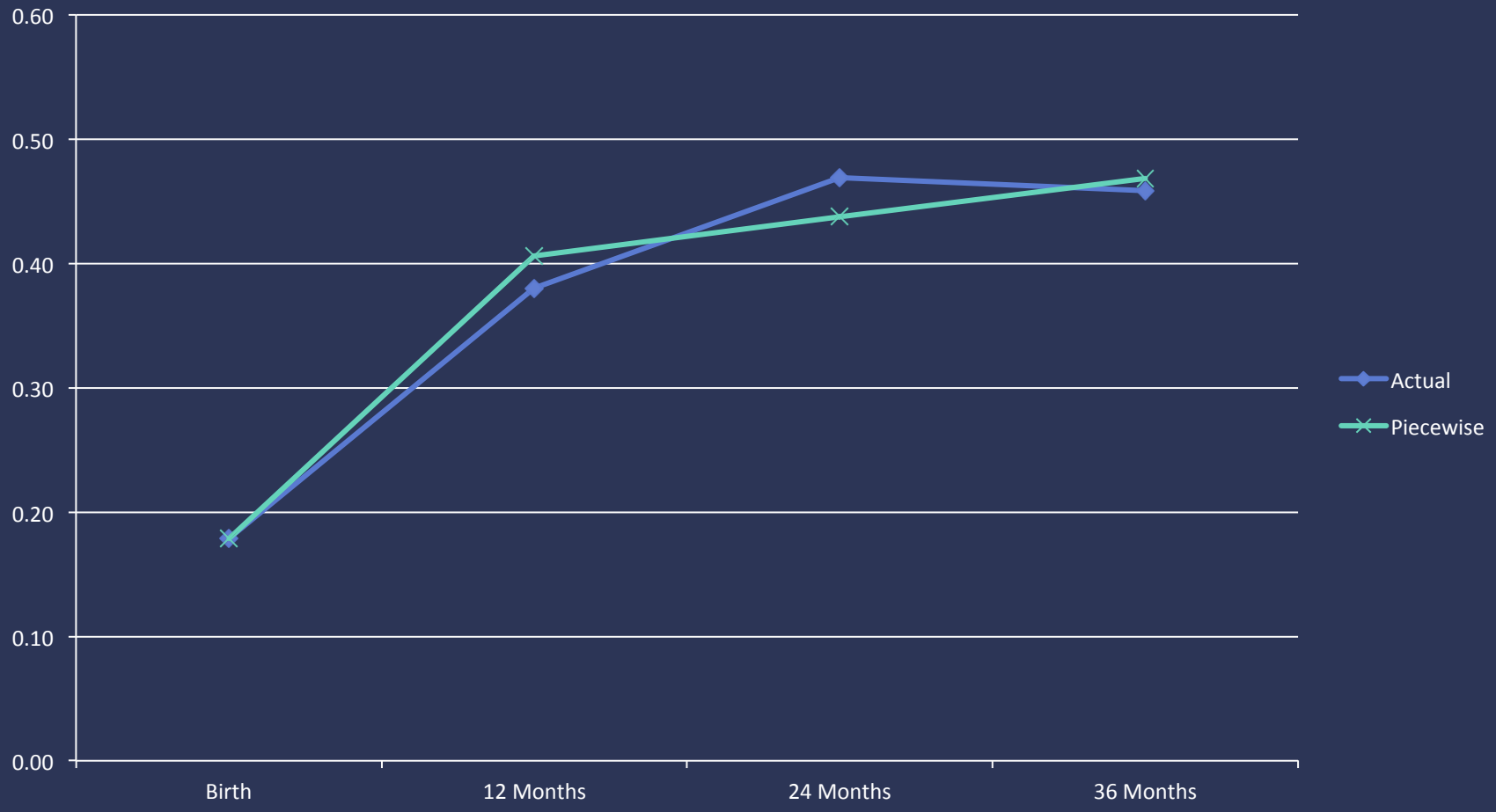
Parameter	Mean	Variance
Baseline: Weight for Age	-0.39*	0.83*
Rate of Change: birth to 12 months	0.41*	1.09*
Rate of Change: 12 to 36 months	0.23*	0.08*
		* $p < 0.05$



Length for Age Z-score

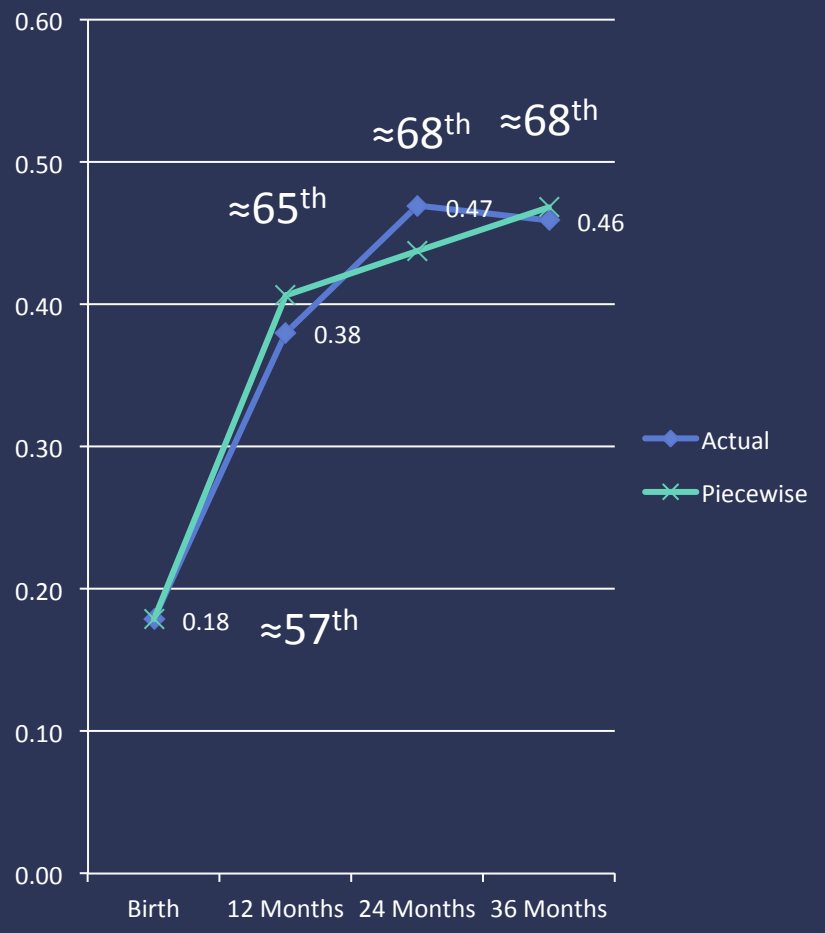


Length for Age Z-score



Growth: Length for Age z-score

Parameter	Mean	Variance
Baseline: Weight for Age	0.18*	0.17
Rate of Change: birth to 12 months	0.23*	0.57*
Rate of Change: 12 to 36 months	0.03	0.00
		* $p < 0.05$



Comparing Changes Weight and Length

Weight

Parameter	Mean	Variance
Baseline: Weight for Age	-0.39*	0.83*
Rate of Change: birth to 12 months	0.41*	1.09*
Rate of Change: 12 to 36 months	0.23*	0.08*
		* $p < 0.05$

Length

Parameter	Mean	Variance
Baseline: Weight for Age	0.18*	0.17
Rate of Change: birth to 12 months	0.23*	0.57*
Rate of Change: 12 to 36 months	0.03	0.00
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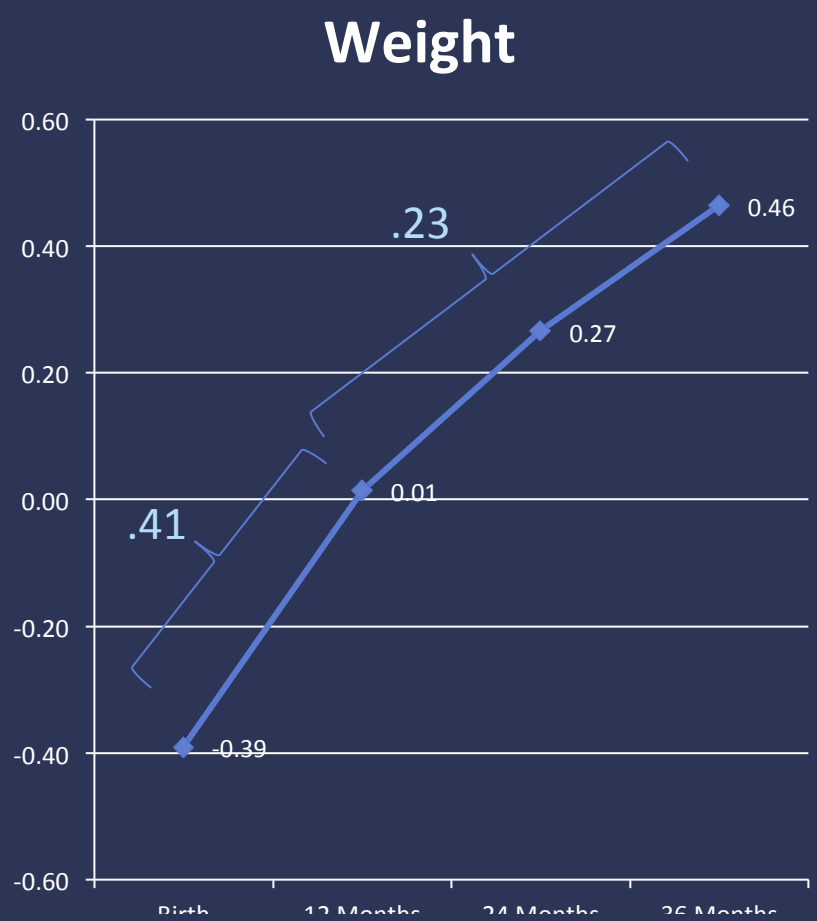
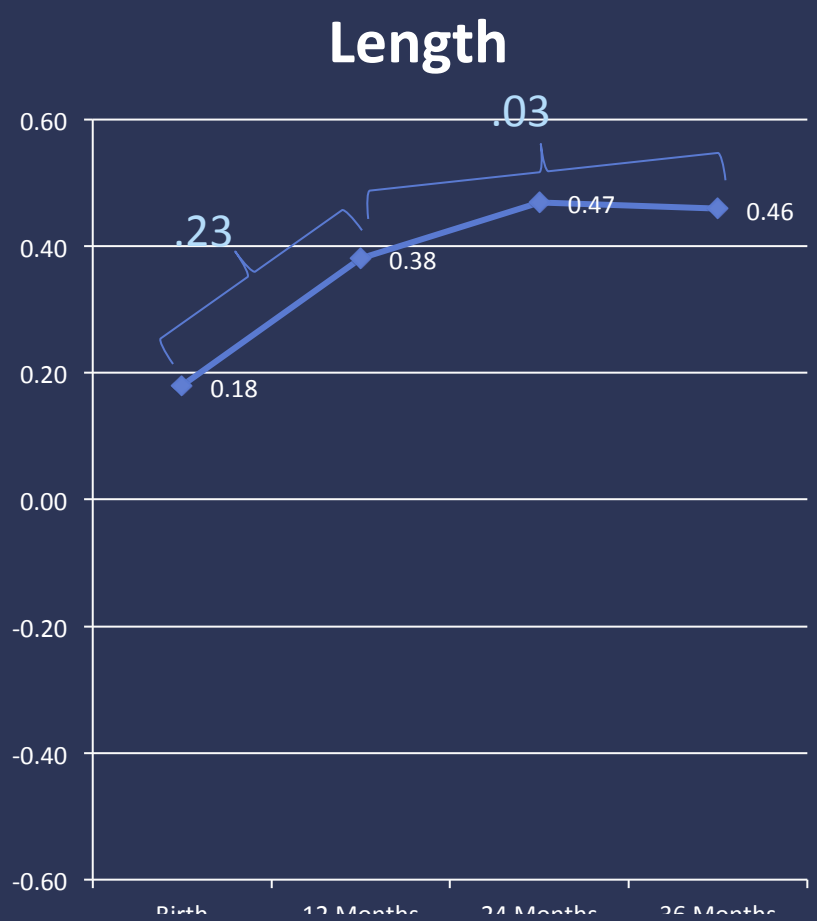
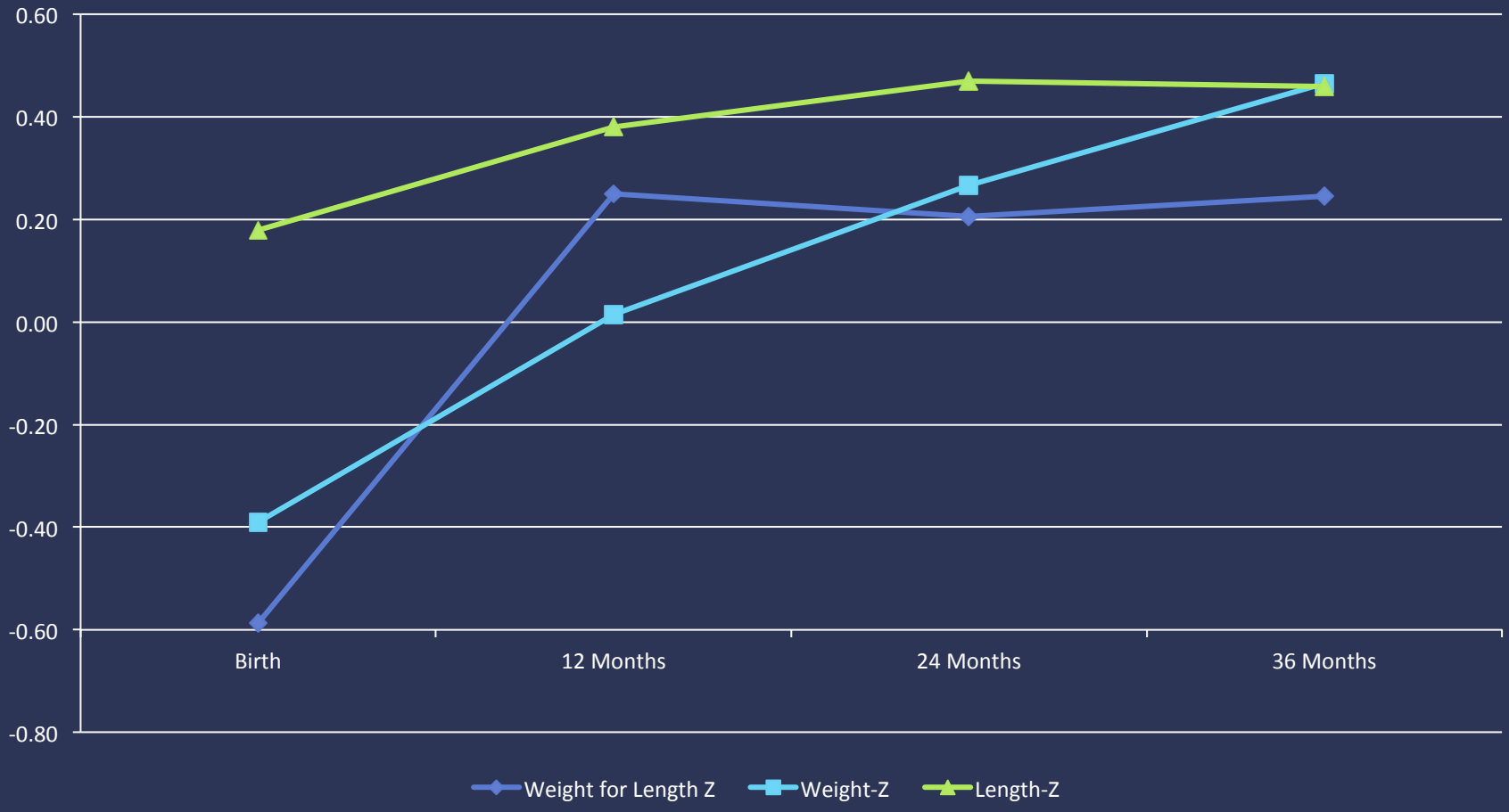
Comparing Changes Weight and Length



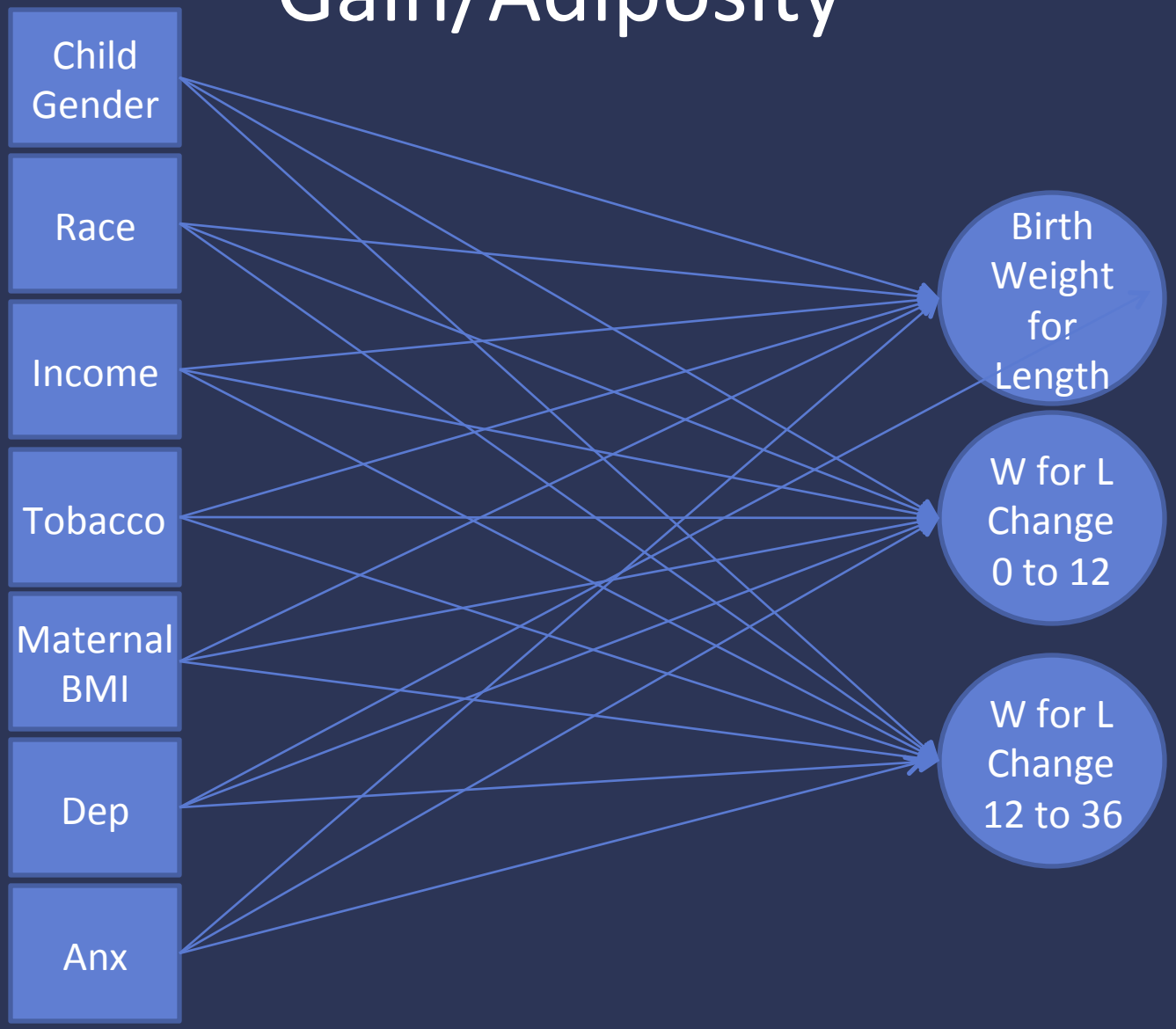


Growth Summary

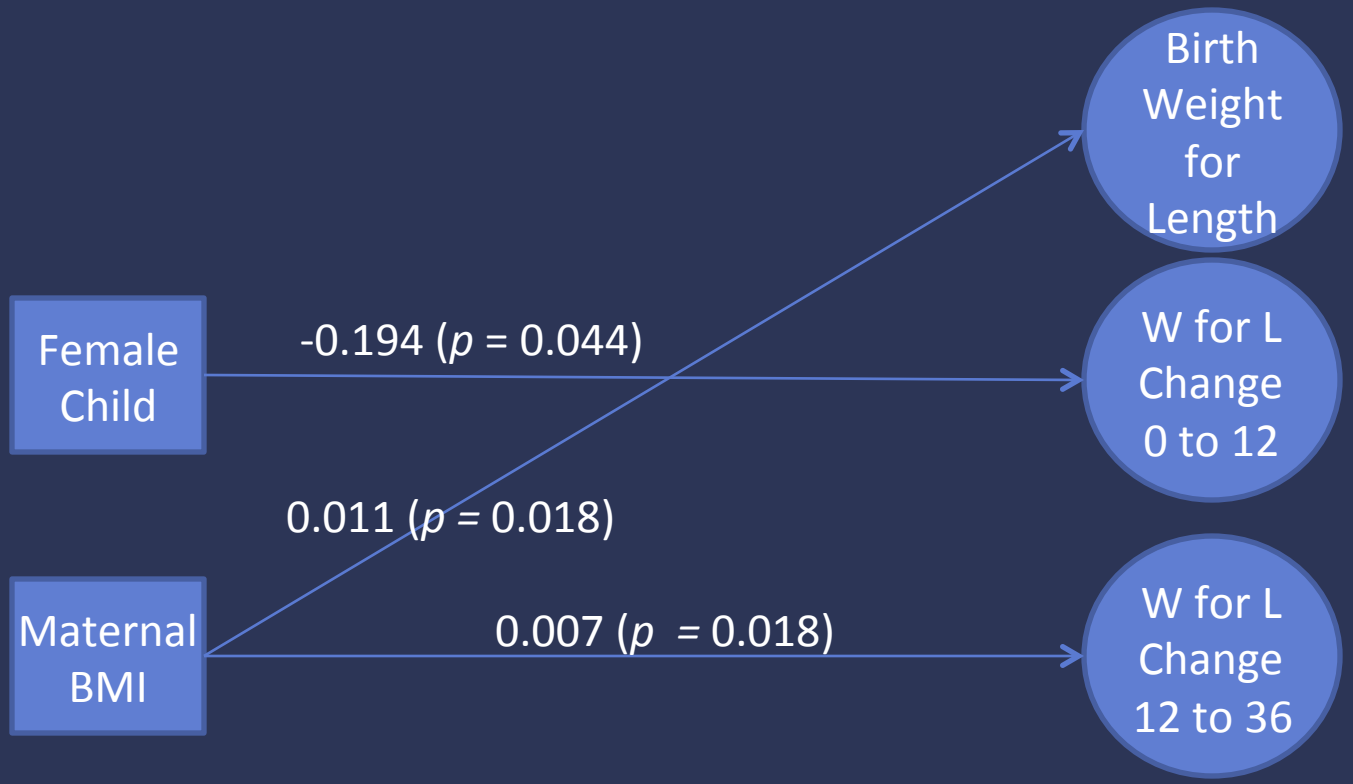


Predictors of Accelerated Weight Gain/Adiposity

Predictors of Accelerated Weight Gain/Adiposity



Predictors of Accelerated Weight Gain/Adiposity



Discussion

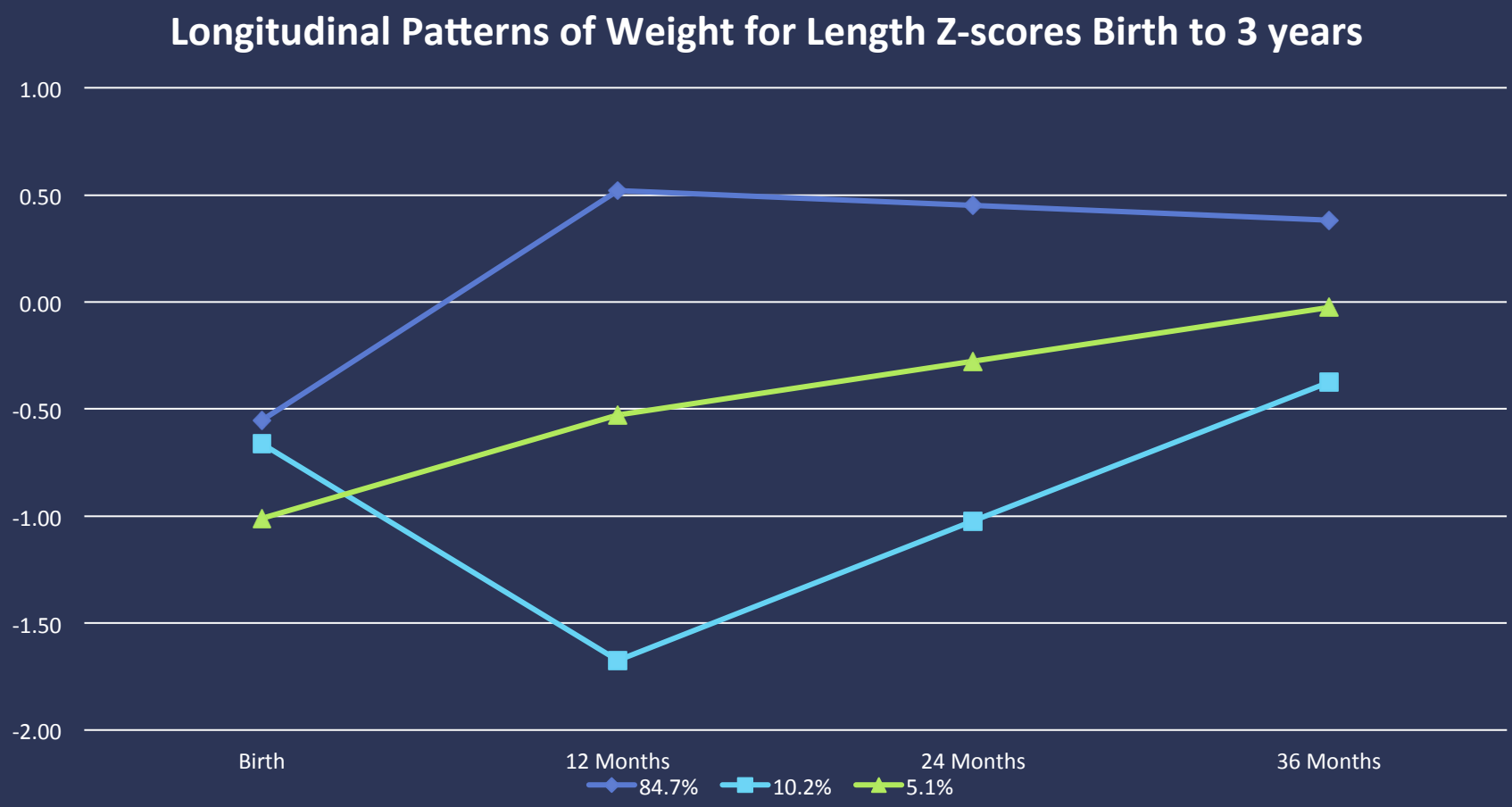
- Non-linear changes in weight, length and adiposity during the first 3 years of life
- Substantial variability
- The direct effects of race, gender, and Pre-Pregnancy Maternal BMI suggest that
  - Mothers with higher BMIs give birth to babies with higher Weight for Lengths and babies who demonstrate more rapid growth between the 1st and 3rd year of life (*transition to table food, etc*),
  - Few Child Gender difference, except boys demonstrated more rapid weight gain in the first year of life
- Other Predictors: feeding practices/styles, outside child care ?

Discussion

- Predictors are very preliminary
- Race, Child Gender, and Income/SES likely interact to influence accelerated/rapid weight gain.
  - For girls of all race/ethnicities, lower SES and higher birth weights predict a "serious obesity trajectory"[1]
  - For African American and Asian boys, higher the SES predicts "rapidly developing obesity" by early adolescence[1]
- Next steps to examine how these variables interact and patterns of rapid growth
- Overall, these findings are helpful to characterize the growth of children from low-income and urban families who are at elevated risk for obesity and overweight

1. Danner, F., & Toland, M. D. (2013). The interactive role of socioeconomic stats, race/ethnicity, and birth weight on trajectories of body mass index growth in children and adolescents. The Journal of Early Adolescence, 33, 293-314

Aim 3 (sneak preview)



Questions?