Punishing Puberty: The perils of Pauline

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What is puberty?

- Interrelated changes that incorporate several systems
  - Linear growth, change in body composition
  - Maturation of adrenal axis, reactivation of the hypothalamic-pituitary-gonadal axis
  - Achievement of ability to reproduce
- Adolescence: paradigm of chronologic age interacting with biologic change
Adolescents and maturation

- Cognitive
  - Concrete to formal operational; abstract thinking; egocentrism; overthinking; apparent hypocrisy
  - “Cool” cognition; “hot” cognition; earlier maturation of nucleus accumbens/ locus ceruleus and later maturation of prefrontal cortex

- Psychosocial
  - Independence; establishment of adult self-identity/ sexual identity; engaged in plans for self-sufficiency
Puberty

- Reactivation of the HPG axis
- Growth and development
  - Growth spurt
  - BMI; change in body composition
  - Changing laboratory parameters
- Sequence and timing of puberty
  - Tanner stages (sexual maturity rating)
  - Relative timing of pubertal onset
  - Rate of change through puberty (tempo)
Changes associated with puberty

- Adrenarche (activation adrenal cortex for production of adrenal androgens)
- Pubarche (appearance of pubic hair)
- Thelarche (appearance of breast tissue)
- Gonadarche (appearance secondary characteristics) (*gonadal production of sex steroids*)
- Menarche (age of first menstrual period)

- Also changes in body composition, stimulation of growth plates, achievement fertility
Sequence of pubertal events - girls

- Onset of puberty
- Peak height velocity
- Menarche
- Completion of puberty

Age in years
Sequence of pubertal events - boys

- Pubic hair stage 2
- Peak height velocity
- Sperm in urine
- Strength spurt
- Completion of pubic hair 5
- Increase in testicular vol
- Pubic hair stage 2

Data from multiple sources: Biro 1995; Neu 2001; Karpati 2002; Dore 2005
Onset of pubertal maturation is occurring earlier

- Herman-Giddens 2012: white boys 10.1, Hispanic 10.0, African-American 9.1
  - Younger than Marshall & Tanner (1960-70) and Biro et al (1984-87)

BCERC girls followed over the past decade; PROS from early 1990
Hormone levels relative to breast development

Months relative to onset of puberty

- DHEAS
- Estrone
- Estradiol

JCEM 2014
Sex steroids and the pubertal brain

- Increased rates of depression in girls during midpuberty (contrasted to boys) related to estrogen and testosterone levels (Angold 1999)
- Gray matter development related to increased levels estradiol in girls (Peper 2008) and testosterone in boys (Koolschijn 2014)
Global self worth, adolescent girls

Short- and long-term consequences of early and late maturation

- Girls with early maturation, as teens: poorer body image (but interaction with BMI); more norm-breaking behaviors at ages 15-16; more likely to have used drugs, advanced drug use

- As adults: lower academic achievement; higher rates of major depression, poorer adjustment and relations
Short- and long-term consequences of early and late maturation

- Boys with early or late maturation greater risk subclinical psychopathology; late maturing with disruptive behavior

- Late maturing boys as adults: more likely current substance as well as tobacco use; lower self-esteem
Consequences of timing of puberty: Not a fait accompli

Westling (2008)
Caveats

- No association between cognitive abilities and pubertal timing (except those with moderate to severe intellectual disability)
- We interact with teens as they appear
- “Risky behaviors” not perceived as risky, and may be normative
  - YRBS: 47% of HS students report they have been sexually active one or more times, and 33% report they have been sexually active in the past three months
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