

**Accelerated Biological Aging:
How ACEs Harm Children and the Adults that They Become**

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Background

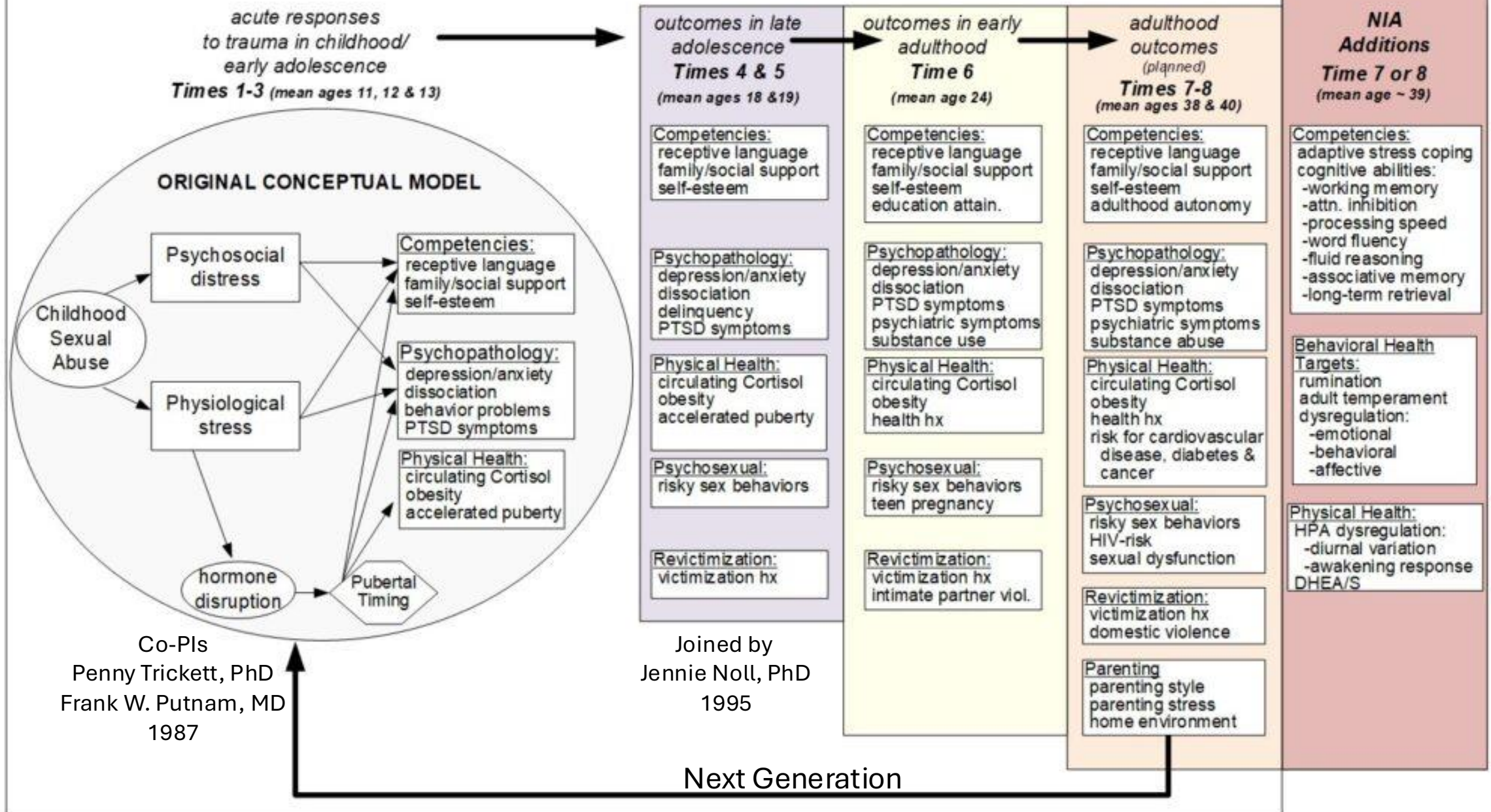
- 1980-1983 – clinical research fellowship at NIMH Intramural Program in Bethesda, MD
- Investigating common elements in rapid shifts in mental state (i.e., bipolar mood switches, panic attacks, PTSD flashbacks, periodic catatonia).
- Discovered 3 cases of MPD/DID → changed focus to dissociative disorders
- MPD/DID research subjects and patients all reported being an “us” since childhood → look for childhood DD case
- Circulated a profile and evaluated >100 seriously behaviorally disturbed and biologically dysregulated children. What has happened to these kids?
Common element: sexual abuse
- Refocused on psychobiological impact of childhood sexual abuse on child development → co-founded (with Dr. Trickett), a prospective, longitudinal, study of the effects of sexual abuse on the growth and development of girls

Female Growth and Development Study (FGDS)

Prospective Longitudinal Study of the Effects of Child Sexual Abuse in Females
(Trickett, Noll & Putnam (2011) Development & Psychopathology 23:453-476)

- 166 girls aged 6 - 15 years & primary non-abusing caretaker
 - 84 Sexually abused by family member
 - 82 Comparison girls matched on: age, race, SES, & family constellation (1 or 2 parents)
- Abuse Statistics
 - All sexual abuse subjects were CPS-substantiated cases
 - Mean age of sexual abuse onset: 7.9 yr. (± 3.3)
 - Mean duration: 26.3 months (± 29.6)
 - Physical violence: 51.9% of cases
 - Primary perpetrators: Biological Father: 23.4%, Father Figure (Stepfather, Live-in boyfriend): 58.4%, Other family member: 18.2%

Figure B2: Original FGDS conceptual model, measurement continuity, and T1-T8 assessments.



Research Themes

- Accelerated puberty
- Dysregulation of critical biological stress response systems
- Cognitive stunting
- Medical health (e.g., morbid obesity)
- Revictimization
- Parenting problems
- Intergenerational cycles of family violence (3 generations)
- Accelerated biological aging

Accelerated Puberty

Figure 1a. Transition to breast stage 2.

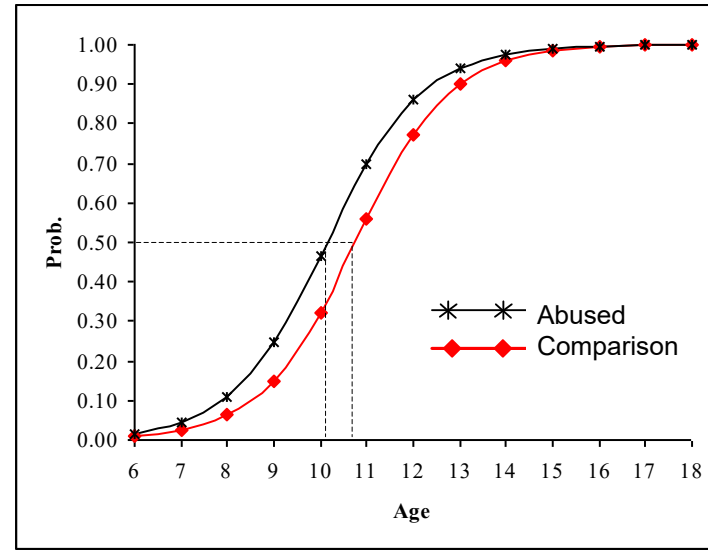


Figure 1b. Transition to pubic hair stage 2.

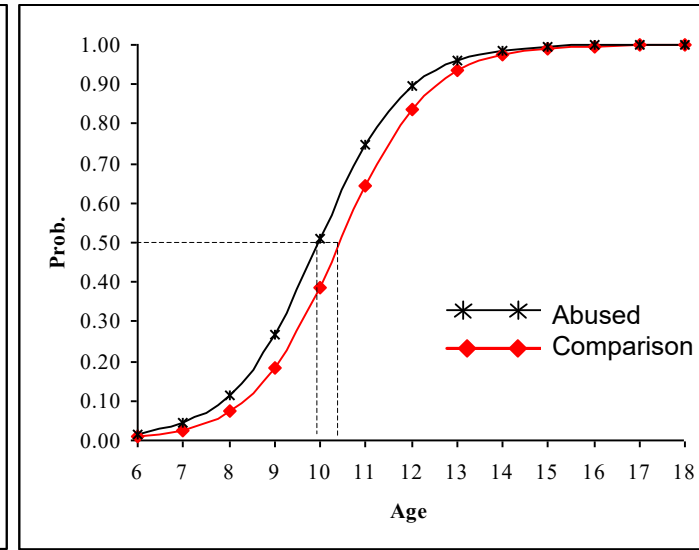


Figure 2a. Transition to breast stage 5.

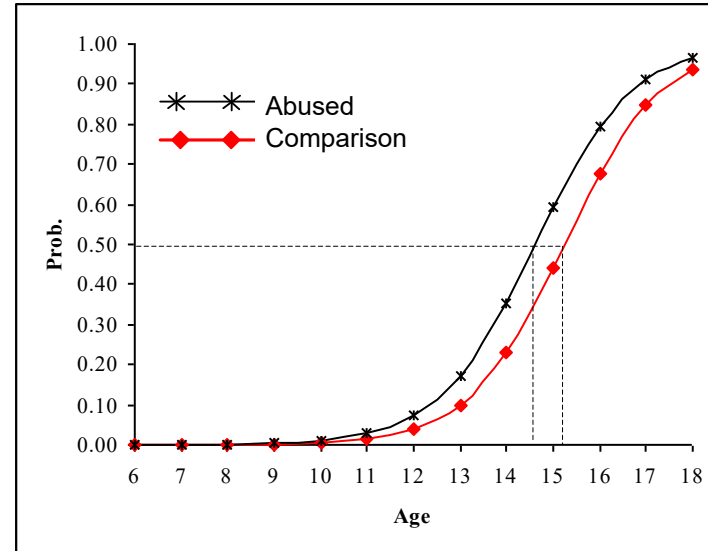
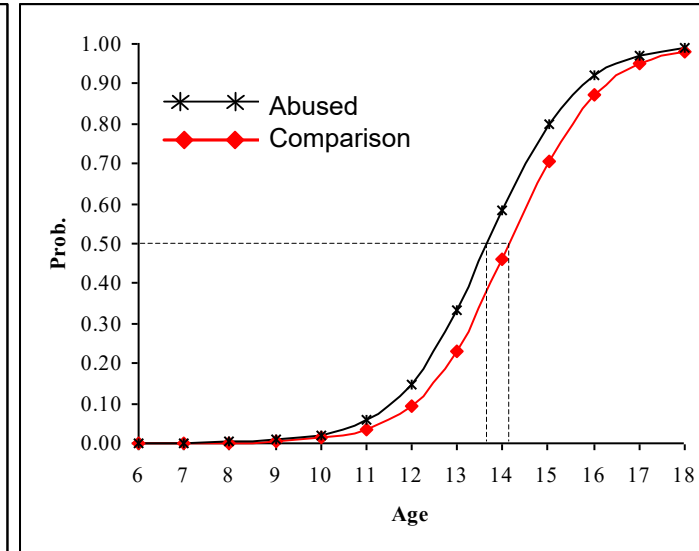


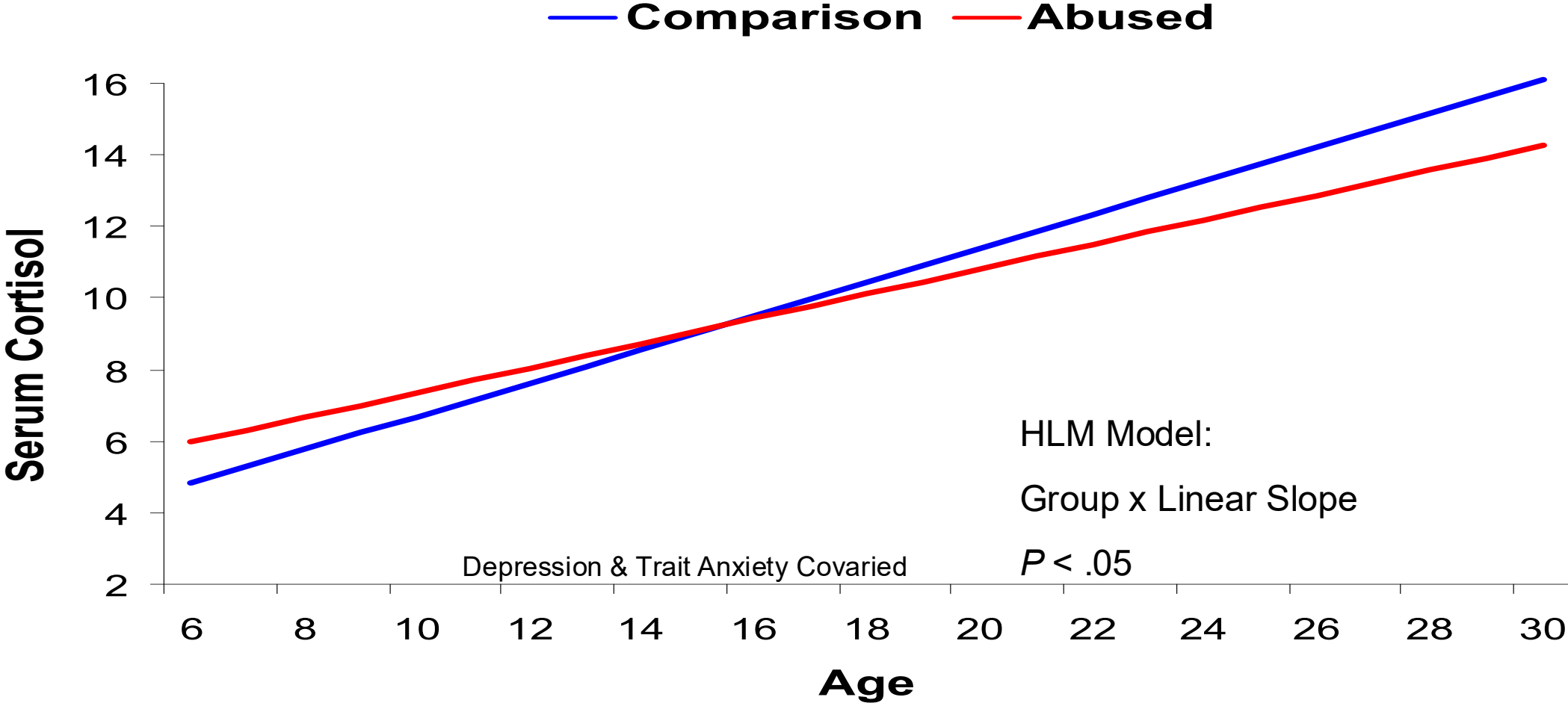
Figure 2b. Transition to pubic hair stage 5.



Poll Question

- Have you encountered maltreated children who appear and/or act "older" than their birth age?
 - 1. Yes
 - 2. No
 - 3. Unsure

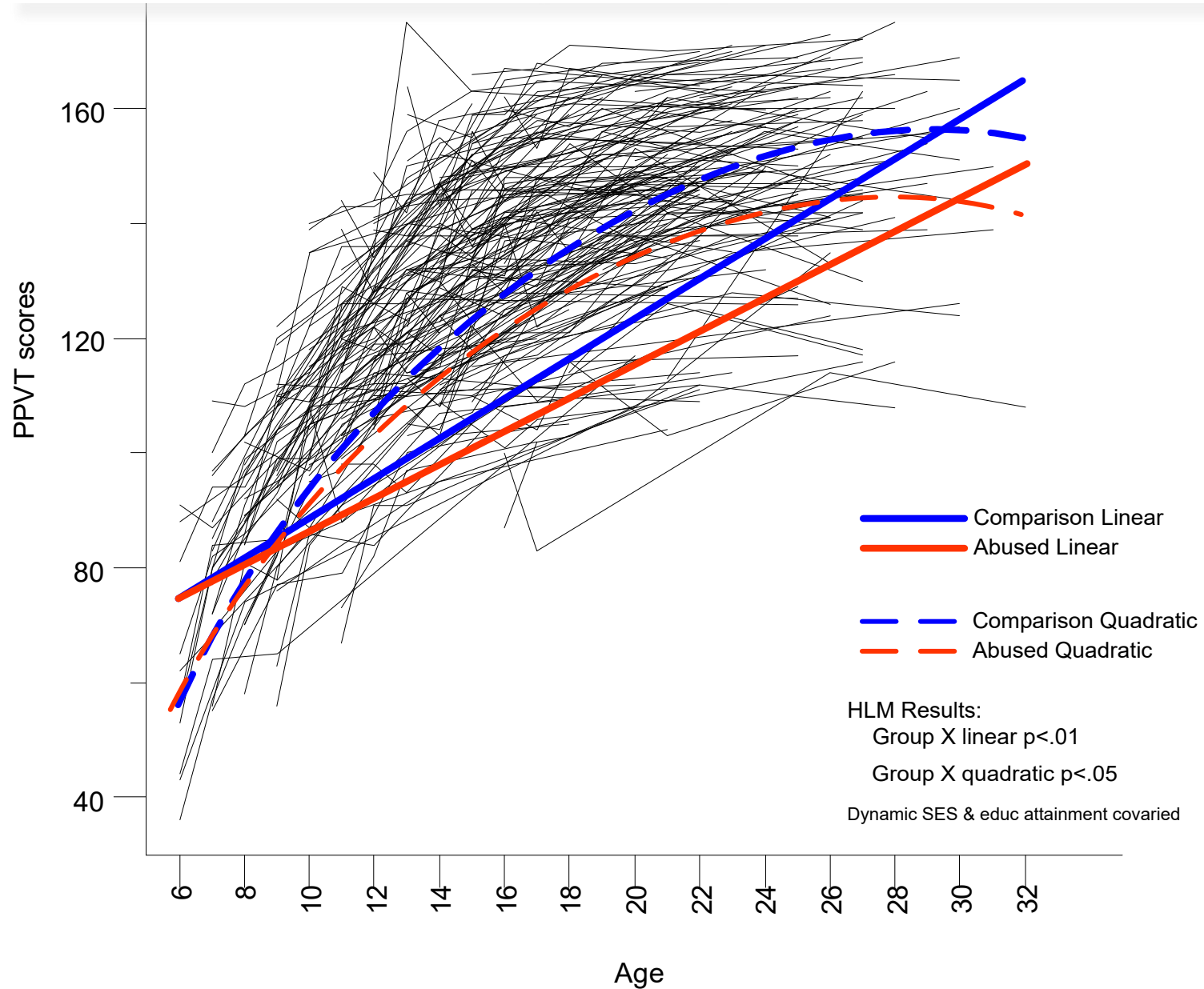
Developmental Life Course of Resting Cortisol in Abused and Matched Comparison Females



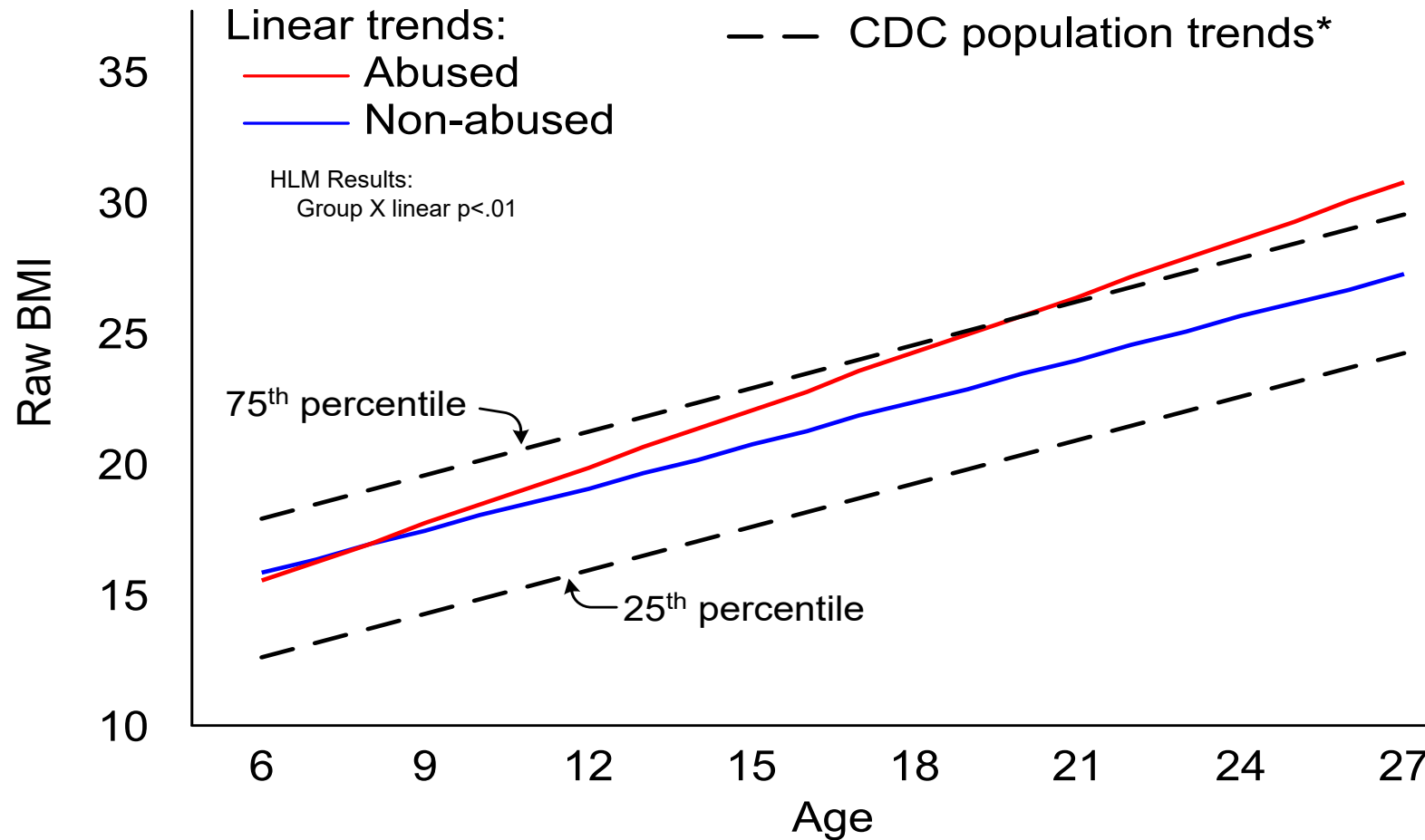
Trickett, P.K., Noll, J.G., Susman, E.J., Shenk, C.E., & Putnam, F.W. (2010). Attenuation of cortisol across development for victims of sexual abuse. *Development and Psychopathology*, 22, 165-175.

Vocabulary Acquisition

Noll, J.G., Shenk, C.E., Fung, M., Juye, J.I., Putnam, F.W., & Trickett, P.K. (2010). Receptive language ability and educational attainment across development for sexually abused females. *Pediatrics*, 126, 3, e615-22.

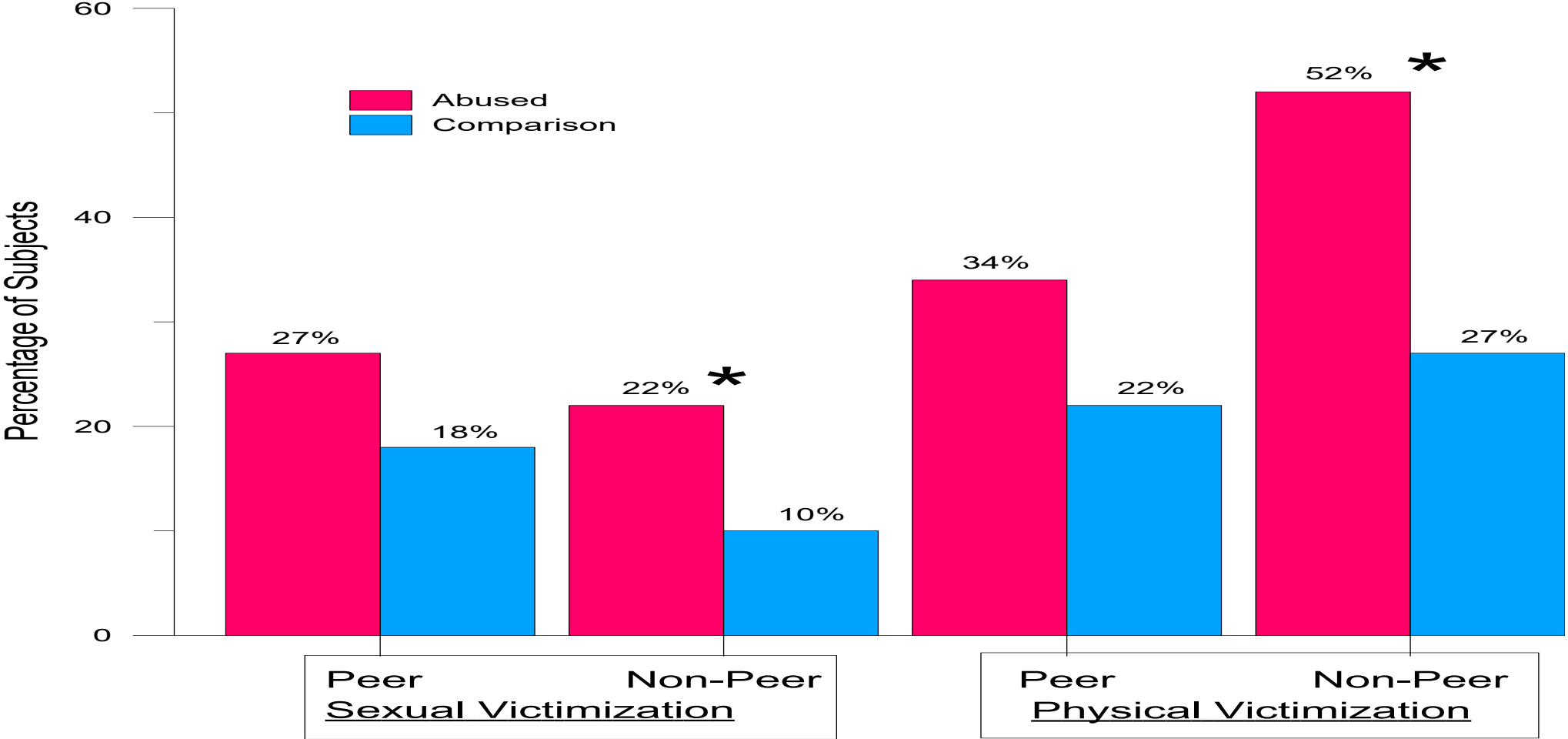


The Development of Obesity



Li, et al., (2021). Hypothalamic-pituitary-adrenal axis attenuation and obesity risk in sexually abused females. *Psychoneuroendocrinology*. 129: <https://doi.org/10.1016/j.psyneuen.2021.105254>

Rates of peer and non-peer sexual and physical victimization by group



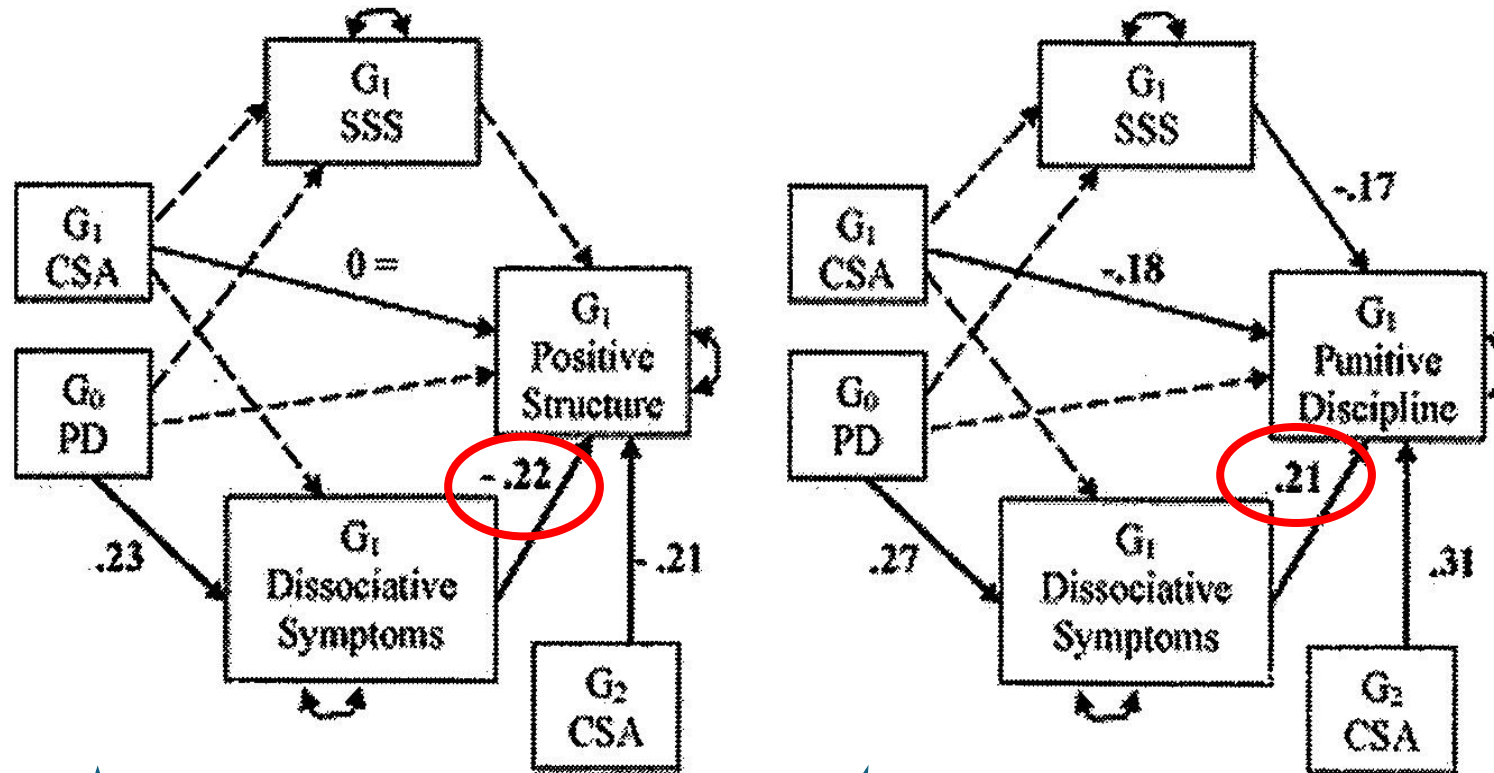
* $p < .05$

Barnes, J.E., Noll, J.G., Putnam, F.W., & Trickett, P.K. (2009). Sexual and physical revictimization among victims of severe childhood sexual abuse. *Child Abuse & Neglect*, 33, 412-420.

Poll Question

- Do you have a protocol to address risk for revictimization in sexually abused children?
 - 1. Yes
 - 2. No
 - 3. Uncertain

Maternal Dissociation Predicts Harsh Parenting



★ [Positive Structure – Model 4,
Spurious effect model]

★ [Punitive Discipline – Model 3,
Direct effect model]

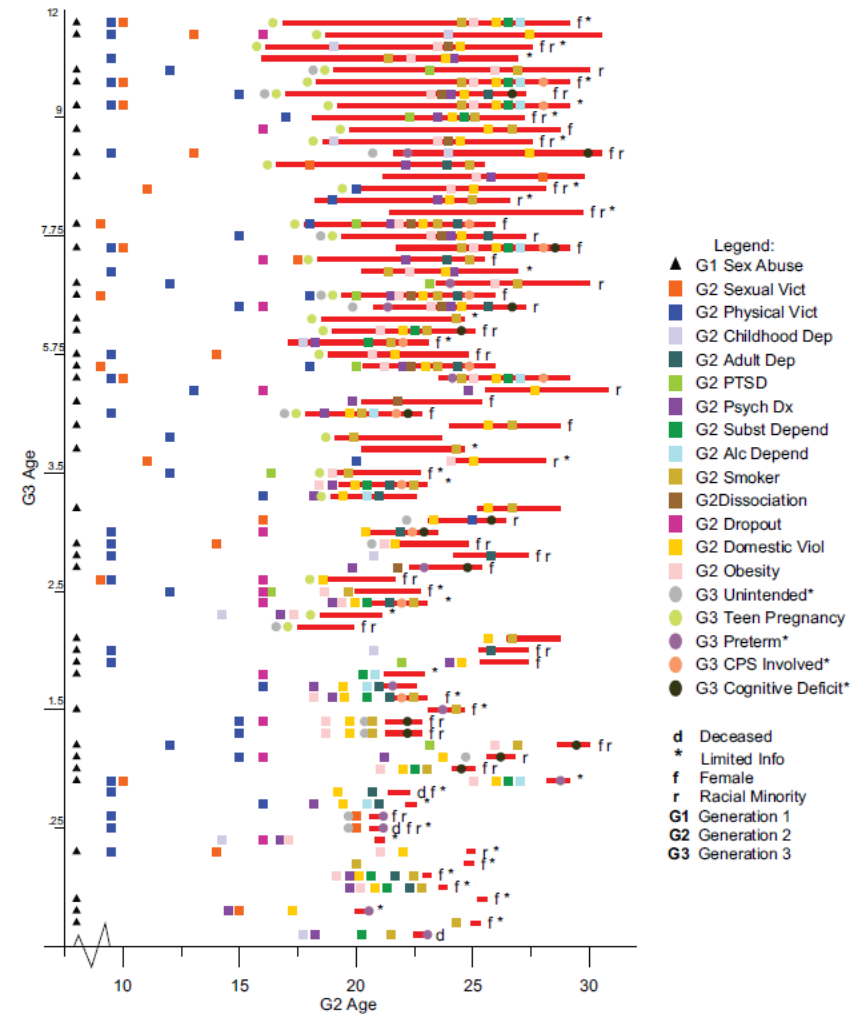
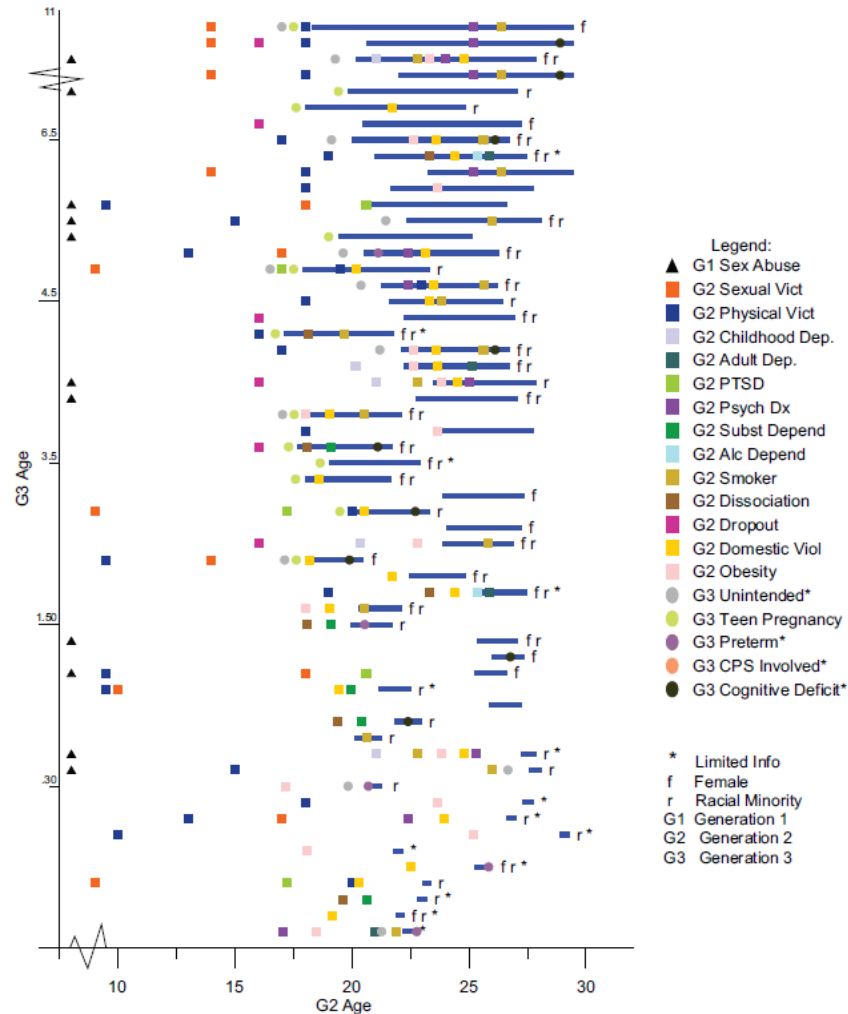
Positive Parenting

Punitive Parenting

Intergenerational Risk in Sexual Abuse and Comparison Families

Comparison Families

Child Sexual Abuse Families



Noll, J.G., Trickett, P.K., Harris, W.W., & Putnam, F.W. (2009). The cumulative burden borne by offspring whose mothers were sexually abused as children: Descriptive results from a multigenerational study. *Journal of Interpersonal Violence*, 24, 3, 424-449.

Chat Question

- What are the implications of the intergenerational transmission of risk for maltreatment for prevention programs?

Old Before Their Time: CSA Accelerates Epigenetic Aging

- The **Epigenome** is a layer above the DNA sequence that can interact with the environment and life experiences to change the expression of DNA.
- The environment and experiences act on the epigenome by attaching histone "tags" to genes.
- Methyl tags often turn genes "off" by blocking transcription.
- Methyl tags often facilitate transcription turning genes "on".
- Acetyl tags often facilitate transcription turning genes "on".
- Methyl tags accumulate with age and can be measured with "clocks" that compare the epigenetic age v. chronological (birth) age.
- CSA increases the number of methyl tags significantly accelerating biological age.
- Different organs age at different rates

C.E. Shenk et al.

Psychoneuroendocrinology 136 (2022) 105606

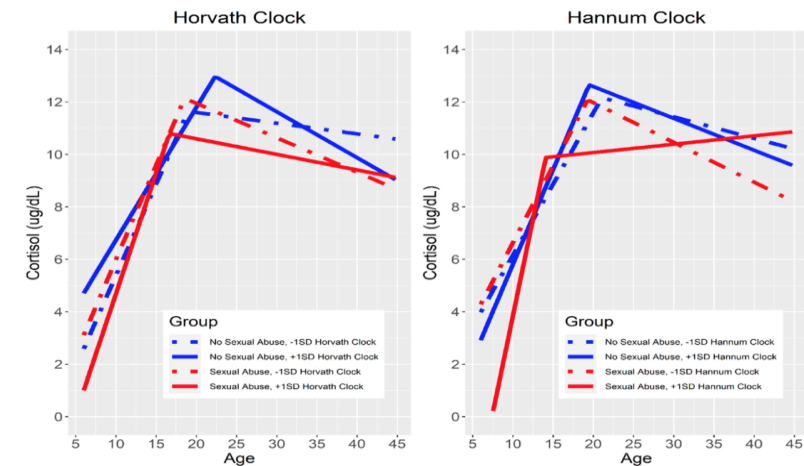


Fig. 2. Relations among childhood sexual abuse, epigenetic age acceleration via the horvath and hannum clocks, and cortisol growth as obtained from conditional bilinear spline growth model.

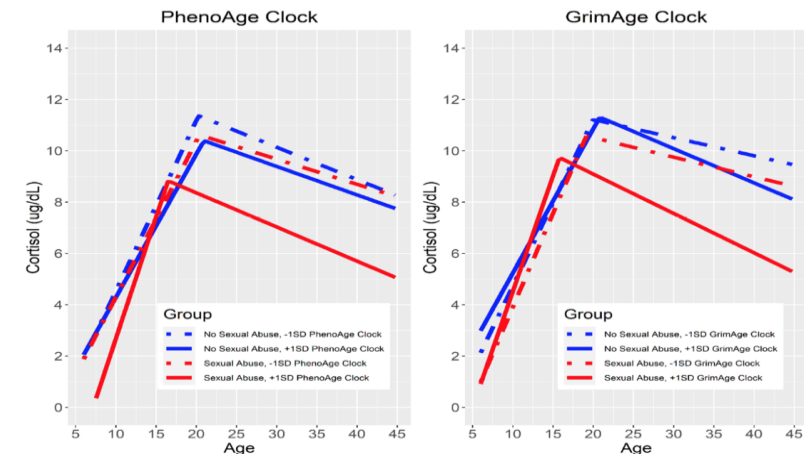


Fig. 3. Relations among childhood sexual abuse, epigenetic age acceleration via the phenoage and grimage clocks, and cortisol growth as obtained from conditional bilinear spline growth model.

Shenk, et al. (2021). Cortisol trajectories measured prospectively across thirty years of female development following exposure to childhood sexual abuse: Moderation by epigenetic age acceleration at midlife. *Psychoneuroendocrinology*. 136: <https://doi.org/10.1016/j.psyneuen.2021.105606>

Implications of the Biological Embedding of Childhood Trauma

- Age is the primary risk factor for the development of chronic illness and the five leading causes of death.
- Our lifespans are largely epigenetically determined rather than genetically determined.
- Epigenetic changes to DNA provide easily available biomarkers that can be prospectively tracked to predict the impact of traumatic exposures on biological aging over time.
- Some epigenetic aging processes are potentially reversible, providing potential therapeutic biomarkers to evaluate treatment efficacy.
- Treatments that target epigenetic accelerated aging can potentially reduce early onsets of chronic illness and premature mortality from common age-related diseases and disorders.
- Growing understanding of the biological mechanisms by which maltreatment and adversity harms children and the adults that they become will facilitate recognition, prediction, and treatment of trauma and its long term sequelae.

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