THE RELATIONSHIP BETWEEN ADHD AND SCHOOL ATTENDANCE, SCHOOL BEHAVIOR AND SCHOOL PERFORMANCE

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Attention Deficit-Hyperactivity Disorder (ADHD)

- Characterized by one or combination of the following:
  - **Inattention**
  - **Hyperactivity**
  - **Impulsivity**
- Genetic & Non-Genetic Factors
  - Heritability 76%
  - Maternal smoking during pregnancy
  - Exposure to lead/polychlorinated biphenols
- Testing
  - Validated parent & teacher rating scales of behavior in everyday situations in various environments.
  - Adolescents also provide self-report.

Background: US ADHD

Reference: Boyle, C.A., Boulet, S., Schieve, L.A. et al.(2011). Trends in prevalence of developmental disabilities in US children, 1997-2008. *Pediatrics, 127,l1034-1042.*

Prevalence in U.S.

- 5.4 million children in US (9.5%)
- Most common neurobehavioral disorder
- Associated with poor functional outcomes.
- 33% increase in diagnosis 1997-1999.
- Males >females

Overdiagnosis

- Disruptive/hyperactive children
- Longterm stressors and/or abuse can mimic ADHD or make ADHD worse
- Regions with pharmaceutical marketing to providers/parents more likely treated

Underdiagnosis

- Inattentive type
- Females

Key Clinical Points about ADHD

Reference:
Feldman, H. M. (2014). Attention deficit-hyperactivity disorder in children and adolescents. *The New England Journal of Medicine, 30*(9), 848-846. http://www.nejm.org/doi/full/10.1056/NEJMcp1307215#t=article

- **Diagnosis**
  - Characterized by **inattention, hyperactivity, impulsivity** or a combination of theses three
  - Validated parent & teacher rating scales of behavior in everyday situations in various environments.
  - Adolescents provide self-report.
- **Common Coexisting Problems**
  - Learning disorders
  - Anxiety and depression
  - Oppositional behaviors
  - Conduct disturbance
  - Autism Spectrum Disorders
- **Management Plans**
  - Multidisciplinary/family-centered
  - Measurable target objectives that relate to functional outcomes
  - Frequently monitor effectiveness.
- **Treatment**
  - **Stimulant medications**
    - Can reduce the ADHD symptoms without improving functional limitations.
  - **Behavior management**
    - Not as effective as medication in reducing symptoms, but it improves functioning.

Table 1. Criteria for the Diagnosis of Attention Deficit–Hyperactivity Disorder (ADHD) and Hyperkinetic Disorder.

Criteria	DSM-IV*	DSM-5†	ICD-10‡
Symptoms			
Inattention	Six of nine symptoms	Six of nine symptoms in children; five of nine symptoms in adolescents and adults (≥17 yr)	Three of five symptoms
Hyperactivity and impulsivity	Six of nine symptoms	Six of nine symptoms in children; five of nine symptoms in adolescents and adults (≥17 yr)	Three of five symptoms of hyperactivity and one of four symptoms of impulsivity
Age at onset	<7 yr	<12 yr	<7 yr
Settings	Either inattention or hyperactivity–impulsivity in ≥2 settings	≥2 settings	Inattention and hyperactivity at home and school
Duration	≥6 mo	≥6 mo	≥6 mo
Impairment	Clinically significant impairment in social, academic, or occupational functioning	Interference with functioning or development; specify mild, moderate, or severe functional impairment or symptoms	Clinically significant distress or impairment in social, academic, or occupational functioning
Subtypes	ADHD: combined type (inattentive and hyperactive–impulsive), predominantly inattentive type, or predominantly hyperactive type	ADHD: combined inattentive and hyperactive–impulsive presentation, predominantly inattentive presentation, or predominantly hyperactive–impulsive presentation	Hyperkinetic syndrome, hyperkinetic conduct disorder, or other hyperkinetic disorders

* The criteria are based on the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV).[1]
† The criteria are based on the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition (DSM-5).[2]
‡ The criteria are based on the *International Classification of Diseases*, 10th edition (ICD-10).[19]

Feldman, H. M. (2014). Attention deficit-hyperactivity disorder in children and adolescents. *The New England Journal of Medicine, 30*(9), 848-846. http://www.nejm.org/doi/full/10.1056/NEJMcp1307215#t=article

ADHD Prevalence Rates by Country

Reference: Al-Yagon et al. (2014). The proposed changes for DSM-5 for SLD and ADHD: International perspectives-Australia, Germany, Greece, India, Israel, Italy, Spain, Taiwan, United Kingdom and United States. *Journal of Learning Disabilities, 46*(1), 58-72. DOI:10.1177/002221942464353.

COUNTRY	% Prevalence in School-Aged Children
Australia	2.3% - 9.9% (some as high as 20%)
Germany	3% - 7%
Greece	0.015%
India	No official rate
Israel	5% (estimated)
Italy	0.43% – 3.6%
Spain	4.9% (estimated Canary Islands/Mallorca)
Taiwan	4.9%
United Kingdom	3%-5% (1% formally diagnosed)
United Stated	9.5%

Previous Research on ADHD

- **Disparity in urban minority youth *(Basch, C.E.,2011)***
  - More likely to be affected
  - Less likely to be diagnosed and treated
  - Poor academic achievement & greater absenteeism
  - Complexity of toxic stress impacting symptoms and treatment success?

- **ADHD and poor academic achievement (*Daley, D. & Birchwood, J., 2010)***
  - Preschool – compromised readiness for learning due to impulse control, attentional capacity, hyperactivity
  - Elementary, Middle and High School
    - Poor longterm reading achievement from preschool to adolescence
    - Associated with poor grades, poor standardized testing (reading and math)
    - Failure to progress

MEPS: What is it?

- **MEPS = Medical Expenditure Panel Survey**
  - Conducted by Agency for Healthcare Research & Quality (AHRQ)
- **Nationally-representative large-scale in-home surveys since 1996:**
  - Sample Families using family informant
  - Medical providers of families and individuals surveyed
  - Employers of families and individuals surveyed about health insurance.
- **Most complete data on the cost and use of health care and health insurance coverage.**
- **Collection of data on specific health services, and**
  - Frequency of use
  - Cost of these services
  - Payment method
  - Health insurance cost, scope, and breadth available to U.S. workers.

Comparison of MEPS to other Nationally-representative Health Surveys

- **NHIS: National Health Interview Survey**
  - **In-home** self-report (Children data obtained from adult proxies).
  - Not enhanced with medical data. (Self-report data from patient not verified by checks with patient's medical records)

- **BRFSS: Behavioral Risk Factor Surveillance Survey**
  - **Telephone** self-report (only persons ≥ 18)
  - World's largest on-going health survey.
  - Not enhanced with medical data

- **MEPS: Medical Expenditure Panel Survey**
  - **In-home** self-report with data points 3 times per year based on diaries and enhanced with medical data
  - Less problems with telescoping or poor recall
  - Validated with diagnostic and cost data from providers.

ADHD Diagnosis Questions= Self-report + Medical Enhancement

- Does your child currently have ADHD?
  - Self-report – YES response, or
  - Self-report – NO, but diagnosed with ADHD/ADD in past 12 months.

- Each item was recorded twice in a year (Yes=Yes at any one time).

Sample description

MEPS Dataset

- 2008 – 2011 (4 years)
- Total dataset of adults and children
- n= 131,032

Selection Criteria

- Children (5-17 yrs)
- Attended school for the entire calendar year
- n = 29,444

Measurement

Parent In-home Interviews 3 times per year:

- School Attendance by parent diary

- **Parent or other adult completed 13-Item Columbia Impairment Scale (CIS) – 2 items used from CIS**
  - Problems with School Behavior 0-4 (4 is worst): > 1 .
  - Problems with School Work 0-4 (4 is worst): >1
  - Also used Sum of all 13 items: > 15

Examining the Relationship between ADHD & School Performance: Confounding Variables

- **ADHD is more prevalent among students who**
  - Have lower family income
  - Are in a household with a single parent or absent mother
  - Are male

- Previous research shows that each of these variables in strongly related to school behavior and performance.

- Need to use multivariate regression analyses to control for influence of these three variables

Regression Model: Independent variables

- ADHD Diagnosis
  - YES (Includes ADHD and ADD)
  - NO
- Gender
  - Male
  - Female
- Income
  - 200% of FPL or more
  - 100% – 199% of FPL
  - 0 – 99% of FPL
- Lived with both parents or married mother
  - Yes
  - No

Table 1: Family Structure of School-Going Children in the U.S. Ages 5-17 years with ADHD

Child Lived with Mother	Child Lived with Father	Mother Married	% (SE)
NO	YES or NO	N/A	7.6 (0.38)
YES	NO	NO	22.5 (0.76)
YES	YES	NO	3.9 (0.23)
YES	NO	YES	0.9 (0.15)
YES	YES	YES	65.1 (0.99)

NA=not available; SE=standard error of estimate.

Must be enrolled in school for the entire year and who had an ADHD diagnosis recorded

(Note: parent variables, such as marital status, are only available if the parent lived in the same household as the child)

Table 2: Family Structure of Child's Family, by Family Income (School-Going Children in the US Ages 5-17 Years)

Annual Family Income	Child lived with BOTH Parents or with Married Mother % (SE)
All children	**69.9 (0.92)**
<100% of FPL	**45.5 (1.87)**
100 – 199% of FPL	**61.9 (1.42)**
≥ 200% of FPL	**80.0 (0.86)**

%=percentage of all school-going children (5 – 17 years) who lived with both parents or with married mother (and had ADHD diagnosis recorded – either yes or no) within family income level, SE=standard error of estimate.

Table 3: Variables Related to Prevalence of ADHD / ADD in School Going Children Ages 5-17 Years

Variable	LEVEL	Percentage of Children Diagnosed with ADHD		
		% (SE)	β (SE)	OR (95% CI)
All School-Going Children		**10.6 (0.43)**		
Gender	**Male** **Female (Ref)**	**15.3 (0.71)** **5.6 (0.34)**	**0.55 (0.039)**	**3.02(2.59-3.52)****
Family Income as Percentage (%) of FPL	**<100% FPL** **100 – 199% FPL** **>200% FPL (Ref)**	**11.7 (0.73)** **10.6 (0.68)** **10.3 (0.39)**	**0.01 (0.083)** **-0.04 (0.081)**	**1.01(086-1.19)** **0.96(0.82-1.13)**
Children Lived with both parents or married mother	**NO** **YES**	**13.7 (0.66)** **9.2 (0.46)**	**0.44 (0.067)**	**1.57(1.37-1.77)****

%=Percentage of school-going children ages 5-17 years in the US who have a diagnosis of ADHD or ADD, SE=standard error of estimate, β =Estimated regression coefficient, OR =multivariate odds-ratio adjusted for covariates, 95% CI=95% confidence interval.. FPL =Federal Poverty Level for U.S.

Table 4: Logistic Regression: Relationship between ADHD and Children's Health Status

Variable	LEVEL	% of Children with Fair or Poor Health		
		% (SE)	β (SE)	OR (95% CI)
All School-Going Children		**5.1(0.24)**		
ADHD	**YES** **NO (Ref)**	**8.5 (0.77)** **4.7 (0.23)**	**0.58(0.104)**	**1.78(1.45-2.19)****
Gender	**Male** **Female (Ref)**	**5.2 (0.30)** **5.0 (0.33)**	**-0.01(0.040)**	**0.98(0.82-1.16)**
Family Income as Percentage (%) of FPL	**<100% FPL** **100 – 199% FPL** **>200% FPL (Ref)**	**8.9 (0.57)** **6.5 (0.44)** **3.5 (0.23)**	**0.82(0.099)** **0.56(0.089)**	**2.28(1.87-2.78)**** **1.76(1.47-2.10)****
Children Lived with both parents or married mom	**NO** **YES (Ref)**	**7.8 (0.47)** **4.0 (0.25)**	**0.46(0.093)**	**1.58(1.31-1.89)****

%=percentage of school going children ages 5-17 years in the US who are in fair or poor health, SE=standard error of estimate, β=Estimated regression coefficient, OR =multivariate odds-ratio adjusted for covariates, 95% CI=95% confidence interval.

Table 5: Logistic Regression: Relationship between ADHD / ADD and Illness/Injury-Related School Absence (Children 5-17 years)

Variable	LEVEL	Missed 7 or More School Days due to Injury/Illness		
		% (SE)	β (SE)	OR (95% CI)
All School-Going Children		**9.7(0.31)**		
ADHD/ADD	**YES** **NO (Ref)**	**13.3(0.84)** **9.3(0.32)**	**0.50(0.083)**	**1.65(1.40-1.94)****
Gender	**Male** **Female (Ref)**	**9.3(0.42)** **10.2(0.43)**	**-0.09(0.031)**	**0.83(0.74-0.93)****
Family Income as Percent (%) of FPL	**<100% FPL** **100 – 199% FPL** **>200% FPL (Ref)**	**11.7(0.71)** **10.0(0.55)** **9.0(0.41)**	**0.18(0.090)** **0.09(0.079)**	**1.20(1.01-1.43)*** **1.10(0.94-1.27)**
Children Lived with both parents or married mom	**NO** **YES (Ref)**	**12.6(0.55)** **8.5(0.37)**	**0.33(0.073)**	**1.39(1.21-1.61)****

%=percentage of school-going children ages 5-17 years in the US who missed 7 or more school days due to illness/injury, SE=standard error of estimate, β =Estimated regression coefficient, OR = multivariate odds-ratio adjusted for covariates, 95% CI=95% confidence interval.

Table 6: Logistic Regression: Relationship between ADHD and Functional Impairment Among US School Children (Sum of 13 items > 15 (Bird et al)

Variable	LEVEL	Functional Impairment		
		% (SE)	β (SE)	OR (95% CI)
All School-Going Children		**11.0(0.34)**		
ADHD	**YES** **NO (Ref)**	**35.5(1.47)** **8.4(0.29)**	**1.76(0.079)**	**5.82(4.98-6.79)****
Gender	**Male** **Female (Ref)**	**6.5(0.14)** **5.6(0.11)**	**0.01(0.033)**	**1.03(0.90-1.16)**
Family Income as Percent (%) of FPL	**<100% FPL** **100 – 199% FPL** **>200% FPL (Ref)**	**14.2(0.75)** **11.6(0.66)** **9.7(0.42)**	**0.23(0.079)** **0.10(0.080)**	**1.25(1.07-1.46)**** **1.10(0.94-1.29)**
Children Lives with both parents or married mom	**NO** **YES (Ref)**	**16.2(0.66)** **8.7(0.38)**	**0.58(0.072)**	**1.79(1.56-2.01)****

% =percentage of students who had rating > 15 on the sum of the 13 item scale for functional impairment, SE= standard error, β=Estimated regression coefficient, OR = multivariate odds-ratio adjusted for covariates, 95% CI=95% confidence interval..

Table 7: Logistic Regression: Relationship between ADHD / ADD and Problems with School Behavior in the US (SCHLBH42 > 1)

Variable	LEVEL	Problems with School Behavior		
		% (SE)	β (SE)	OR (95% CI)
All School-Age Children		**9.9(0.29)**		
ADHD	**YES** **NO (Ref)**	**29.9(1.32)** **7.7(0.26)**	**1.47(0.079)**	**4.35(3.72-5.07)****
Gender	**Male** **Female (Ref)**	**13.0(0.42)** **6.6(0.32)**	**0.29(0.031)**	**1.71(1.56-1.87)****
Family Income as Percent (%) of FPL	**<100% FPL** **100 – 199% FPL** **>200% FPL (Ref)**	**14.9(0.64)** **11.5(0.59)** **7.7(0.32)**	**0.16(0.064)** **0.12(0.058)**	**1.64(1.42-1.90)**** **1.39(1.21-1.60)****
Children lived with both parents or married mom	**NO** **YES (Ref)**	**16.3(0.60)** **7.0(0.27)**	**0.77(0.066)**	**2.16(1.89-2.45)****

% =percentage of students who had rating > 1 on the variable, problem with school behavior, SE= standard error, β =Estimated regression coefficient, OR = multivariate odds-ratio adjusted for covariates, 95% CI=95% confidence interval.

Table 8: Regression: Relationship between ADHD / ADD and Problems with School Work in the US (SCHPRO42 > 1)

Variable	LEVEL	Problems with School Work		
		% (SE)	β (SE)	OR (95% CI)
All School-Going Children		**16.0(0.37)**		
ADHD/ADD	**YES** **NO (Ref)**	**48.3(1.47)** **12.4(0.32)**	**1.76(0.064)**	**5.79(5.10-6.56)****
Gender	**Male** **Female (Ref)**	**20.2(0.55)** **11.5(0.40)**	**0.23(0.025)**	**1.59(1.44-1.75)****
Family Income as Percent (%) of FPL	**<100% FPL** **100 – 199% FPL** **>200% FPL (Ref)**	**18.3(0.82)** **16.9(0.66)** **14.8(0.49)**	**0.07(0.071)** **0.07(0.067)**	**1.07(0.93-1.23)** **1.08(0.94-1.23)**
Children Lives with both parents or married mother	**NO** **YES (Ref)**	**21.8(0.70)** **13.3(0.42)**	**0.52(0.060)**	**1.68(0.94-1.23)**

% =percentage of students who had rating > 1 on the variable, problem with school work, SE= standard error, β =Estimated regression coefficient, OR = multivariate odds-ratio adjusted for covariates, 95% CI=95% confidence interval.

Key Findings

- **Prevalence of ADHD is 10.6% in school-aged children**
  - **Higher than previous research**
- **Prevalence in Boys is 15.3% (Girls 5.6%)**
  - **Boys almost 3X more likely to have ADHD than girls**
  - **Girls also under-diagnosed**

Statistically-Significant Findings

- ADHD has a **negative impact** on school-aged children:
  - Health status
  - School attendance,
  - Problems with school behavior
  - Problems with schoolwork
  - Functional impairment

Functional Impairment

Univariate Analysis

- Boys **more likely** to have functional impairment than girls
- Boys **not more likely** to have functional impairment than girls after *excluding* children with ADHD.

Multivariate Analysis

- Boys **not more likely** to have functional impairment than girls after *controlling* for ADHD.

Statistically-Significant Findings

School Behavior and School Work

- Univariate Analysis
  - Boys **more likely** than girls to have problems with school behavior and school work.
  - Boys **more likely** than girls to have problems with school behavior and school work after *excluding* children with ADHD
- Multivariate Analysis
  - Boys **more likely** than girls to have problems with school behavior and school work after statistically controlling for ADHD

Key Findings: Role of Genetics and Environment

References: Bornovalova, et al. (2014); Wymbs, et al. (2008).

Results

- Low income families **more likely** to have children with ADHD.
- Children living with both parents or married mother **less likely** to have ADHD.

Link with Previous Research

- ADHD is inherited
- Adults with ADHD have **less schooling** and **lower incomes,** and **are more likely to get divorced.** Is this why children of single parents more likely to have ADHD – Is this genetic?

Implications for Practice & Future Research

- **Sustainable School-Based Health**
  - Person-Centered Health Home (PCMH)
  - Team interventions for ADHD programs
  - Intensive family and group therapy
- **Further research**
  - Heredity versus environment
  - Adult ADHD
  - Disparities in diagnosis
  - Impact & Treatment of Toxic Stress
  - Treatments
    - Nutrition
    - Functional/Chiropractic Neurology
    - Acupuncture
    - Breastfeeding as protective factor
    - Pharmaceutical treatment

Limitations of Study

- **School Attendance**
  - Measured but diary, not school attendance records
- **School Performance**
  - Measured by self-report of informant not grades or test scores
  - Measured by 1-item of the Columbia Impairment Scale (CIS)
- **School Behavior**
  - Measured by 1-item of the Columbia Impairment Scale (CIS)
- **Data does not differentiate:**
  - School type or quality
  - Urban from suburban

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QUESTIONS?