



Epidemiology of Autism Spectrum Disorders: Etiologic Studies and Prevention Strategies

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Background

- Autism Spectrum Disorders (ASDs) are defined by considerable impairments in social interaction and communication skills, and the presence of unusual behaviors and interests.
- Both the epidemiology and etiology of these serious developmental disorders are poorly understood.



Background

- ASDs can be identified as early as 14 months and last throughout a person's life.
- ASDs include autistic disorder, pervasive developmental disorder-not otherwise specified (PDD-NOS, including atypical autism), and Asperger disorder.
- Many people with ASDs also have unusual ways of learning, paying attention, or reacting to different sensations.

Background

- ASDs are neurobiological disorders, meaning the behavioral symptoms are a result of differences in brain development
- For the majority of people with autism spectrum disorders, the cause is not known. There may be multiple causes that are a combination of genetic and environmental factors.
- However, research has pointed to some possible risk factors:
 - co-occurring with other conditions [Fragile X, PKU]
 - sibling recurrence
 - family history of psychiatric disorders
 - adverse birth events
 - specific environmental exposures such as certain medications [valproic acid, thalidomide] or illnesses [rubella] have been associated with subtle effects.

Background

Estimates of population prevalence vary widely within the U.S. and abroad. Two primary factors contributing to this wide variation in prevalence estimates are:

- differences in case finding and ascertainment methods, and
- lack of standardization in evaluating diagnostic criteria for ASDs

Epidemiologic/Prevalence Studies

- Three US studies from 1980's and early 1990's estimated the prevalence of Autistic disorder ranging from 0.3 to 0.4 per 1,000
- 1998 CDC study in Brick Township, NJ estimated the prevalence of Autistic disorder at 4 per 1,000 and the broader Autism spectrum (ASD) at 6.7 per 1,000
- Studies from outside the US in the 1990's estimated the prevalence of Autism/ASD ranging from 1 to 6 per 1,000

Epidemiologic/Prevalence Studies

Two 1999 meta-analyses of autism prevalence studies

- Fombonne (1999)
 - Minimum estimate for ASDs = 1.87/1,000
- Gillberg and Wing (1999)
 - .44/1,000 from 1966-1973
 - .96/1,000 from 1989-1999
- Overall "best-estimate" was 1/1,000 for autism; 2/1,000 for ASDs

Studies Based on ICD 10 or DSM-IV Criteria

Estimates from more recent population-based studies

- Kadesjo et al. (1999)
 - Baird et al. (2000)
 - Chakrabarti & Fombonne (2001)
 - Bertrand et al. (2001)
 - Yeargin-Allsopp et al. (2003)
 - Tebrugge et al. (2004)
 - Baird et al. (2006)
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- Autistic disorder: range between 1.7 – 4.0 per 1,000
 - Autism spectrum: 5.8 to 12.1 per 1,000
 - Average range of recent estimates: 2-6 per 1,000 for all ASDs

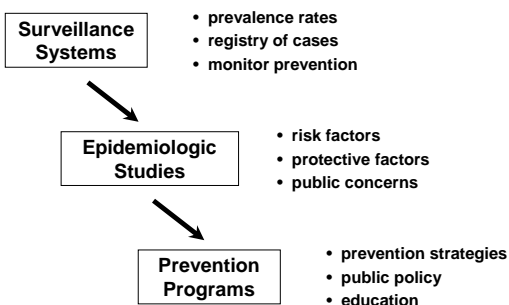
Challenges Interpreting Autism Trends

- Studies conducted in diverse populations using different methods
- Changing diagnostic criteria (DSM-IIIR, DSM-IV, DSM-IV (TR), etc.)
- Expansion of autism to a "spectrum" of disorders
- Changes in level of awareness and use of diagnosis over time
- Changes in service eligibility
- Autism not a required category for U.S. DOE reporting until 1992

Statement of Need

- A more precise estimate of the public health impact of ASDs would serve to inform appropriate and well-coordinated responses by planners at the local and national level.

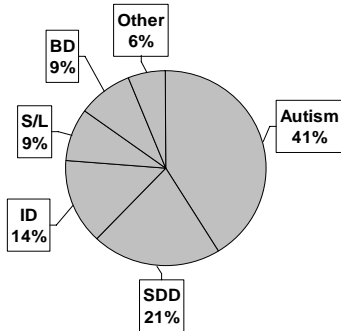
CDC/NCBDDD Role in Birth Defects and Developmental Disabilities Prevention



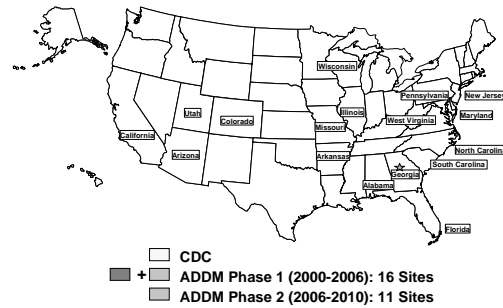
Overcoming Roadblocks in Epidemiologic Knowledge

1. Prevalence
 - Comparable, population-based rates at different sites
 - Changes over time
2. Descriptive epidemiology
 - Characteristics of children with autism
 - Is autism more common in some groups of children than others?
 - Coexisting disabilities
3. Improve consistency in identification of people with autism
 - Education and outreach

Primary Special Education Exceptionality



Autism and Developmental Disabilities Monitoring (ADDM) Network



Mission of the ADDM Network



"Working together to understand the magnitude and characteristics of the population of children with autism and related developmental disabilities to inform science and policy"

ADDM Network Objectives

The objectives of the ADDM Network are:

- Determination of reliable ASD prevalence rates in the participating states
- Establishment of an ASD surveillance system to determine trends in ASD prevalence, and
- Development of population-based data for special studies

This is the first, integrated, multi-state, ASD prevalence investigation in the United States

Strengths

- Large, population-based study of autism
- Multiple-source case ascertainment, including school records
- Coding scheme and systematic review of abstracted information on behaviors to arrive at DSM-IV classification
- Information on presence of other developmental disabilities
- Record review methodology maximizes population coverage

Limitations

- No clinical validation of case status
- Difficult to get severity ratings and to subtype
- Underascertainment of children with milder phenotypes, e.g., PDD-NOS, Asperger's Disorder

ADDM Surveillance Years

Study Year	Birth Year	# Sites	Status
2000	1992	6	Published
2002	1994	14	Published
2004	1996	8	In process
2006	1998	11	In process

Phase 1 Results

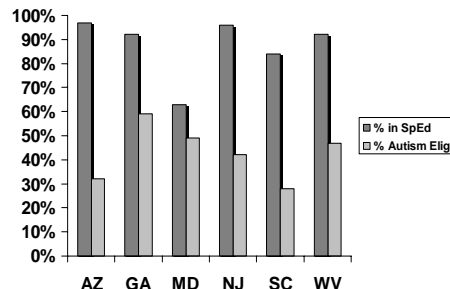
- Three reports from the ADDM Network were published in CDC's MMWR Surveillance Summaries (Feb 9, 2007)
 - ADDM 2000 ASD Prevalence Findings
 - ADDM 2002 ASD Prevalence Findings
 - Evaluation of ADDM Methods



ADDM 2000 Surveillance Year

- The projects monitored ASDs in children at age 8 because previous studies have shown that by this age most children with ASD have been identified for population-based surveillance.
- The six surveillance sites represented approximately 4.5% of US 8-year-old children (born in 1992).
- A total of 1,252 children were identified with an ASD
- The weighted average ASD prevalence across the six participating sites in 2000 was 6.7 per 1,000 8-year-old children.
- However, the total prevalence of ASDs ranged from 4.5 in WV to 9.9 in NJ per 1,000 8-year-old children. The other 4 sites had more similar rates ranging from 5.5 to 6.5 per 1,000 children.

ADDM 2000 Surveillance Year



ADDM 2002 Surveillance Year

- For surveillance year 2002, from the 14 sites representing approximately 10% of US 8-year-old children (born in 1994) – 2,685 children were identified with an ASD.
- The average prevalence across all 14 sites was very similar to 2000 at 6.6 per 1,000.
- There was also a wide range, from 3.3 (AL) to 10.6 (NJ) per 1,000 8-year-old children.
- However, for 12 of the 14 sites ASD prevalence was in a relatively closer range, from 5.2 to 7.6 per 1,000.

ADDM 2002 Surveillance Year

- For every 1 girl with ASD there were approximately 3 to 7 boys identified as cases.
- 5 (including GA) of the 14 sites identified more White non-Hispanic children with ASD than Black non-Hispanic children. ASD prevalence was lower among Hispanic children across all 14 sites.
- Most children identified as ASD surveillance cases were receiving special education services at age 8. The proportion served under a primary exceptionality of autism ranged from 31% (CO) to 74% (MD).
- Between 33% (UT) and 62% (SC) of children with an ASD also had cognitive impairment. Girls were more likely to have ASD and cognitive impairment than boys in most sites reported.

ADDM 2000 & 2002 Surveillance Years

- In both reports, the majority of children identified with an ASD had documented concerns by a parent or professional before 3 years of age, such as concerns about the child's language, social, or play development, but the median age of earliest ASD diagnosis was approximately 4 ½ to 5 ½ years.
- Over the 2 year period from 2000 to 2002, this delay in documented ASD diagnosis did not decline for the 6 sites included in both study years.

ASDs Over 2 Time Points - 6 Sites

- When we compare the six sites with data for two different years, prevalence was stable from 2000 to 2002 in four sites, but increased in 2 sites (slightly in GA and significantly in WV).
- While the stability of ASDs in 4 of the 6 sites is encouraging, the increase in 2 sites is a concern.
- We cannot yet say if ASDs are increasing overall, but these reports provide important baseline information continued monitoring of ASD prevalence in these sites will help us answer that question starting with children born in the 1990's.
- We are continuing to work with the ADDM Network to track the prevalence of ASDs in 8-year-olds in 2004 and 2006 and will report additional results as soon possible.

Conclusions

- The causes of ASDs are not known, but appear to be multiple, complex genetic and environmental interactions. Since we do not know the causes of ASDs, we can not say why the rates of ASD are higher in the NJ site than the other 13 areas of the US included. Continuing to monitor the prevalence of ASD over time and increasing research on multiple causes of ASDs is needed.
- The findings help build awareness of the significant strain placed on families, health care and education systems in providing appropriate identification, intervention, and support for people with an ASD.

Conclusions

- We do not know the prevalence of autism in most communities in the United States, but there are more children diagnosed with autism today than in the past.
- We do not know the etiology of most cases of autism.
- Recent attention to autism issues has the potential to lead to more answers through research.
- CDC is conducting research with many partners in an attempt to understand more about the prevalence, causes, and how to best support communities and families of children with autism and other developmental disabilities.

CDC Information Dissemination

- Launched in September 2002
- Information about ASDs
- Activities of federal agencies
- State activities funded by CDC
- Education, services, and research resources
- Activities to help children use the Internet to learn more about ASD
- Located at www.cdc.gov/ncbddd/dd/ddautism.htm



Other Epidemiologic Studies

Study to Explore Early Development (SEED)

- Funded by CDC; currently being implemented in 6 U.S. sites
- Enrolling children with ASD and 2 comparison groups
- Detailed family histories and biomarkers

Baby Sibling Studies

- High-risk group
- Prospective accounts of pregnancy and early development

Environmental Studies

- Genetic risk factors have been clearly demonstrated through twin and family studies, although the interaction of various environmental exposures is a hot topic of investigation.
- Characteristic traits of autism are rarely seen before 2-3 years of age, but the cascade of events leading to autism probably occurs much earlier, most likely during early gestation.
- Research focused on environmental exposures during critical periods of neurodevelopment should be prioritized.

Environmental Studies – OB

- Obstetric factors associated with autism in select samples point to maternal and paternal age, firstborn child, and various obstetric complications.
- Mediation between immune and nervous systems is another area of study (serotonin, neuropeptides, autoantibodies, cytokines).

Environmental Studies – Exposures

- Up to 50 physical and chemical environmental agents have been linked with neurodevelopmental toxicity in humans. The most likely culprits include heavy metals such as lead and organic mercury, pesticides, and PCBs.
- Windham et al. (2006) suggest a potential association of autism with higher ambient air concentrations of metals and possibly chlorinated solvents in the geographic area of birth residence.
- Limitations of environmental studies typically point to lack of appropriate dose-response measures.

Environmental Studies - Mercury

- The principal source of human exposure to organic mercury is fish consumption.
- The most common route for human exposure to inorganic mercury takes place via dental amalgams.
- The fetal brain is especially susceptible to damage from exposure to organic mercury.
- Levels of methyl mercury documented in “outbreak” studies (fish in Japan, bread in Iraq) were far higher than those recurring from natural dietary exposure.

Environmental Studies - Mercury

- Landmark study by Philip Davidson conducted in controlled environment of the Seychelle Islands (SCDS) concluded only one possible adverse outcome from elevated prenatal exposure to methylmercury (increased time to complete grooved pegboard at 107 months)
- Another controlled-environment study in the Faroe Islands showed more adverse associations between prenatal methylmercury exposure and tests of memory, attention, language, and visual-spatial perception at 7 years of age.
- Recent peer-reviewed studies have all but closed the book on any possible link between exposure to Thimerisol in vaccinations and risk for autism.

CDC Public Health Response

- Partnerships to increase awareness
“Learn the Signs: Act Early” campaign
 - American Academy of Pediatrics (AAP)
 - Autism Coalition
 - Autism Society of America (ASA)
 - Autism Speaks
 - Cure Autism Now (CAN)
 - First Signs
 - National Alliance for Autism Research (NAAR)
 - Organization for Autism Research (OAR)

