The Epidemiology of ADHD:
Prevalence, Natural History & Clues to Etiology

Andrew S. Rowland PhD
University of New Mexico Health Sciences Center
Outline

• Prevalence of ADHD and how it varies

• Natural History of ADHD and its impact

• Etiology of ADHD
  – Can exposures to environmental toxicants cause ADHD?
  – How likely is a gene-environment interaction as an explanation?
Estimates of Prevalence of ADHD

• Prevalence stated in DSM-IV, TR 3-7 %

• Many problems with many current estimates: (Skounti et al 2007)
  – Different definitions of ADHD
  – Clinic samples
  – Use of only 1 informant
  – Children taking medication
  – Symptoms caused by other disorders
Epidemiologic Compass

Prevalence varies by:

- Gender
- Age
- Race/Ethnicity
- SES
- Over time
- Geographically
Age-adjusted Estimates of Parent-reported ADHD
National Health Interview Survey, 2005

Source: NHIS, Series 10, 231, 2005
ADHD as a Developmental Disorder

- Sex ratio for ADHD is about 3:1
- Male predominance true for many developmental disabilities
- Male vulnerability through birth, infancy, childhood
Relation between Age and Parent-reported ADHD, NHIS, 2005

- 3-4 years: 0.7%
- 5-11 years: 6.1%
- 12-17 years: 8.9%
Age-adjusted Prevalence of Parent-Reported ADHD
By Race/Ethnicity

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>6.6</td>
</tr>
<tr>
<td>Black</td>
<td>8.2</td>
</tr>
<tr>
<td>Native Am.</td>
<td>9.1</td>
</tr>
<tr>
<td>Asian</td>
<td>4.7</td>
</tr>
<tr>
<td>Multi-racial</td>
<td>7.2</td>
</tr>
<tr>
<td>Hispanic</td>
<td>6.6</td>
</tr>
<tr>
<td>Not Hispanic</td>
<td>8.2</td>
</tr>
</tbody>
</table>

Source: NHIS, 2005
Age-adjusted Prevalence of Parent-reported ADHD by Annual Family Income

Source: NHIS, 2005
Age-adjusted Prevalence of Parent-reported ADHD By Family Structure

- Parent and father: 5.6
- Mother, no father: 8.3
- Father, no mother: 6.4
- Neither mother or father: 15.9

Source: NHIS, 2005
Prevalence of Stimulant Use
U.S. Population - Age 18 and Under

Source: Medical Expenditure Database, AHRQ
Impact of Natural History
### Percent of ADHD Children with Comorbid Conditions
**Ontario Child Health Study**

<table>
<thead>
<tr>
<th></th>
<th>% ADHD + Comorbid Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males 4-11</td>
<td>53.0</td>
</tr>
<tr>
<td>Females 4-1</td>
<td>42.1</td>
</tr>
<tr>
<td>Males 12-16</td>
<td>36.9</td>
</tr>
<tr>
<td>Females 12-6</td>
<td>67.0</td>
</tr>
</tbody>
</table>

**Source:** Szatmari et al. 1989
Natural History of ADHD

Follow-up studies suggest:

- 30-45% will meet criteria for ADHD at age 20
- Risks persist
- Risk of substance abuse and conduct disorder
Accidents and Health Risk behaviors

- **Long term costs** (Discala et al. 1998)
  - Accidents
  - Health risk behaviors

- **Youth with ADHD + Conduct Disorder at particularly high risk**
Etiology
Genetic Risk of ADHD
Farone et al. 2005

- Familial risk
- Heritability estimates
- Many polymorphisms, weak relationships
- May suggest gene-environment interaction
Pregnancy Complications: Collaborative Perinatal Project 1959-1965

Risk of hyperkinetic-impulsive Behavior

- Prenatal smoking
- Hospitalized during pregnancy
- Convulsions during pregnancy
- Breech delivery
Toxicant Exposure and ADHD

- Prenatal exposure to smoking
- Environmental tobacco smoke
- Prenatal exposure to alcohol
- Prenatal stress
- Lead
- Pesticides
Prenatal Smoking and ETS

- Prenatal smoking
  - 2003 review (Linnet et al 2003)
  - evidence mixed, but overall positive

- Environmental tobacco smoke
  - evidence mixed
Prenatal Alcohol / Prenatal Stress

• Nine studies reviewed (Linnet et al, 2003)
  - Evidence mixed
  - Critique comparing ADHD and FAS/FAE

• Implications for environmental studies

• Prenatal stress and ADHD (O’Connor et al 2002, Rodriguez 2005)
Dentine Lead and Teacher-Reported School Problems

Source: Needleman et al. 1979. N EJ
Relation between Dentine Lead Levels at Age 6-8 and Adjusted Symptoms of Inattention/restlessness at Age 12-13

Source: Fergusson et al. 1993
Relation between Blood Lead and Odds Ratio for ADHD, NHANES 1999-2002

Source: Braun et al. 2006
<table>
<thead>
<tr>
<th>Prenatal Exposure</th>
<th>Attention Problems</th>
<th>ADHD Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Tobacco Smoke</td>
<td>2.8 (0.4-17.8)</td>
<td>8.1 (1.2-54.7)</td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>11.3 (1.8-71.0)</td>
<td>6.5 (1.1-38.7)</td>
</tr>
</tbody>
</table>

Source: Rauh et al. 2006
Points to Consider

• Does the endpoint matter?
  – Tests of attention, ADHD symptoms, or ADHD
  – Multi-method approaches
  – Standardization of the case definition

• How can we incorporate social factors into our studies of environmental and genetic risk factors?

• We need to develop more effective ways to control for SES and poverty in our models.
Points to Consider Continued

- Need for more complex models that account for adverse life events and timing of exposures during different stages of child development.

- Epidemiologic tools don’t work very well at low exposures. We need to make good use of the tools we do have.
Collaborators

**North Carolina**

Dale Sandler and David Umbach NIEHS
Lil Stallone SSS
Jack Naftel UNC
David Rabiner Duke
Vanessa Thornburg RTI

**New Mexico**

Betty Skipper UNM
Richard Campbell UNM
Richard Hough UNM
Rebeccah Rodriguez UNM
Bibliography
