The Changing Epidemiology of Child Mental Health

Stephen L. Buka, ScD
Department of Epidemiology
Brown University

"And it was so typically brilliant of you to have invited an epidemiologist."
LCRN-NAS Mental Health Webinar Series

Challenging Trends of Mental Health Disorders in Children and Youth (September)

Changing Epidemiology of Children’s Mental Health (October)

Developmental Origins of Children Mental Health Disorders – Scientific Advances (November)

Reframing dysfunction/disease as an adaptive response to experiences and exposures (January)

Generating a comprehensive policy response to children’s changing mental health needs (February)

The Early Family Caregiving Environment and Child Mental and Behavioral Health (March)

Primary Care Approach to Prevention (April)

Thank you Erin Kellogg - NAS
Challenging Trends for Improving Health Systems to Address Children’s Mental Health Risks: A Three Horizons Perspective

**Q1:** Trends in children's mental health service needs, use, and disparities

**Q2:** The three horizon perspective and its application to children’s mental health system changes

**Q3:** Emerging models: Towards improved health systems that promote children’s mental health within a life course health and development model
Goals for today’s presentation:

1) Are child and adolescent mental disorders on the rise in the 21st century?

2) Is this grounds for concern?

3) Are there opportunities for prevention?

4) The road ahead...
Dr. Robert Haggerty

concept of “new morbidities”

distinct from the “old morbidities”
(infectious diseases and nutritional problems)

These “new morbidities” are rooted in social difficulties, behavioral problems, and developmental issues, including, but not limited to, autism, ADHD, learning disability, substance use, suicide.

Haggerty, Roghmann, Pless, 1975: Child Health and the Community
The Changing Landscape of Disability in Childhood

Neal Halfon, Amy Houtrow, Kandyce Larson, and Paul W. Newacheck

The Future of Children, Volume 22, No. 1, Spring 2012, pg. 13-42
<table>
<thead>
<tr>
<th>Chronic condition</th>
<th>Number of cases per 100,000 children</th>
<th>Standard error</th>
<th>As a share of all disability cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speech problem</td>
<td>1,815</td>
<td>87.5</td>
<td>23.6</td>
</tr>
<tr>
<td>Learning disability</td>
<td>1,775</td>
<td>86.8</td>
<td>23.1</td>
</tr>
<tr>
<td>ADHD</td>
<td>1,715</td>
<td>74.7</td>
<td>22.3</td>
</tr>
<tr>
<td>Other mental, emotional, or behavioral problem</td>
<td>1,452</td>
<td>75.9</td>
<td>18.9</td>
</tr>
<tr>
<td>Other developmental problem</td>
<td>779</td>
<td>57.1</td>
<td>10.1</td>
</tr>
<tr>
<td>Asthma/breathing problem</td>
<td>632</td>
<td>48.4</td>
<td>8.2</td>
</tr>
<tr>
<td>Other impairment/problem</td>
<td>431</td>
<td>36.5</td>
<td>5.6</td>
</tr>
<tr>
<td>Birth defect</td>
<td>423</td>
<td>35.7</td>
<td>5.5</td>
</tr>
<tr>
<td>Bone/joint/muscle problem</td>
<td>260</td>
<td>31.0</td>
<td>3.4</td>
</tr>
<tr>
<td>Hearing problem</td>
<td>256</td>
<td>29.9</td>
<td>3.3</td>
</tr>
<tr>
<td>Vision problem</td>
<td>244</td>
<td>27.1</td>
<td>3.2</td>
</tr>
<tr>
<td>Mental retardation</td>
<td>207</td>
<td>25.9</td>
<td>2.7</td>
</tr>
<tr>
<td>Epilepsy/seizures</td>
<td>173</td>
<td>24.6</td>
<td>2.3</td>
</tr>
<tr>
<td>Injuries</td>
<td>76</td>
<td>16.4</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Source: Authors’ tabulations of data from the 2008–09 National Health Interview Survey.

Note: Categories are not mutually exclusive—more than one condition could be reported as contributing to the child’s activity limitation.
### Table 4. Leading Causes of Limitation in Usual Activities due to Chronic Conditions, U.S. Children

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Diseases of the respiratory system</td>
<td>1. Diseases of the respiratory system</td>
<td>1. Speech problems</td>
</tr>
<tr>
<td>2. Impairment of speech, special sense, and intelligence</td>
<td>2. Impairment of speech, special sense, and intelligence</td>
<td>2. Learning disability</td>
</tr>
<tr>
<td>3. Mental, nervous system disorders</td>
<td>3. Mental, nervous system disorders</td>
<td>3. ADHD</td>
</tr>
<tr>
<td>4. Diseases of the eye and ear</td>
<td>4. Certain symptoms, ill-defined conditions</td>
<td>4. Other emotional, mental, behavioral problems</td>
</tr>
<tr>
<td>5. Specified deformity of limbs, trunk, and back</td>
<td>5. Deafness and impairment of hearing</td>
<td>5. Other developmental problems</td>
</tr>
</tbody>
</table>


NAS 2015 Monograph: Mental Disorders and Disabilities Among Low-Income Children
Conclusion:

the number of children with disabilities is increasing

the nature and type of health conditions responsible for these impairments is dramatically changing.

**Lack of long-term longitudinal cohort data** ... hampers our ability to fully understand their causes and inhibits formation of more strategic, responsive, and effective policies, programs, and interventions.

Need to strengthen existing data systems and develop programmatic enhancements to reduce the prevalence and severity of childhood disability.

Special attention should be given to eliminating long-standing disparities in the prevalence of disability.
Are child and adolescent mental health problems increasing in the 21st century? A systematic review

William Bor¹,², Angela J Dean¹,², Jacob Najman³ and Reza Hayatbakhsh³

William Bor, Mater Children’s Hospital, South Brisbane, QLD 4101, Australia.
Up to one in five children experience mental health problems.

Social and cultural factors may influence emergence of mental health problems.

The 21st century has led to changes in many of these factors, but it is unclear whether rates of internalizing and externalizing problems have also changed in recent cohorts of young people.
METHOD:
Comprehensive literature search:

cohort or population studies,

changes in mental health of children over time, repeating same methods over time,

participants \( \leq 18 \) years,

change 10+ years,

data in the 21st century compared to data in the 20th century.
Figure 1. Flow chart of reviewed articles.

- 2349 abstracts identified and reviewed
- 2309 abstracts excluded, unrelated to time trends in mental health symptoms in children or adolescents
- 51 potentially relevant articles retrieved
- 36 articles excluded: no data from 21stC (n=7), no new data (n=7), no repeated measure of mental health symptoms (n=6), not a population sample (n=5), sample age ≥ 18 years (n=5), no data reported (n=3), comparison period < 10 years (n=2), no statistical comparisons (n=1).
- 15 articles met criteria for review
- Searching reference lists and other websites: 4 additional studies eligible for review
- 19 studies included in review
<table>
<thead>
<tr>
<th>Source</th>
<th>Age Group</th>
<th>Sampling Frame</th>
<th>Country</th>
<th>Years</th>
<th>Sample Size</th>
<th>Key Assessment Instruments</th>
<th>Internalizing Symptoms Boys and girls</th>
<th>Girls</th>
<th>Boys</th>
<th>Externalizing Symptoms Boys and girls</th>
<th>Girls</th>
<th>Boys</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sourander et al. (2012)</td>
<td>Adolescents (13–17 years)</td>
<td>Schools</td>
<td>Finland</td>
<td>1998–2008</td>
<td>1458–1569</td>
<td>SDQ (self-report)</td>
<td>No change</td>
<td>No change</td>
<td>No change</td>
<td>↓ (d=−0.30) (hyperactivity); no change (conduct)</td>
<td>No change</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Tick et al. (2008)</td>
<td>Adolescents (11–18 years)</td>
<td>Population</td>
<td>Netherlands</td>
<td>1993–2003</td>
<td>1120–810</td>
<td>YSR</td>
<td>↑ (d=0.27)</td>
<td>↓ (d=−0.14)</td>
<td>No change</td>
<td>No change</td>
<td></td>
<td>(d=−0.33)</td>
<td>6</td>
</tr>
<tr>
<td>Centers for Disease Control and Prevention (2012)</td>
<td>Adolescents (14–18 years)</td>
<td>Schools</td>
<td>USA</td>
<td>1991–1993</td>
<td>At least 10,000 at each time-point</td>
<td>Items developed for this study: 5 items (physical fights or use of weapons)</td>
<td>No change</td>
<td>↓ (d=−0.31)</td>
<td>No change</td>
<td></td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Collishaw et al. (2012)</td>
<td>Adolescents (16–17 years)</td>
<td>Population</td>
<td>UK</td>
<td>1986–2006</td>
<td>4524–716</td>
<td>Rutter Questionnaire (parent)</td>
<td>↑ (d=0.12)</td>
<td>↑ (d=0.17)</td>
<td>No change</td>
<td>No change</td>
<td></td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

BITSEA, Brief Infant Toddler Social Emotional Assessment; CBC, Child Behaviour Checklist; CBCL, Child Behavior Checklist; GHQ, General Health Questionnaire; HBSC, Health Behaviours among School Children Study; MMPI, Minnesota Multiphasic Personality Inventory; SDQ, Strengths and Difficulties Questionnaire; TRF, Teacher Report Form; YSR, Youth Self Report.
Conclusion: The systematic review of secular changes in mental health symptoms suggests that the burden of internalizing symptoms is increasing in adolescent girls. {from 20th century to 21st century} increases were not restricted to Western nations.

unclear whether this is also occurring for boys.

This finding has a number of public health implications...reinforces the importance of prevention, identification, and treatment programmes.

essential for further research to regularly monitor trajectories of mental health symptoms in young people to permit appropriate public health responses for prevention and treatment
Thomas Friedman and 2007
Few studies after 2007, but no evidence of greater increases in rates of mental problems among those 4 later studies.

# studies by year of last assessment – Bor et al.
Hypothesis: Negative Facebook experiences can lead to or exacerbate depressive symptoms.
Follow-up of 17,000 pregnancies: Boston, Providence cohorts of the Collaborative Perinatal Project (born 1960-66)

60 year follow-up

Original study parents (G1); CPP offspring (G2); their offspring (G3)

Mental illness, substance abuse, CVD, cognitive decline, others.

Laboratory-based clinical assessments

Longitudinal follow-up of G3 adolescents

Buka et al.
Social Media Project Data Collection

- Baseline diagnostic interviews including depression symptoms and diagnosis ~ 2002
- Re-located about 10 years later
- N= 264 completed 15-20 minute web-based survey
- Facebook use, demographics
- Center for Epidemiologic Studies Short Depression Scale (CES-D 10)

N = 564 G3s
Avg. Age: 14

Age: 20-30
### Odds of serious depressive symptoms associated with different types of negative Facebook experiences

<table>
<thead>
<tr>
<th>Lifetime experience</th>
<th>N = 264 (%)</th>
<th>Depressive symptoms</th>
<th>Adjusted (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bullying or meanness</td>
<td>115 (44)</td>
<td>2.75 (1.53, 4.91)</td>
<td>3.45 (1.73, 6.88)</td>
</tr>
<tr>
<td>Unwanted contact</td>
<td>161 (61)</td>
<td>2.08 (1.12, 3.88)</td>
<td>2.51 (1.20, 5.28)</td>
</tr>
<tr>
<td>Misunderstandings</td>
<td>161 (61)</td>
<td>2.25 (1.19, 4.24)</td>
<td>2.83 (1.31, 6.09)</td>
</tr>
<tr>
<td>Any negative experience</td>
<td>217 (82)</td>
<td>2.54 (1.01, 6.39)</td>
<td>3.21 (1.11, 9.31)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Past-year experience</th>
<th>Depressive symptoms</th>
<th>Adjusted (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bullying or meanness</td>
<td>44 (18)</td>
<td>1.40 (.67, 2.93)</td>
</tr>
<tr>
<td>Unwanted contact</td>
<td>94 (37)</td>
<td>1.86 (1.04, 3.35)</td>
</tr>
<tr>
<td>Misunderstandings</td>
<td>95 (38)</td>
<td>2.12 (1.19, 3.80)</td>
</tr>
<tr>
<td>Any negative experience</td>
<td>143 (55)</td>
<td>2.21 (1.19, 4.09)</td>
</tr>
</tbody>
</table>

Adjusted ORs controlling for sex, race/ethnicity, social support, baseline adolescent depressive episode, parental depression, average monthly income, educational attainment, employment, daily Facebook use

- Negative Facebook experiences are associated with increased levels of and risk for depression
Limitations

- Temporality of negative experiences and depression
- Recall Bias
- Self-reports
- Generalizability

Strengths

- Controlled for adolescent depressive episode, parental depression
- Depressive history assessed prior to FB
- Test-retest reliability (N=117)

- Negative Facebook experiences are associated with increased levels of and risk for depression
So what else do we know about the potential rise in child and adolescent mental disorders since 2007?
Mental Health Surveillance Among Children — United States, 2005–2011

May 2013
summarizes information about ongoing federal surveillance systems of mental disorders and indicators of mental health among children living in the United States,

presents estimates of childhood mental disorders and indicators from these systems during 2005–2011,

explains limitations and identifies gaps in information while presenting strategies to bridge those gaps.
Surveillance during 1994–2011 has identified increased reported prevalence of ADHD, ASDs, and bipolar disorder, as well as changes in patterns of drug use, among children.

NHIS data indicate an average annual increase in ADHD diagnosis of 3% during 1997–2006,

NSCH data indicate a 21.8% increase in ADHD during 2003–2007.

NHIS data indicate a nearly fourfold increase in autism from 1997–1999 to 2006–2008; NSCH data also indicate increases in autism.
Changes over time might be associated with:

- actual change in prevalence,
- changes in case definition,
- changes in public perception
- improvements in diagnosis

No dedicated surveillance system on mental health in children exists. Available data do not allow for an overall estimate of the prevalence of all childhood mental disorders.
So extremely limited surveillance data on mental disorders (and other ‘new morbidities’)... 

sadly, we can count deaths (mortality)....

(keep an eye on 2007)
Death Rates Due to Suicide and Homicide Among Persons Aged 10–24: United States, 2000–2017

Sally C. Curtin, M.A., and Melodie Heron, Ph.D.
After a stable period from 2000 to 2007, suicide rates for persons aged 10–24 increased from 2007 to 2017, while homicide rates increased from 2014 to 2017.
The suicide rate for persons aged 10–14 declined from 2000 (1.5) to 2007 (0.9), and then nearly tripled from 2007 to 2017 (2.5).

Figure 2. Suicide and homicide death rates among children and adolescents aged 10–14: United States, 2000–2017.

1Significant decreasing trend from 2000 to 2007; significant increasing trend from 2007 to 2017, p < 0.05.
2Rate significantly higher than the rate for homicide from 2000 to 2005 and from 2009 to 2017, p < 0.05.
3Significant decreasing trend from 2000 to 2017, p < 0.05.
Suicide and homicide death rates for persons aged 15–19 have increased recently during 2000–2017, from 2007 to 2017 for suicide and from 2014 to 2017 for homicide.

Figure 3. Suicide and homicide death rates among adolescents aged 15–19: United States, 2000–2017

1Significant increasing trend from 2000 to 2007; significant decreasing trend from 2007 to 2014; significant increasing trend from 2014 to 2017, p < 0.05.
2 Stable trend from 2000 to 2007; significant increasing trend from 2007 to 2017 with different rates of change over time, p < 0.05.
3 Rate significantly lower than the rate for homicide from 2000 to 2010 and significantly higher from 2011 to 2017, p < 0.05.
Surveillance data limited … what about health care utilization?

The Increasing Rate of Childhood Mental Illnesses And Associated Healthcare Costs in the US

Joseph Tkacz, MS and Brenna L. Brady, PhD
IBM Watson Health, Bethesda, MD, USA

Poster presented ISPOR2019, May 18-22, 2019, New Orleans, LA, USA
IBM® MarketScan® Commercial and Medicare Database (2010-2017)

- contains de-identified patient level administrative claims records including inpatient, outpatient, and outpatient prescription data of several million individuals and their dependents annually covered under a variety of fee-for-service and capitated health plans*;

seven annual samples (2011 – 2017) of children aged 4-17;

continuous medical and pharmacy enrollment for the calendar year of interest and the year prior.

* Does not include Medicaid
Mental illness diagnoses were identified via ICD-9 and ICD-10 diagnostic codes.

Prevalent patients - mental health diagnosis in the calendar year of interest, regardless of the presence of prior diagnoses.

Incident patients - mental health diagnosis in the calendar year of interest, but no mental health diagnoses during the year prior.
The incidence of mental illness increased 19% and prevalence 30% 2011 - 2017
Over the study period, the prevalence of depression (55.7%), anxiety (85.3%), attention/conduct disorders (25.5%), and developmental disorders (66.8%) all increased (Figure 3).
Figure 2. Prevalence of Mental Illness Over Time by Gender

Males significantly more likely to present with a mental illness in all years ($p < 0.001$)
<table>
<thead>
<tr>
<th>Demographics</th>
<th>Calendar Year 2011 Sample N=538,724</th>
<th>Calendar Year 2017 Sample N=431,616</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>SD/%</td>
<td>SD/%</td>
</tr>
<tr>
<td>Age Category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early Childhood (4-8)</td>
<td>24.7%</td>
<td>22.6%</td>
</tr>
<tr>
<td>Middle Childhood (9-11)</td>
<td>21.4%</td>
<td>20.9%</td>
</tr>
<tr>
<td>Adolescence (12-17)</td>
<td>53.9%</td>
<td>56.6%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>58.9%</td>
<td>55.4%</td>
</tr>
<tr>
<td>Female</td>
<td>41.1%</td>
<td>44.6%</td>
</tr>
<tr>
<td>Geographic Region</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>19.9%</td>
<td>19.1%</td>
</tr>
<tr>
<td>North Central</td>
<td>26.0%</td>
<td>21.7%</td>
</tr>
<tr>
<td>South</td>
<td>35.3%</td>
<td>45.0%</td>
</tr>
<tr>
<td>West</td>
<td>17.5%</td>
<td>13.7%</td>
</tr>
<tr>
<td>Missing</td>
<td>1.3%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Mental Health Diagnoses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol Abuse</td>
<td>1.4%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Substance Abuse/Dependence</td>
<td>3.8%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Depression</td>
<td>14.5%</td>
<td>17.3%</td>
</tr>
<tr>
<td>Anxiety</td>
<td>28.4%</td>
<td>40.3%</td>
</tr>
<tr>
<td>Bipolar Disorder</td>
<td>3.0%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Eating Disorder</td>
<td>0.9%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Attention/Conduct Disorder</td>
<td>49.8%</td>
<td>47.9%</td>
</tr>
<tr>
<td>Schizophrenia</td>
<td>0.1%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Developmental Disorder</td>
<td>10.5%</td>
<td>13.4%</td>
</tr>
</tbody>
</table>
In all calendar years assessed, the presence of a mental health diagnosis was associated with annual healthcare costs that were at least double that of the control population ($p < 0.001$; Figure 5).
Figure 1: US population distribution by insurance status – 2014

Racial Disparities in Pediatric Mental Health-Related Emergency Department Visits: A Five-Year Multi-Institutional Study


The Pediatric Health Information System®, a comparative pediatric database, includes clinical and resource utilization data for inpatient, ambulatory surgery, emergency department and observation unit patient encounters for more than 45 children's hospitals.

293,198 patients with mental health-related diagnoses in pediatric EDs (58,640/year).

Mean age 13.3 (SD 3.9) years

Majority were publicly insured (54.7%).

Higher rates of mental health-related diagnoses among non-Whites.
Rates of mental health-related ED visits increased significantly over time

50.4 visits per 100,000 children in 2012 compared to 78.5 in 2016 for all race/ethnic groups

Mental health-related PED visits increased at a higher rate among NH black (β=11.9) compared to NH white (β=6.6) children (p<0.05)

Summary of trends in 21st Century

Limited available national surveillance data in US

However...published literature, CDC surveillance estimates, insurance claims, emergency department visits indicate:

- Increase in anxiety disorders among females
- Dramatic increases in completed suicides since 2007
- Increases in reported rates of ADHD, autism (CDC)
- Increases in medical claims for depression, anxiety, ADHD, developmental disorders
- Increases in emergency department visits for mental disorders

Evidence that adverse social media experiences are associated with increased rates of serious depressive symptomatology.

Adverse child experiences on the rise.
So...rates of and treatment for child and adolescent disorders are on the rise...

how concerned should we be?

Developmental Implications

a) looking forward
b) looking backward
Direct Impact - family, self Cost ($300 billion annually) Indirect Impact (classmates, society) Etc.

**Figure 5. Healthcare Costs Associated with Mental Illness**

<table>
<thead>
<tr>
<th>Year</th>
<th>Mental Illness Cohort</th>
<th>Control Cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>$5,506</td>
<td>$1,712</td>
</tr>
<tr>
<td>2012</td>
<td>$5,723</td>
<td>$1,780</td>
</tr>
<tr>
<td>2013</td>
<td>$6,011</td>
<td>$1,831</td>
</tr>
<tr>
<td>2014</td>
<td>$6,211</td>
<td>$1,857</td>
</tr>
<tr>
<td>2015</td>
<td>$6,694</td>
<td>$1,975</td>
</tr>
<tr>
<td>2016</td>
<td>$6,995</td>
<td>$2,085</td>
</tr>
<tr>
<td>2017</td>
<td>$7,123</td>
<td>$2,110</td>
</tr>
</tbody>
</table>
Child and adolescent mental health

Worldwide 10-20% of children and adolescents experience mental disorders. Half of all mental illnesses begin by the age of 14 and three-quarters by mid-20s. Neuropsychiatric conditions are the leading cause of disability in young people in all regions. If untreated, these conditions severely influence children’s development, their educational attainments and their potential to live fulfilling and productive lives. Children with mental disorders face major challenges with stigma, isolation and discrimination, as well as lack of access to health care and education facilities, in violation of their fundamental human rights.
Age of onset of mental disorders: A review of recent literature

Ronald C. Kessler, PhD, G. Paul Amminger, MD, Sergio Aguilar-Gaxiola, MD, PhD, Jordi Alonso, MD, Sing Lee, MD, and T. Bedirhan Ustun, MD

World Mental Health Survey Initiative

coordinated population surveys from 16 countries

conducted face-to-face by trained lay interviewers in multi-stage household probability samples.

A total of 85,052 interviews using the WHO Composite Diagnostic Interview (CIDI)
Age of onset of mental disorders: A review of recent literature

Roughly half of all lifetime mental disorders in most studies start by the mid-teens and three-fourths by the mid-20s.

Later onsets are mostly secondary conditions.

Severe disorders are typically preceded by less severe disorders that seldom are brought to clinical attention.
So, thinking developmentally and looking forward, we should be concerned about child and adolescent mental disorders – not only for their immediate burden – but for consequences in later life.

What about looking backward (at developmental origins)?
# Child and adolescent psychiatric genetics

Johannes Hebebrand · André Scherag · Benno G. Schimmelmann · Anke Hinney

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Heritability estimates (%)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDD</td>
<td>90</td>
<td>[139]</td>
</tr>
<tr>
<td>Enuresis</td>
<td>67–70</td>
<td>[54]</td>
</tr>
<tr>
<td>Conduct disorder</td>
<td>53</td>
<td>[51]</td>
</tr>
<tr>
<td>OCD</td>
<td>47</td>
<td>[25]</td>
</tr>
<tr>
<td>Anxiety disorders</td>
<td>30–40</td>
<td>[33]</td>
</tr>
<tr>
<td>ADHD</td>
<td>60–80</td>
<td>[64]</td>
</tr>
<tr>
<td>Anorexia nervosa</td>
<td>48–88</td>
<td>[141]</td>
</tr>
<tr>
<td>Bulimia nervosa</td>
<td>28–83</td>
<td>[141]</td>
</tr>
<tr>
<td><strong>Schizophrenia</strong></td>
<td><strong>73–90</strong></td>
<td>[160]</td>
</tr>
<tr>
<td>Bipolar disorder</td>
<td>60–85</td>
<td>[149]</td>
</tr>
<tr>
<td>Major depression</td>
<td>31–42</td>
<td>[159]</td>
</tr>
</tbody>
</table>

*OCD* Obsessive Compulsive Disorder; *PDD* Pervasive Developmental Disorders (including autistic disorder, Asperger disorder, disintegrative disorder, and PDD not otherwise specified); *ADHD* Attention Deficit/Hyperactivity Disorder
Independent of genes expressed in brain, associations were enriched among genes expressed in tissues that have important roles in immunity, providing support for the speculated link between the immune system and schizophrenia.
Convergence of placenta biology and genetic risk for schizophrenia

Gianluca Ursini\textsuperscript{1,2,3}, Giovanna Punzi\textsuperscript{1,2}, Qiang Chen\textsuperscript{1}, Stefano Marenco\textsuperscript{4,5}, Joshua F. Robinson\textsuperscript{6}, Annamaria Porcelli\textsuperscript{2}, Emily G. Hamilton\textsuperscript{6}, Marina Mitjans\textsuperscript{7}, Giancarlo Maddalena\textsuperscript{2}, Martin Begemann\textsuperscript{7}, Jan Seidel\textsuperscript{7}, Hidenaga Yanamori\textsuperscript{8}, Andrew E. Jaffe\textsuperscript{1,9}, Karen F. Berman\textsuperscript{4}, Michael F. Egan\textsuperscript{10}, Richard E. Straub\textsuperscript{1}, Carlo Colantuoni\textsuperscript{11,12,13}, Giuseppe Blasi\textsuperscript{1,2}, Ryota Hashimoto\textsuperscript{10,14}, Dan Rujescu\textsuperscript{15}, Hannelore Ehrenreich\textsuperscript{7}, Alessandro Bertolino\textsuperscript{2} and Daniel R. Weinberger\textsuperscript{1,3,11,12,13,16*}
"This should be an eye-opening study, especially for anyone who thinks disease risk is all genetic," said Janine LaSalle, of the University of California, Davis, who studies the genetics of autism and was not involved in the schizophrenia research. "Genes don’t exist in a lock-box away from everything else that happens to you."
“We need to create a new risk score for schizophrenia, incorporating not only genes but also placental health,” Weinberger said.

“The odds of becoming schizophrenic based on your polygenic risk score is more than 10 times greater with these early-life complications than without them.”

But the genes-only risk score, “in the absence of a serious complicated pregnancy, explains very little risk for schizophrenia — less that 2 percent” of the chance the individual will develop the disease.
Polygenic Risk Score 1 (PRS1, i.e. p<5e-08)

**Fig. 1.** Polygenic Risk Score 1 (PRS1), Early Life Complications scores (ELCs) and schizophrenia. A) Boxplots of the realizations when PRS1, contiguously determined from all ELCs showing. 

***

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Fig. 1. Polygenic Risk Score 1 (PRS1), Early Life Complications scores (ELCs) and schizophrenia. A) Boxplots of the real data. B) Scatter plots showing the relationship between Polygenic Risk Score 1 (PRS1, i.e. p<5e-08) and ELCs. ELC: Early Life Complications.
Fig. 2. History of ELCs affects the variance explained by the most significant PRS's (i.e. PRS1 and ... holder for this preprint (which. http://dx.doi.org/10.1101/147207doi: bioRxiv preprint first posted online Jun. 7, 2017;

prs1 = polygenic risk score 1
Polygenic risk scores are weak predictors of risk for schizophrenia (R-square) in the absence of early life complications
Fig. 3. Schizophrenia risk genes dynamically modulated in placenta drive the interaction between genetic risk and ELCs.
So, thinking developmentally and looking forward, we should be concerned about child and adolescent mental disorders – not only for their immediate burden – and for consequences in later life.

But also to understand their developmental origins / etiology.
Summary & Implications

Even the most highly heritable psychiatric disorders (eg schizophrenia, autism) are likely to have major environmental components that operate during pregnancy and early life.

The conditions that contribute to the etiology of child and adolescent mental disorders; and the disorders themselves are increasing in the 21st century.

These disorders have substantial immediate and long-term consequences.

Greater emphasis is needed on: surveillance; course; cost; and

- PREVENTION
An Approach to Framing the Issues
Three Horizons Thinking for Children’s Mental Health

Children’s Mental Health

1st Horizon
- Abundance (declining)
- Knowledge Expansion
- Science-based programs, therapies and services; system fragmentation

2nd Horizon
- Constraints & Scarcity
- Messy Mix
- Short vs. long term responses

3rd Horizon
- New Abundance?
- Viable Sustainability
- Transformed health systems

Degree of strategic fit with external environment

HORIZON 1
- Availability of reliable and valid screening & diagnostic tools
- Robust science base on effective treatment & services
- Fed gov't funding support on neurodevelopment, treatment and mechanisms

HORIZON 2
- Shift from FFS to mgd care
- Digital technologies
- Continuous quality improvement, msmt feedback & accountability
- Population health experiments w/awareness of social risk factors and accountability

HORIZON 3
- Population health system for all children
- Lifecourse perspective
- Seamless, flexible and responsive with shared responsibility for outcomes

Source: Figure adapted from Curry et al. 2009.
VISION

NIMH envisions a world in which mental illnesses are prevented and cured.

MISSION

To transform the understanding and treatment of mental illnesses through basic and clinical research, paving the way for prevention, recovery, and cure.
NIMH: Four High Level Strategic Objectives

1) Define the mechanisms of complex behaviors.

2) Chart mental illness trajectories to determine when, where, and how to intervene.

3) Strive for prevention and cures.

4) Strengthen the public health impact of NIMH-supported research.
STRATEGY 3.1: DEVELOP NEW TREATMENTS BASED ON DISCOVERIES IN GENOMICS, NEUROSCIENCE, AND BEHAVIORAL SCIENCE

STRATEGY 3.2: DEVELOP WAYS TO TAILOR EXISTING AND NEW INTERVENTIONS TO OPTIMIZE OUTCOMES

STRATEGY 3.3: TEST INTERVENTIONS FOR EFFECTIVENESS IN COMMUNITY PRACTICE SETTINGS
The Substance Abuse and Mental Health Services Administration leads efforts to advance the behavioral health of the nation and to improve the lives of individuals living with mental and substance use disorders, and their families.

1. Combating the Opioid Crisis through the Expansion of Prevention, Treatment, and Recovery Support Services

2. Addressing Serious Mental Illness and Serious Emotional Disturbances

3. Advancing Prevention, Treatment, and Recovery Support Services for Substance Use

4. Improving Data Collection, Analysis, Dissemination, and Program and Policy Evaluation

5. Strengthening Health Practitioner Training and Education
DISCUSSION AND NEXT STEPS:
Three Horizons Thinking for Children’s Mental Health

Children’s Mental Health

<table>
<thead>
<tr>
<th>Abundance (declining)</th>
<th>Constraints &amp; Scarcity</th>
<th>New Abundance?</th>
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</thead>
</table>

1st Horizon

Knowledge Expansion
Science-based programs, therapies and services; system fragmentation

2nd Horizon

Messy Mix
Short vs. long term responses

3rd Horizon

Viable Sustainability
Transformed health systems

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Source:
Figure adapted from Curry et al. 2008.
END OF PRESENTATION
Under-18 U.S. Population: 73,708,179

Children in Households Under 200% FPL: 32,269,000

Moderate/Severe ADHD Prevalence: 4.6%

Pool of Children Potentially Eligible for SSI for ADHD: 1,484,374

Pool of Children Receiving SSI for ADHD: 225,035