Lecture 6: Puberty & Puberty Rituals

- Menarche
  - What causes menarche?
    - 1. Frisch “Fatness” hypothesis
    - 2. Tanner/Ellison “Pelvic Size”
  - Hormonal Changes with menarche
  - Sex differences in timing of puberty
- Puberty Rituals

Menarche

What Triggers Menarche?

- Frisch “Body Fat” Hypothesis
- Tanner/Ellison: “Pelvic Size” Hypothesis

Frisch “Body Fat” Hypothesis

- Accumulation of weight or fat is critical for menarche

Frisch Hypothesis - Version 1

- Average weight at menarche is 47 kg
- Thus, 47 kg is a critical weight that triggers menarche
- PROBLEM: Graph shows there is NO relationship!

Frisch Hypothesis - Version 2

- Looked at weight for height instead
- Found critical body composition that triggers menarche
- PROBLEM: assumes Difference in body composition is due to FAT

(Frisch & Revelle, 1970)
Frisch Hypothesis - Version 3

- Few girls reached menarche below 17% body weight as fat
- Said this was a minimum threshold for menarche
- PROBLEM: No evidence of increase in probability of reaching menarche after attain 17% body fat

Pelvic Size Hypothesis

- A girl must reach an appropriate age of skeletal development in order to reproduce
- Pelvic dimensions are significantly correlated with menstrual age
- A bi-iliac diameter (pelvic breadth) of 24 centimeters seems to be a minimum threshold

Comparison of Hypotheses

- Ellison studied data from 67 girls weighed and measured twice a year from 8 to 18 yrs.

Graph of Menarcheal age and Wt.

- Weight accounts for 18% of the variance in menarcheal age
Skeletal Growth and Age at Menarche

- Height accounts for 50% of the variance

Comparison of Hypotheses

- Weight accounts for 18% of the variance in menarcheal age
- Height accounts for 50% of the variance
- Menarche occurs after peak growth spurt
- Natural selection has delayed menarche until pelvis can handle reproduction without complications

Why the Confusion?

- Fat IS important for female reproduction
- But, attaining an adequate SIZE comes first
- Attaining adequate ENERGY for reproduction comes next
Hormonal and Developmental Changes

**Androgens**


- Androgens from adrenal gland and ovary stimulate pubic and axillary hair development

**Estradiol - I**

- Increase in estradiol ~8-9 yrs starts development of breasts, uterus, vagina, parts of pelvis

- Pelvic remodeling finishes at the end of skeletal maturation

**Breast Development**

- Breast development occurs first

- Influence of estradiol and prolactin (from anterior pituitary)
Estradiol - II

- Eventually stimulates mineral deposition resulting in ossification and fusion of epiphyses

Precocious Puberty

- Treatable with estrogen antagonist

Delayed or Loss of Puberty

- Treatable with GnRH

Skeletal Development - Overall

- Androgens (testosterone)
  - Estradiol
  - Growth Hormone from anterior pituitary

Pubertal Development

- During 3rd month in utero negative feedback starts
- As system matures more estrogen needed to turn system off
- Finally enough FSH released to stimulate follicle to develop
• Positive feedback starts in response to high estrogen
• Capacity to evoke LH Surge occurs late in pubertal process

Gonadal Maturation: 3 Hypotheses

- Pituitary Drive Hypothesis
  • Pituitary produces increasing FSH and LH (gonadotropins) in response to the same GnRH stimulus from hypothalamus

- Gonadal Drive Hypothesis
  • Changes in gonad come first
  • Increasing amounts of steroid cause hypothalamus to lose sensitivity to negative feedback

Development of LH pulses

- Pre-puberty: No LH Pulses
- Early Puberty: Production of LH pulses begins, especially at night
- Late Puberty: Increasing magnitude and frequency of pulses, also during day

Adolescent Subfecundity

- Between 55%-85% menstrual cycles during first 2 years are anovulatory
• HOWEVER, Any individual cycle may be ovulatory!

Differences between males and females

<table>
<thead>
<tr>
<th>Congruence pivotal event</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximal rate of skeletal growth</td>
<td>12 yrs</td>
<td>14 yrs</td>
</tr>
<tr>
<td>Maximal rate of pubic hair growth</td>
<td>12</td>
<td>13-15</td>
</tr>
<tr>
<td>Adult pubic hair count</td>
<td>13.14</td>
<td>14-15</td>
</tr>
<tr>
<td>Pubic hair</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Testes enlargement</td>
<td>15-16</td>
<td>16</td>
</tr>
<tr>
<td>Penis enlargement</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Growth spurt</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Axillary hair</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Facial hair</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Voice changes</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Menstruation</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Fat deposition</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Secular Trend

Secular Trend

Stages of Puberty

Females
• Breast Development
• Pubic Hair
• Growth Spurt
• Hip broadening
• Menstruation
• Fat Deposition
• Fully “fecund” cycles

Males
• Testes enlargement & sperm production
• Pubic hair
• Penis enlargement
• Growth spurt
• Axillary hair
• Facial hair
• Voice changes
• Broadening of shoulders “filling out”

Puberty Rituals
Surma

Western Puberty Rituals?

• Signs of menarche
  • Scarification
  • Adornment
  • Hair style changes
• Restricted access to men
  • Seclusion
  • Symbolic clothing

Mbuti

Puberty Rituals

Next Time...

• Menstruation — why did it evolve?

• Menstrual seclusion huts and menstrual taboos