Adolescents and Nutrition

Nutrition Think Tank Symposium
October 15 2014
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Adolescent Development

• Individual

• Not a smooth progression or synchronous
  – Biologically: begins with secondary sexual characteristics, ends with reaching final height/weight

• Involves not just biological but intellectual, social, and emotional maturation
  – Physical development and sexual development depends on nutritional support
    • Stunting and poor fecundity without adequate nutrition
Development: growth

- Development begins in utero
- Fastest growth prenatally and in the two years of life
- Second fastest in puberty (height and weight)
Development: sexual maturation

• Sexual Maturity Rating/Tanner stages I-V
  – Breast, Pubic hair, Genital development

• Pubertal stages
  – Early: 10-13 years old (USA = middle school)
  – Middle: 14-17 years old (USA = high school)
  – Late: 17-21 years old (USA = college or working)

• Dependent on adequate nutrition before and during sexual maturation
  – Arrest if nutritional support is reduced or withdrawn
  – May not return to previous trajectory of final sexual maturation if inadequate nutrition is prolonged
Development: Female SMR

1. Prepubertal
2. Areola widens, breast bud, fine hair on labia
3. Breast tissue extends beyond areola, curly, coarser hair across midline
4. Areola and papilla form a mound projecting from the breast contour, adult hair not on thighs
5. Areola and breast in same plane, adult hair on thighs

Sexual Maturity Rating/Tanner stages I-V
Breast development/Pubic hair for females
1. Prepubertal
2. Testicular enlargement, scrotum reddened and thinner, fine hair development
3. Testes enlarged, penis lengthens, hair coarser and crosses the midline
4. Testes enlarged, scrotum rugae and darken, penis lengthens and widens, adult hair not on thighs
5. Adult pattern

Sexual Maturity Rating/Tanner stages I-V
Pubic hair/genital development for males
PHV = Peak Height Velocity
(later in males, earlier in females)
Chronologic Changes of Adolescence

Males

- Height spurt: 10½ - 16 years, 13½ - 17½ years
- Penis: 11-14½ years, 13½ - 17 years
- Testis: 10-13½ years, 14½ - 18 years
- Pubic hair: 2 - 3 - 4 - 5, 10-15, 14-18 years

Females

- Height spurt: 9½ - 14½ years
- Menarche: 10-16½ years
- Breast: 8-13 years
- Pubic hair: 2 - 3 - 4 - 5, 8-14 years
Adolescents need adequate nutrition during development to support their sexual and physical maturation (the *prevention*).

Inadequate nutrition during *adolescence* leads to:

- Stunting, decreased final adult height
- Poor bone density (gain 1/3 during teen years; peak at 30)
- Poor muscle mass
- Poor brain development
  - Brain continues to develop and gain executive function (risk-assessments) well into mid-20s
- Poor fecundity (need to be the best host for future pregnancies)
Adolescent Nutritional Needs

Adolescents need adequate nutrition during a pregnancy to support their own growth and their fetus (the treatment). Inadequate nutrition during adolescent pregnancy leads to:

- Pregnancy complications
  - Embryo and fetuses are excellent “parasites” on the nutrition of mom-to-be
  - Need to go into a pregnancy with adequate macro- and micronutrients
- Specific issues with:
  - Iron, Vitamin A, Calcium, Folate, Iodine
- Delivery complications
  - Specific concerns for stunted, undernourished mother and adequately nourished fetus – double burden
- Delay in 1st pregnancy, and spacing of pregnancies are best to ensure adequate adolescent nutrition and growth
Acknowledgements

• Adolescent Medicine Nutrition Team
  – Laura Hooper, MS, RDN, CD
  – Alicia Dixon Docter, MS, RDN, CD
  – Celia Framson, MPH, RDN, CD
  – Kimberly Amundson, MSPH, RDN, CD

  – Tanner staging
<table>
<thead>
<tr>
<th>Nutrient</th>
<th>average needs <em>(recommended daily allowance)</em></th>
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<tbody>
<tr>
<td>Iron</td>
<td>7.9mg/d <em>(11mg/d)</em></td>
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<tr>
<td>Vitamin A</td>
<td>485µg/d <em>(700µg/d)</em></td>
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<tr>
<td>Calcium</td>
<td>1,100mg/d <em>(1,300mg/d)</em></td>
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<tr>
<td>Folate</td>
<td>330µg/d <em>(400µg/d)</em></td>
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<tr>
<td>Iodine</td>
<td>95µg/d <em>(150µg/d)</em></td>
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<tr>
<td>Carbohydrates</td>
<td>100g/d <em>(130g/d)</em></td>
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<tr>
<td>Protein</td>
<td>0.7g/kg/d <em>(46g/d)</em></td>
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<tr>
<td>Water</td>
<td>2.3L/d</td>
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Body composition changes

Estrogen and progesterone promote the deposition of proportionately more fat than muscle tissue in girls

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<th></th>
<th>Pre-pubertal</th>
<th>lean mass</th>
<th>fat mass</th>
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<tbody>
<tr>
<td>Boys</td>
<td>equal</td>
<td></td>
<td>15%</td>
</tr>
<tr>
<td>Girls</td>
<td>equal</td>
<td></td>
<td>19%</td>
</tr>
<tr>
<td>Adults</td>
<td></td>
<td>doubled</td>
<td>12-15%</td>
</tr>
<tr>
<td>Males</td>
<td></td>
<td>doubled</td>
<td>12-15%</td>
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<tr>
<td>Females</td>
<td></td>
<td>----------</td>
<td>23%</td>
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</table>

Athletic girls: fat mass 16-25% with normal vitals and menses
Athletic boys: fat mass 8-18%

Spear, B. Adolescent growth and development, JADA Suppl S23-29, Mar. 2002
Weight gain post menarche

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<tr>
<th>Postmenarcheal year</th>
<th>pounds</th>
<th>kg</th>
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<tr>
<td>1</td>
<td>10.12</td>
<td>4.6</td>
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<tr>
<td>2</td>
<td>6.16</td>
<td>2.8</td>
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<tr>
<td>3</td>
<td>2.42</td>
<td>1.1</td>
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<tr>
<td>4 and 5</td>
<td>1.76</td>
<td>0.8</td>
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