Moving Beyond Birthweight: Examining Developmental Origins of Disease Using Dynamic Postnatal Growth Indicators

Eva Tanner[1], Carl-Gustaf Bornehag[1,2], Chris Gennings[1]

[1]Icahn School of Medicine at Mount Sinai, NY, NY
[2]Karlstad University, Karlstad, Sweden

Conclusion

NOVEL NONLINEAR MODEL APPLICATION EXPLAINS SHIFTING PFOA-INDUCED CHILD GROWTH PATTERNS

Background

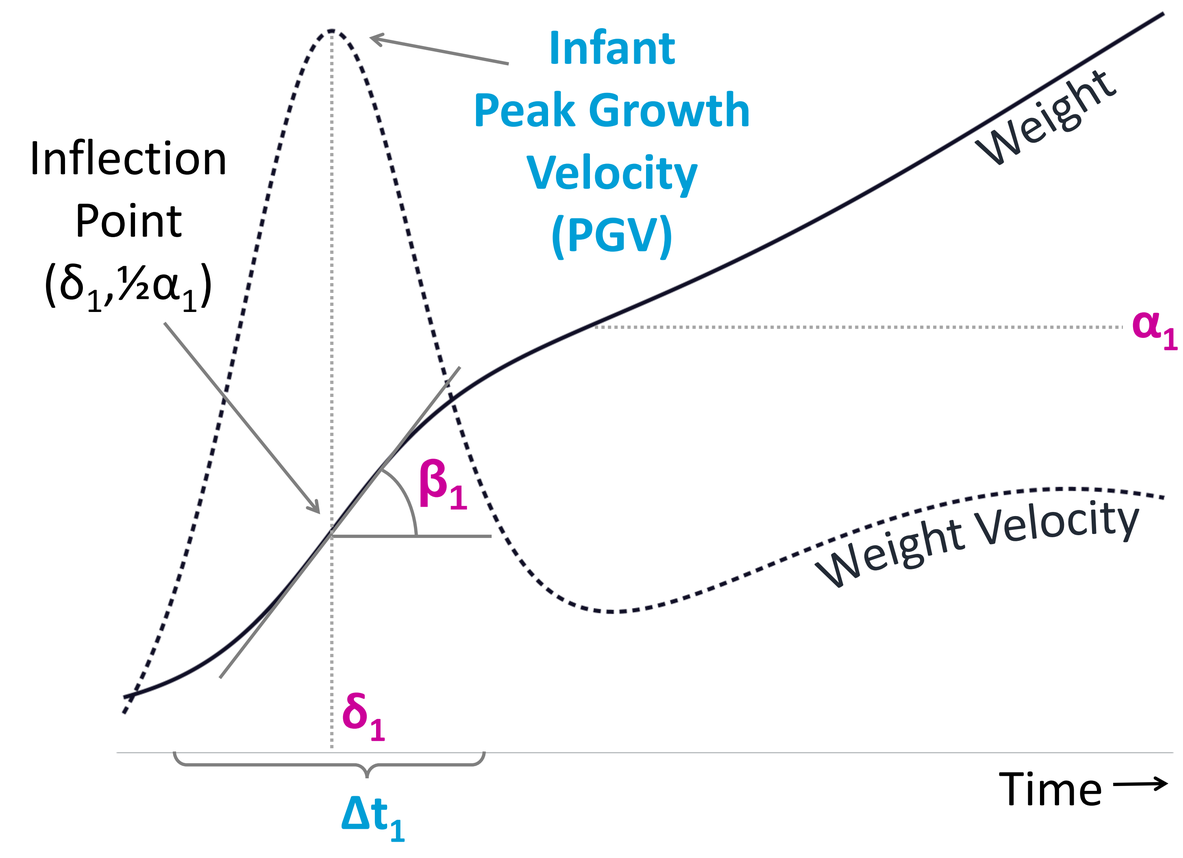
- Most prenatal exposure and growth studies use cumulative outcome measures (e.g. weight, BMI)
- PFOA related to lower birthweight, but higher weight later on

Methods

- Modeled weight trajectory from birth to 5.5 years among 1334 children in the SELMA Study

$$\mu(t) = \frac{\alpha_1}{1 + e^{-\beta_1(t-\delta_1)}} + \frac{W - \alpha_1}{1 + e^{-\beta_2(t-\delta_2)}}$$

Double Logistic Model



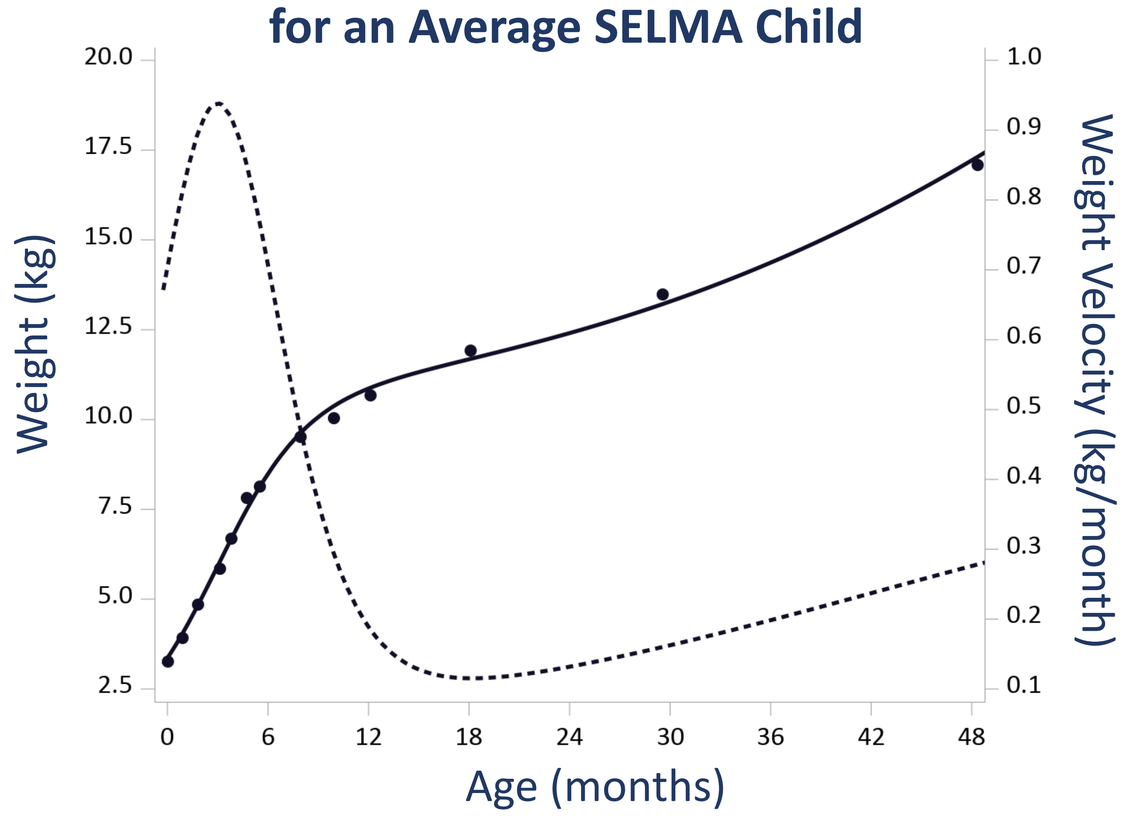
- Assessed prenatal PFOA exposure in relation to growth
  - Infant **PGV**
  - Age at infant PGV (δ_1)
  - Infant growth spurt length (Δt_1)
  - Post-spurt weight plateau (α_1)

More Info

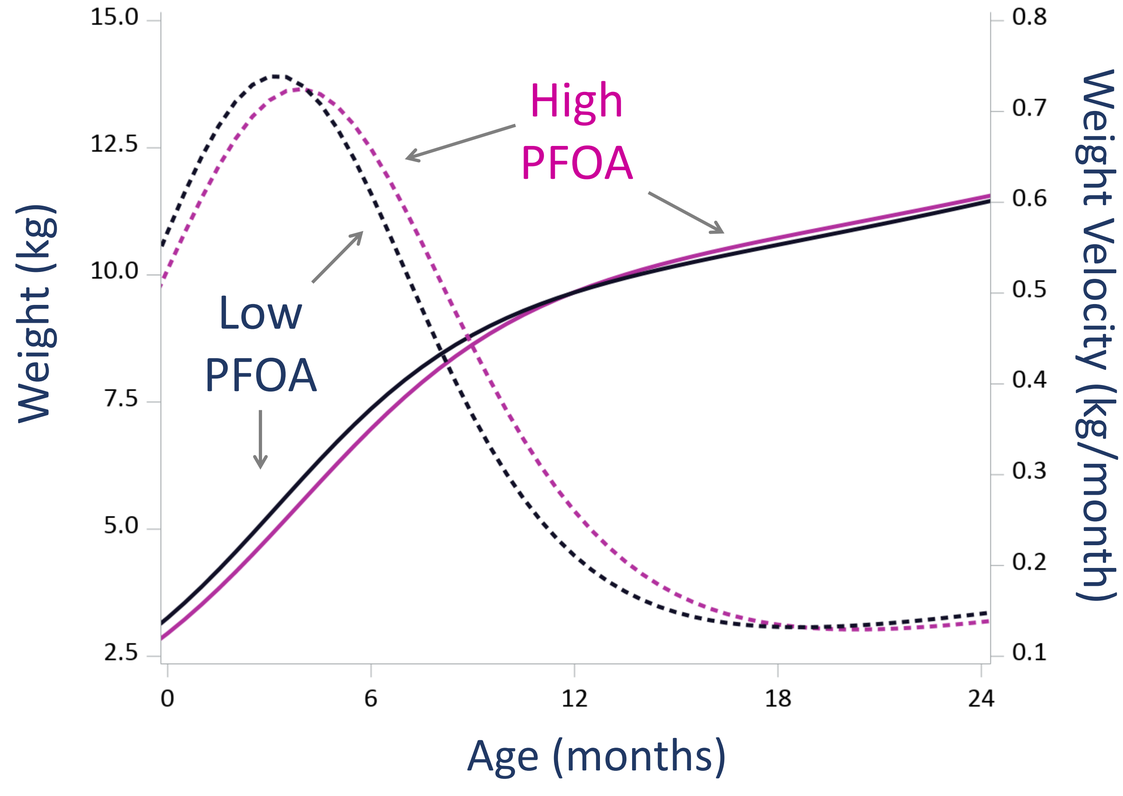
- Eva.Tanner@mssm.edu
- SELMASTUDIEN.SE

Results

Observed vs. Predicted Weight & Weight Velocity for an Average SELMA Child



Average Predicted Weight & Weight Velocity Trajectories for 10th% vs. 90th% PFOA Levels



Discussion

- PFOA-induced low birthweight followed by delayed PGV (δ_1), longer infant growth spurt (Δt_1), higher post-spurt weight (α_1)
- Nonlinear model useful to identify shifting growth patterns
- Future studies can extract additional dynamic growth metrics

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References:

- Bock RD, Wainer H, Petersen A, Thissen D, Murray J, Roche A. 1973. A parameterization for individual human growth curves. Hum Biol 45: 63–80.
- Bornehag C-G, Moniruzzaman S, Larsson M, Lindström CB, Hasselgren M, Bodin A, et al. 2012. The SELMA Study: A Birth Cohort Study in Sweden Following More Than 2000 Mother-Child Pairs. Paediatr Perinat Epidemiol 26:456–467; doi:10.1111/j.1365-3016.2012.01314.x.
- Gyllenhammar I, Diderholm B, Gustafsson J, Berger U, Ridefelt P, Benskin JP, et al. 2018. Perfluoroalkyl acid levels in first-time mothers in relation to offspring weight gain and growth. Environ Int 111:191–199; doi:10.1016/j.envint.2017.12.002.
- Høyer BB, Ramlau-Hansen CH, Vrijheid M, Valvi D, Pedersen HS, Zviezdai V, et al. 2015. Anthropometry in 5- to 9-Year-Old Greenlandic and Ukrainian Children in Relation to Prenatal Exposure to Perfluorinated Alkyl Substances. Environ Health Perspect 123:841–846; doi:10.1289/ehp.1408881.
- Lauritzen HB, Larose TL, Øien T, Sandanger TM, Odland JO, Van De Bor M, et al. 2018. Prenatal exposure to persistent organic pollutants and child overweight/obesity at 5-year follow-up: A prospective cohort study. Environ Heal A Glob Access Sci Source 17:1–12; doi:10.1186/s12940-017-0338-x.
- Maisonet M, Terrell ML, McGeehin MA, Christensen KY, Holmes A, Calafat AM, et al. 2012. Maternal concentrations of polyfluoroalkyl compounds during pregnancy and fetal and postnatal growth in British girls. Environ Health Perspect 120:1432–7; doi:10.1289/ehp.1003096.
- Negri E, Metruccio F, Guercio V, Tosti L, Benfenati E, Bonzi R, et al. 2017. Exposure to PFOA and PFOS and fetal growth: a critical merging of toxicological and epidemiological data. Crit Rev Toxicol 47:482–508; doi:10.1080/10408444.2016.1271972.