



HEALTH BARRIERS TO LEARNING: The Prevalence and Educational Consequences in Disadvantaged Children



A Review of the Literature

Contributions & Acknowledgements

This report was prepared by Children’s Health Fund (CHF). CHF’s mission is to deliver high-quality healthcare to America’s most disadvantaged children. We envision a future where all children in America get the care they need to be healthy and ready to reach their potential in learning and in life.

For more information, please go to: www.childrenshealthfund.org

Authors of this report are:

Delaney Gracy, MD, MPH, Chief Medical Officer & Senior Vice President
Anupa Fabian, MPA, Director of Evaluation
Virginia Roncaglione, MSc, Evaluation Associate
Katie Savage, MPH, Program Officer
Irwin Redlener, MD, Co-Founder and President

We are grateful to the following content experts for their review and insights:

Health and Education: **Chuck Basch**, BS, MS, PhD, Richard March Hoe Professor of Health and Education, Teachers College, Columbia University

Asthma: **John C. Carlson**, MD, PhD, Director of Pediatric Residency and Allergy/Immunology Fellowship, Tulane University School of Medicine

Vision: **Chandak Ghosh**, MD, MPH, Senior Medical Advisor for Federal Policy/Ophthalmologist, Department of Health and Human Services (DHHS) / Health Resources and Services Administration (HRSA) Office of Regional Operations

Hearing: **Karen L. Anderson**, PhD, Director, Supporting Success for Children with Hearing Loss

Dental: **Richard Neiderman**, DMD, MA, BS, Professor, Chairperson, Epidemiology and Health Promotion, NYU College of Dentistry

Hunger: **Duke Storen**, MA Public Policy, Senior Director, Research, Advocacy, and Partnership Development, Share Our Strength

Lead: **Nathan Graber**, MD, MPH, Adjunct Faculty, Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai

Mental Health: **Alyson McCain**, PhD, Clinical Psychologist, Baton Rouge Children’s Health Project
Denise Sellers, PhD, Clinical Psychologist, Baton Rouge Children’s Health Project

Policy: **Dennis Johnson**, MPS, Executive Vice President, Policy & Advocacy, Children’s Health Fund

Health Information Technology: **Jeb Weisman**, PhD, Chief Information Officer, Children’s Health Fund

We would also like to acknowledge:

Chenyue Zhao for his preliminary review of the literature on Health Barriers to Learning,
Tinotenda Muchena for her invaluable assistance in fact-checking and references,
Jennifer Pruitt for her meticulous editing,
Katie MacKenzie for creating charts,
and **Dennis Walto** for his leadership in this project.

Published January, 2017.

Contents

EXECUTIVE SUMMARY	<u>5</u>
I. INTRODUCTION	<u>11</u>
II. BACKGROUND: ADVERSE CHILDHOOD EXPERIENCES	<u>14</u>
Definitions	<u>14</u>
Prevalence	<u>15</u>
Unmet need for services	<u>16</u>
Impact on mental and behavioral health	<u>16</u>
Impact on learning	<u>17</u>
III. HEALTH BARRIERS TO LEARNING	<u>19</u>
1. UNCONTROLLED ASTHMA	<u>19</u>
Definitions	<u>19</u>
Prevalence	<u>19</u>
Unmet need for services	<u>21</u>
Impact on learning	<u>22</u>
Conclusions	<u>24</u>
2. UNCORRECTED VISION PROBLEMS	<u>25</u>
Definitions	<u>25</u>
Prevalence	<u>26</u>
Unmet need for services	<u>27</u>
Impact on learning	<u>29</u>
Conclusions	<u>31</u>
3. UNADDRESSED HEARING PROBLEMS	<u>32</u>
Definitions	<u>32</u>
Prevalence	<u>33</u>
Unmet need for services	<u>34</u>
Impact on learning	<u>35</u>
Conclusions	<u>37</u>
4. DENTAL PAIN	<u>38</u>
Definitions	<u>38</u>
Prevalence	<u>38</u>
Unmet need for services	<u>39</u>
Impact on learning	<u>41</u>
Conclusions	<u>43</u>
5. PERSISTENT HUNGER	<u>44</u>
Definitions	<u>44</u>
Prevalence	<u>45</u>
Unmet need for services	<u>46</u>
Impact on learning	<u>47</u>
Conclusions	<u>49</u>

6.	CERTAIN MENTAL HEALTH AND BEHAVIORAL PROBLEMS	<u>50</u>
	Definitions	<u>50</u>
	Prevalence	<u>50</u>
	Unmet need for services	<u>52</u>
	Impact on learning	<u>54</u>
	ADHD	<u>55</u>
	Conclusions	<u>57</u>
7.	EFFECTS OF LEAD EXPOSURE	<u>58</u>
	Definitions	<u>58</u>
	Prevalence	<u>59</u>
	Unmet need for services	<u>59</u>
	Impact on Learning	<u>60</u>
	Conclusions	<u>62</u>
IV.	DISCUSSION AND RECOMMENDATIONS	<u>63</u>
	Discussion	<u>63</u>
	Recommendations	<u>66</u>
V.	REFERENCES	<u>70</u>

EXECUTIVE SUMMARY

Maximizing the educational experience and success of every child in America must be a priority and a critical national goal. Vitally important for each child and family as a pathway out of poverty, the issue is also larger. If the nation is to remain economically stable, prosperous, innovative, and influential internationally over the coming decades, it is essential that children are healthy and well-educated, graduate from high school on time, and perform at their full potential. Unfortunately, many children are not ready even for kindergarten, and even less for the rigors of the educational demands later in life.

Poor educational attainment has its roots in early childhood. Many children are not adequately prepared to read at grade level in the early elementary years; they subsequently struggle to perform in middle school, and are unable to graduate from high school on time. There are many reasons for less than optimal academic performance, especially for children who live with persistent adversities or chronic stress. However, too often, among these reasons are health conditions that have been unrecognized or undermanaged.



These conditions, referred to in this report as “Health Barriers to Learning” (HBLs), include the following: uncontrolled asthma, uncorrected vision problems, unaddressed hearing loss, dental problems, persistent hunger, certain untreated mental health and behavioral problems, and effects of lead exposure. Left untreated or undermanaged, HBLs can adversely affect children’s ability to see, hear and pay attention in the classroom, their ability and motivation to learn, their attendance, their academic performance, and even their chances of graduating from high school. These particular

HBLs have been identified due to their prevalence, evidence of their link to learning, and availability of effective screening and treatment approaches.

A number of underlying factors contribute to the higher prevalence and impact of HBLs among economically disadvantaged children. Poor access to health care and quality schools, excessive absenteeism, and other social issues affect development, learning, and health. Among the most important factors are **Adverse Childhood Experiences**, or “**ACEs**.” Adverse Childhood Experiences are events during childhood that increase the short- and long-term risk of negative health and social outcomes. These experiences include the child suffering physical, psychological, or sexual abuse, and the presence of substance abuse, mental illness, domestic violence, or criminal behavior in the household. Though not HBLs themselves, they—and other severe psychosocial stressors—are relevant in the lives and health trajectories of children.

Nationally, nearly half of children (48%) in the US have experienced at least 1 ACE, with the rates being particularly high for black children (60%) and children in poverty (67%). A national survey of pediatricians showed that only about 1 in 3 pediatricians regularly ask about any ACE, thus missing opportunities to

connect children and families to the support they need. In addition to numerous health effects, ACEs are associated with impaired development of the brain, leading to long-term negative consequences on cognitive, language and academic abilities, and mental health. Negative educational outcomes include grade repetition, lower academic scores, disengagement with school, and attendance problems.

This report describes the Health Barriers to Learning and the supporting evidence base for their impact on academic success. It also describes the disproportionate prevalence of HBLs in disadvantaged children, the extent of unmet need for services for identification, management and treatment, and each HBL's impact on learning. Screening and management for each of these should be essential to supporting school and learning readiness. This report offers parents, practitioners and policymakers in the healthcare, education and children's services sectors recommendations to strengthen and integrate the safety net for children. A summary follows. For a detailed review, please refer to the full report.

1. UNCONTROLLED ASTHMA

Nationally, almost 1 in 10 children have asthma. However, rates are significantly higher among children living in poverty and disproportionately affect black children (13%) and Puerto Rican children (24%). Studies in low-income communities find rates close to 30%.

Children with well controlled asthma can live normal, active lives, but the consequences of poorly controlled asthma are Emergency Department visits, hospitalizations, missed school, disrupted sleep, asthma attacks, and frequent use of medications for quick relief. Nationally, children with asthma miss 13.8 million days of school. Studies find that children commonly experience asthma symptoms at night, which disturbs sleep and causes tiredness during the day. Studies have also found a link between uncontrolled asthma and poor school performance in children with severe and persistent asthma and in children from low-income families.

2. UNCORRECTED VISION PROBLEMS

Vision problems that affect children include myopia (inability to see distant objects), hyperopia (inability to see near objects), astigmatism (blurry vision at all distances), amblyopia (blurry vision caused by abnormal development of the connections between the brain and eye during early childhood), and strabismus (misalignment of the eyes).

In some underserved communities, 22% to 30% of children fail vision screening. Nationally, only 67% of children had their vision tested according to the timeframe set out by clinical guidelines and about 18% of 12 to 17 year olds have impaired vision due to uncorrected refractive error. Uncorrected vision problems and low rates of timely vision screening are disproportionately high among children from poor families, black children, Hispanic children, uninsured children, and children on public insurance.

About 80% of learning occurs through visual tasks such as reading, writing and using computers. Studies find that uncorrected vision problems impede a child's ability to read. They conclude that severe uncorrected hyperopia impedes reading performance, providing glasses to correct myopia improves school performance, uncorrected astigmatism results in a slow reading rate, and amblyopia adversely affects reading and the motor skills needed in practical, daily tasks.

3. UNADDRESSED HEARING PROBLEMS

Hearing loss can be permanent, fluctuating, or a combination of both and can affect one or both ears. Some children are born with hearing loss while others develop hearing loss later in childhood. Recurrent ear infections and high frequencies such as loud music from headphones can also impair hearing.

Between 1 and 6 out of every 1,000 babies born in the US each year have some degree of permanent hearing loss. In recent years, 95% of newborns receive hearing screening; however, poor children are disproportionately lost to follow-up, and newborn screening will miss children who develop hearing loss later. Thus, an estimated 9 to 10 children out of every 1000 will have permanent hearing loss by school age. Clinical guidelines recommend hearing screening during the school years; however, the consistency and enforcement of screening vary across states.

Hearing loss can impact a child's educational trajectory. In a typical classroom, often noisy with poor acoustics, even minimal or fluctuating hearing loss interferes with a child's ability to understand speech. Hearing loss, even in one ear, can significantly increase the likelihood a child will require special support or repeat a grade. Minimal hearing loss places children at over 4 times the risk of speech and language deficits compared with their peers who have normal hearing, and children with hearing loss are at higher risk of social emotional issues and behavior problems. For children in poverty, hearing loss is more likely to remain undetected or be identified late.

4. DENTAL PAIN

Dental caries, commonly known as dental cavities or dental decay, are bacterial infections that destroy the tooth's enamel and the underlying layer of dentin. If the cavities are not treated, they will continue to grow, leading to pain and infection, which in turn can result in problems with eating, speaking and learning, and other health effects. In rare instances, the spread of bacteria can lead to serious and even fatal systemic infections.

Caries are common, experienced by about 1 in 4 of 2 to 5 year olds (23%), and more than half of 6 to 8 year olds (56%). Many children go without treatment; nationally, about 22% of children aged 6 to 9 have untreated caries, with rates particularly high in black children (32%), Mexican American children (29%) and children living in poverty (27%). Clinical guidelines state that a child should see a dentist every 6 months for evaluation, treatment, and to receive dental sealants and fluoride for preventing and controlling tooth decay. However, national data show that just 44% of children received dental services and only 14% received recommended preventive care (topical fluoride, sealants) in the past year.

The impact of untreated caries goes far beyond oral health. Children with untreated caries and associated toothaches have trouble sleeping and eating, increased school absences, difficulty paying attention in school, difficulty keeping up with peers academically and completing homework, and lower standardized test scores. Moreover, they are more likely to report feeling worthless, shy, and unhappy and are less likely to appear friendly.

5. PERSISTENT HUNGER

Families experience food insecurity when they are unable to acquire enough food for one or more members due to lack of money and other resources. Food insecurity can lead to persistent hunger, and may cause families to choose quantity over quality, leading to nutritional deficiencies such as iron deficiency. Also, the stress and anxiety that families experience may negatively affect children's well-being.

Nationally, children in 3 million households experience food insecurity (i.e. about 8% of households with children). Of these, an estimated 274,000 households experience food insecurity so severe that children were hungry, skipped a meal, or did not eat for a whole day or more. Rates of food insecurity in households with children are even higher in households that are single female-headed (15%), black (11%), Hispanic (12%), and poor (21%).

Food insecurity and hunger can cause behavioral and cognitive impairments in children. Food insecurity negatively affects the emotional state, interactive abilities and social skills of the child. Research on the impact of hunger and food insecurity on academic performance is mixed. Studies find that food insecurity is linked to lower levels of school engagement and a greater risk of being placed in special education. Studies on reading and math scores reach different conclusions, with some studies finding links to performance.

6. CERTAIN MENTAL HEALTH AND BEHAVIORAL PROBLEMS

Childhood mental disorders are serious changes in the ways children typically learn, behave, or manage their emotions. Externalizing disorders manifest in a child's outward behavior and include ADHD (characterized by levels of inattention, hyperactivity, impulsivity, or a combination of these, that are inappropriate for child's stage of development and impair their ability to function), Oppositional Defiant Disorder (persistent pattern of developmentally inappropriate, negative, aggressive, and defiant behavior) and Conduct Disorder (behaviors that consistently ignore the basic rights of others and violate social norms and rules). Internalizing disorders, such as anxiety and depression, affect the child's internal psychological environment more than the external world.

Attention-Deficit/Hyperactivity Disorder (ADHD) is the most common mental health problem in children, with about 10% of school-aged children diagnosed at some point in their lives. Other issues include behavioral problems (4%), anxiety (5%), and depression (4%). Prevalence varies by race and ethnicity groups, with ADHD being most commonly diagnosed in black (11%) and white children (12%), compared with Hispanic children (6%). Behavioral disorders are most commonly diagnosed in black children (6%), compared with white children and Hispanic children (about 4% each). An important caveat to these prevalence estimates is concern about the inaccuracy in the diagnosis of mental health problems due to racial bias. The impact of childhood mental disorders on vulnerable children is magnified by poor access to services; children who are from poor families, uninsured or whose parents have low levels of education tend to have less access to the mental health care they need.

Several studies conclude that externalizing disorders are strongly associated with failure to graduate from high school. In particular, studies find that ADHD negatively impacts learning, and is associated with grade retention, suspensions, placement in special education, failure to complete high school, and low reading and math test scores.

7. EFFECTS OF LEAD EXPOSURE

For most children in the US, the main source of exposure to lead is deteriorating lead-based paint in older, poorly maintained homes. However, other sources include imported products contaminated with lead and remnants from its previous use as an additive in gasoline and plumbing. Children are more vulnerable to lead poisoning than adults, and even low lead exposure levels can affect a child's mental and physical growth and ability to thrive.

Given that no safe blood lead level has been identified, the primary health strategy is to prevent exposures before they occur. However, nationwide, an estimated 1.1 million low-income homes with children under the age of 6 still contain lead-based paint hazards. Higher mean blood lead levels are found in children living in homes built before 1978, and particularly in those who are also living in poverty.

Lead exposure has persistent, adverse effects on learning, notably on IQ, academic performance, and behavior. Increases in blood lead levels are associated with corresponding decreases in IQ and are associated with decreased academic scores in kindergarten and elementary school. Finally, lead exposure is linked to behavioral problems in children, including ADHD as well as destructive and aggressive behaviors.

CONCLUSIONS & RECOMMENDATIONS

The prevalence of Health Barriers to Learning is higher in children of color or in poverty, and these same children bear more burden of disease—in part due to their poor access to healthcare services. To empower at-risk communities and to keep children healthy and ready to learn, the healthcare and education sectors, parents, and other community agencies need to work together to create an integrated safety net. Children’s Health Fund makes the following recommendations to increase the identification, management, and treatment of HBLs for all children, with a focus on those living in poverty.



Healthcare Sector

All children should have an affordable, accessible medical home. Clinicians should:

- Prioritize annual, age-appropriate, systematic screening and management of the Health Barriers to Learning;
- Ensure effective communication of the results, importance to educational success, and relevant management considerations to schools and parents; and
- Promote the utilization of tools and inter-agency, cross-sector communication systems to consistently identify and track HBLs.

Education Sector

Schools should be supported as points of influence and access for annual screening and referral for Health Barriers to Learning, to ensure children who haven’t been engaged with a medical home are screened and connected to health care. School systems/educational professionals should:

- Ensure teachers and other school personnel receive adequate training on the importance of Health Barriers to Learning and relevant school/classroom support to mitigate any potential effects on children’s educational success; and
- Require annual screening for age-appropriate Health Barriers to Learning, either onsite, or in collaboration with children’s primary care providers.

Family Service Agencies and Organizations

Children with documentable HBLs may need medical attention, health services, and social services that are relevant to their status and critical to meet their needs and coordinate care and intervention. Court and family service agencies should:

- Receive appropriate training on the relevance of HBLs to children in their care; and
- Ensure HBLs are appropriately addressed in their decision-making and care plans.

Parents and Caretakers

Public awareness campaigns and aligned messaging from the medical and educational sectors are ways to engage and empower parents to become informed advocates for their children. Parents should:

- Proactively request screening of their children for HBLs; and
- Ensure communication between their child's clinical team and school on any HBLs.

Policymakers

Resources and systems need to be in place to support services for screening, treatment, and mitigation of HBLs. Policymakers should:

- Ensure coverage of services such as case management and health education in the clinical environment.
- Make provisions to cover screening and referral of HBLs in schools and other settings.
- Ensure that as regulatory guidance for states and school districts is developed, the identification and amelioration of HBLs are encouraged and incentivized as a priority within Title I and other categorical funding streams in federal education legislation.

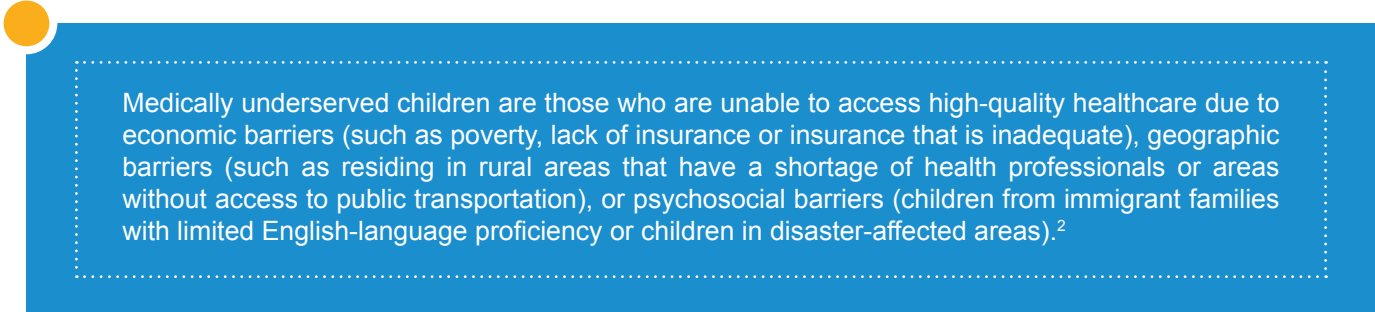
I. INTRODUCTION

Maximizing the educational experience and success of every child in America must be a priority and a critical national goal. Vitally important at the level of each child and family as a pathway out of poverty, the issue is also larger. If the nation is to remain economically stable, prosperous, innovative, and influential internationally over the coming decades, it is essential that children are healthy and well-educated, graduate from high school on time, and perform at their full potential.

Unfortunately, many children are not ready even for pre-kindergarten or kindergarten, or the rigors of the usual educational demands. The trajectory heading toward an inadequate academic experience may have its roots in early childhood, with children not reading at grade level in the early elementary years, poor performance in middle school and failure to graduate on time. In fact, in some low performing schools, on-time graduation may be as low as 50%.¹


There are many reasons for less than optimal academic performance. This is especially true for children who live with persistent adversities or chronic stress. Among the issues which can negatively affect learning are those that clearly relate to medical or health issues that have been unrecognized or undermanaged. In this report, these conditions are called “health barriers to learning,” or HBLs.

These conditions, referred to in this report as “Health Barriers to Learning” (HBLs), include the following: uncontrolled asthma, uncorrected vision problems, unaddressed hearing loss, dental problems, persistent hunger, certain untreated mental health and behavioral problems, and effects of lead exposure. Medically underserved children disproportionately suffer from untreated health conditions that undermine their ability to succeed in school.



Medically underserved children are those who are unable to access high-quality healthcare due to economic barriers (such as poverty, lack of insurance or insurance that is inadequate), geographic barriers (such as residing in rural areas that have a shortage of health professionals or areas without access to public transportation), or psychosocial barriers (children from immigrant families with limited English-language proficiency or children in disaster-affected areas).²

Left untreated, these *Health Barriers to Learning* can adversely affect children’s ability to see, hear, and pay attention in the classroom; their ability and motivation to learn; their attendance; their academic performance; and even their chances of graduating from high school. Strategic action by policymakers and practitioners in both the healthcare and education sectors requires a solid understanding of the nature and magnitude of the problem of *Health Barriers to Learning*. This report describes the disproportionate prevalence of HBLs in medically underserved children, how each HBL adversely affects learning, and what practitioners and policymakers can do to address and ultimately eliminate HBLs.



Race and ethnicity are complex constructs that have significant cultural significance. This report uses the definitions that the National Center for Education Statistics uses when reporting about race and ethnicity in government publications. These definitions are excerpted from the NCES website³:

Hispanic/Latino: This category includes individuals of any race who identify as Hispanic or Latino.

American Indian or Alaska Native: This category includes only persons who reported American Indian or Alaska Native as their sole race and did not report Hispanic/Latino ethnicity.

Asian: This category includes only persons who reported Asian as their sole race and did not report Hispanic/Latino ethnicity.

Black or African American: This category includes only persons who reported black or African American as their sole race and did not report Hispanic/Latino ethnicity.

Native Hawaiian or Other Pacific Islander: This category includes only persons who reported Native Hawaiian or Other Pacific Islander as their sole race and did not report Hispanic/Latino ethnicity.

White: This category includes only persons who reported white as their sole race and did not report Hispanic/Latino ethnicity.

What is known about the topic: As described in Annie E Casey's *2016 KIDS COUNT Data Book* report,⁴ disparities in educational achievement by race and income persist. Attaining proficiency in reading and math and graduating from high school are important educational milestones that put children on track to reach their life potential. While national rates of achievement on all three of these milestones are low, they are even lower for minority children and children in poverty. Nationwide, 65% of fourth graders in public school read below the proficient level. This rate is even higher in black (82%), Hispanic (79%) and American Indian (78%) children. Children with low reading proficiency are more likely to feel disengaged from school and drop out, compromising their earning potential, and chances of success in later life. About 68% of eighth graders in public school are not proficient in math, with higher rates in black (88%), Hispanic (81%) and American Indian (81%) children. A basic competence in math is critical for everyday functioning and improves one's employability. Nationally, almost 1 in 5 (18%) of children do not graduate from public high school on time, with even higher rates for children who are Hispanic (24%), black (28%), American Indian (30%), economically disadvantaged (25%), and who have limited English language proficiency (37%). Students who graduate from high school are more likely to pursue future education, earn more, and enjoy better health.

A vast body of literature shows that educational attainment is complex and determined by a variety of factors, including sociodemographic factors (race, ethnicity, socioeconomic status, gender, family structure, family size, educational and occupational attainment of parents), individual factors (cognitive ability, self-esteem, attitudes towards school, educational and occupational aspirations), participation in early intervention programs, family-related factors (parents' involvement, parents' attitudes and values toward educational attainment, child taking on adult roles, family stressors), and school-related factors (academic achievement, absenteeism, behavior problems, grade retention, changing schools, school characteristics).⁵

This report aims to draw attention to the important ways in which health influences these determinants of educational success. Two prominent literature reviews that present considerable evidence about this

topic are: C.E. Basch's 2010 report *Healthier Students are Better Learners: A Missing Link in School Reforms to Close the Achievement Gap*⁶ and the 2015 article *Critical Connections: Health and Academics*⁷ published in the *Journal of School Health*. Basch's 2010 report provides a detailed description of how vision problems, asthma, teen pregnancy, aggression and violence, lack of physical activity, lack of breakfast, and inattention and hyperactivity disproportionately affect urban minority youth. The report also examines specific ways in which these health conditions impede motivation and ability to learn, and focuses on school-based interventions that can offer specific, evidence-based solutions. More recently, the *Journal of School Health* article, which also draws upon Basch's 2010 report, summarizes the literature on the connection between health and academic achievement using the Whole School, Whole Community, and Whole Child (WSCC) framework, which is an ecological approach that focuses on the health and education of students through services and programs provided by the school, a supportive school environment, and contributions of family and community.

What this report adds: This report builds on these and other literature reviews, as well as other studies on specific HBLs—but originates from a clinical perspective. For almost 30 years, Children's Health Fund, a national nonprofit organization, has been bringing primary and mental health care to children living in poverty. Working intensively within communities at schools, homeless shelters, and drop-in centers for street youth, the clinical teams see children every day who have fallen through the cracks of both the medical and educational systems, challenged by health problems that threaten their wellbeing and chances for success in school. Driven by this experience, this report brings a social determinants of health- and trauma-informed clinical perspective to describe the nature and prevalence of HBLs in vulnerable children. Secondly, this report presents evidence of the huge gap between the services that clinical guidelines recommend for identifying, managing and treating HBLs and what children actually receive. Thirdly, the report offers practitioners and policymakers in both the healthcare and education sectors a comprehensive set of recommendations to deepen and broaden the safety net for vulnerable children in a variety of settings—school, clinic, home and community.

Structure of the Report: For each HBL, this report describes: i) the prevalence of the HBL; ii) the extent of unmet need for services to identify, manage, and treat the HBL; iii) the impact of the HBL on learning; and iv) conclusions summarizing the key points. The report ends with a set of recommendations for practitioners and policymakers in the healthcare and education sectors.

LITERATURE REVIEW STRATEGY: The particular Health Barriers to Learning discussed in this review were chosen based on: i) their prevalence in pediatric underserved populations; ii) the presence of evidence in the literature supporting a connection to educationally-relevant outcomes; and iii) the existence of implementable screenings and interventions to treat or mitigate the condition. For each Health Barrier to Learning, a number of key documents based on relevance to the topic were identified—literature reviews summarizing evidence on the link between a specific HBL and learning as well as original research. The references listed in the key documents as well as literature that cited the key documents were then reviewed. The main criterion for including a literature source was relevance to topic. In order to paint a broad picture, all types of literature (i.e. not only articles in peer-reviewed journals but also reports by government agencies and nonprofit organizations) and all types of study designs (i.e. not restricted to study designs that would allow for causal inference) were considered for inclusion. While study authors' self-reported assessment of bias has been included when relevant, this report does not independently and systematically assess risk of bias for each study and across studies. All sections were reviewed by content experts.

II. BACKGROUND: ADVERSE CHILDHOOD EXPERIENCES

Definitions

A number of underlying factors contribute to the higher prevalence and impact of HBLs among economically disadvantaged children. Poor access to health care and quality schools, excessive absenteeism, and other social issues affect development, learning, and health. Among the most important factors are **Adverse Childhood Experiences**, or “**ACEs**.” Adverse Childhood Experiences are events during childhood that have been shown to increase the short- and long-term risk of negative health and social outcomes. These experiences include: the child suffering physical, psychological, or sexual abuse and the presence of substance abuse, mental illness, domestic violence, or criminal behavior in the household.⁸ The resulting stress from ACEs may become “toxic” when there is a “strong, frequent, or prolonged activation of the body’s stress response systems in the absence of the buffering protection of a supportive, adult relationship.”⁹

In addition to numerous health effects, ACEs are associated with impaired development of the brain, leading to long-term negative consequences on cognitive, language and academic abilities, and mental health. Negative educational outcomes including grade repetition, lower academic scores, disengagement with school, and attendance problems. Trauma from Adverse Childhood Experiences (ACEs), particularly child abuse and neglect, has great impact, particularly on underserved children. These experiences may result in children failing to thrive at home, at school, or in the community. Furthermore, they can be associated in later life with continued impairment, as well as with illness, substance abuse, delinquency, and unsafe behavior. Trauma disproportionately affects children in poverty, and is both a significant pathway towards mental health and behavioral problems, as well as a predictor of lower academic outcomes.



From the sentinel study published in 1998, Adverse Childhood Experiences with demonstrated impact on long-term health and well being include:

- Emotional abuse
- Physical abuse
- Sexual abuse
- Emotional neglect
- Physical neglect
- Mother treated violently
- Household substance abuse
- Household mental illness
- Parental separation or divorce
- Incarcerated household member

Other studies have included single, acute events as well as those sustained over time, such as death of a parent and exposure to community violence.

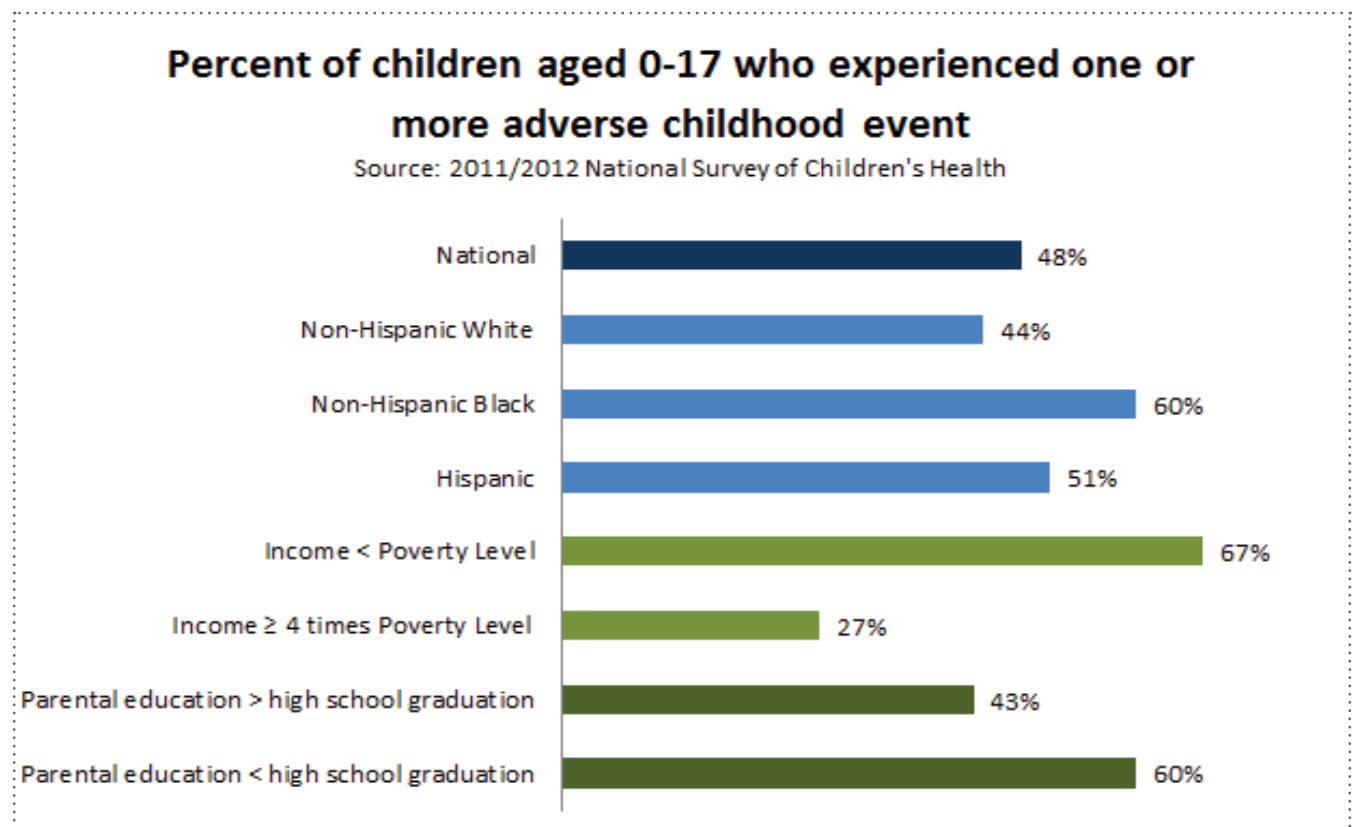
Sources:

- 1) American Academy of Pediatrics (AAP). *Adverse Childhood Experiences and the Lifelong Consequences of Trauma*.
- 2) Felitti, V.J., et al., Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med*, 1998. 14(4): p. 245-58.

As described by Child Welfare Information Gateway, the trauma that originates from abuse and ACEs can lead to impaired development, by causing “regions of the brain to fail to form or grow properly. These alterations in brain maturation have long-term consequences for cognitive, language, and academic abilities, and are connected with mental health disorders.”¹⁰ For example, a study of the National Survey of Child and Adolescent Wellbeing (NSCAW) found that, among children that come in contact with the child protection and welfare system and therefore who have likely been subject to abuse or neglect, only 13% of infants and toddlers were at low or no risk for developmental delay or neurological impairment. More than one-third (36%) were at moderate risk, while 51% were at high risk for developmental delay or neurological impairment. These percentages are similar to the rates found in infants born prematurely, with low birth weight, and/or with respiratory distress syndrome, rather than the rates in the non-clinical or general population.¹¹

Prevalence

ACEs disproportionately affect underserved populations as shown in the following chart. The rates of ACEs are substantially higher in children who are black, Hispanic, living in poverty and whose parents have low levels of education, compared with rates for the general population. According to the 2011/12 National Survey of Children’s Health, nearly half (48%) of US children 17 years and below experienced one or more ACE, i.e. about 35 million children. Rates are high in black children (60%) and Hispanic children (51%), compared with white children (44%). About two-thirds of children in families below the Federal Poverty Level (67%) experience at least one ACE, 2.5 times the rate in children from families that are at least 4 times above the poverty level (27%). A similar disparity is seen when looking at household educational levels; 60% of children from families where neither parent/guardian had completed high school have experienced at least one ACE, compared with 43% in children from families where at least one parent/guardian had more than a high school education.¹²



Unmet need for services

The American Academy of Pediatrics (AAP) calls for pediatric medical homes to play an important role in addressing early childhood adversity and toxic stress in its policy statement “Early Childhood Adversity, Toxic Stress, and the Role of the Pediatrician: Translating Developmental Science Into Lifelong Health.”¹³

AS DEFINED BY THE AMERICAN ACADEMY OF PEDIATRICS:

“A **medical home** represents an approach to pediatric health care in which a trusted physician partners with the family to establish regular ongoing care. Through this partnership, the primary health care professional can help the family and patient access and coordinate specialty care, other health care services, educational services, in and out of home care, family support, and other public and private community services that are important to the overall health of the child and family. Providing a medical home means addressing the medical and non-medical needs of the child and family.”

Source:

Definition of medical home from [healthychildren.org](https://www.healthychildren.org/English/family-life/health-management/Pages/A-Medical-Home-Where-Everybody-Knows-Your-Name.aspx) (from the American Academy of Pediatrics). Link: <https://www.healthychildren.org/English/family-life/health-management/Pages/A-Medical-Home-Where-Everybody-Knows-Your-Name.aspx>

Specifically, it recommends that pediatric medical homes should: “(1) strengthen their provision of anticipatory guidance to support children’s emerging social-emotional-linguistic skills and to encourage the adoption of positive parenting techniques; (2) actively screen for precipitants of toxic stress that are common in their particular practices; (3) develop, help secure funding, and participate in innovative service-delivery adaptations that expand the ability of the medical home to support children at risk; and (4) identify (or advocate for the development of) local resources that address those risks for toxic stress that are prevalent in their communities.” A recent national survey investigated the extent to which pediatricians follow AAP’s recommendation to adopt a broad framework for understanding how social/emotional and familial factors such as ACEs affect child health. This survey found considerable gaps between recommendations and practice. While more than 80% of respondents said that screening for familial factors was within the scope of their responsibility, about a third (32%) did not usually ask about any ACE. About half reported usually asking about maternal depression (46%) or parental separation/divorce (42%), about a third usually ask about physical or sexual abuse (32%) or domestic violence (26%), and only 1 in 10 usually ask about incarcerated relatives (9%) or emotional abuse (10%).¹⁴

Impact on mental and behavioral health

Behavioral and cognitive problems are more common in children who are victims of abuse and neglect. This holds true both in the general population as well as for children in the welfare system. According to the 2011/12 National Survey of Children’s Health (a survey of children in the general population), 52% of children with emotional, behavioral, or developmental issues have experienced two or more ACEs, which is almost twice the rate for children without any emotional, behavioral, or developmental issues (27%).¹⁵

Trauma, poverty, and mental health risks

Trauma disproportionately affects children in poverty, and is both a significant pathway towards mental health and behavioral problems, as well as a predictor of lower academic outcomes. Mental health/behavioral issues are also more common in underserved children, and affect their ability to thrive at school and in life. The National Survey of Child and Adolescent Well-being (NSCAW, a survey of children involved in the child protection and welfare system) found that children who come in contact with the child protection and welfare system are at higher risk for cognitive and behavioral problems, compared to the general population. About two-thirds of children (67%) of children aged 6 to 17 years had higher risk for cognitive or behavioral problems. About 10% had a risk of cognitive problems, 43% had a risk of behavioral or emotional problems, and 13% had both types of risk.¹⁶

Based on caregivers' reports, the percentage of children with clinically relevant mental health issues was higher in children involved in the child welfare system than in children in the general population. About 21% of children scored in the clinical range for externalizing behaviors, 18% for Internalizing behaviors, and 23% on the 'Total Problems' scale. Similarly, based on teachers' report, the proportion of children with scores in the clinical range was 20% for externalizing behaviors, 24% for internalizing behaviors, and 19% on the Total Problems scale.¹⁷ Attention-Deficit/Hyperactivity Disorder (ADHD) and emotional problems (depression, anxiety, eating disorder or other emotional problem) were among the three most common health conditions reported by caregivers, with ADHD affecting 16% of children and emotional problems affecting 14% of children.¹⁸ The percentage of children with ADHD was higher than the proportion of children with ADHD nationally (10%).¹⁹ Similarly, a study of children aged 18 -71 months who were investigated by child welfare examined the association between ACEs, and mental health/social development. For every additional ACE, there was a 32% increase in the odds of having clinically significant behavior problems. For children aged 3 to 6 years, for every additional ACE there was a 77% increase in the odds of having poorer socialization skills.²⁰

Impact on learning

Experiences of abuse have been proven to impact academic achievement both in children in the welfare system, and in the general population. Caregivers reported that more than one fourth (25.9%) of children involved in the child welfare system had repeated at least one grade.²¹ Nationally, the proportion of children who have repeated a grade is less than half as high.²² Furthermore, children 5 to 17 years old involved in the child welfare system scored significantly lower than the general population in academic performance.²³ The CDC reported that the Adverse Childhood Experiences Study found a dose-response relationship between ACEs and poor academic achievement, meaning that as the number of ACEs increases, so does the risk of poor academic achievement.²⁴

A study using the 2011/2012 National Survey of Children's Health assessed the prevalence of ACEs and the association with school engagement and grade repetition, controlling for socio-demographic characteristics and health status. Children with two or more ACEs were 2.67 times more likely to repeat a grade, compared to children with no such experiences. Likewise, children who had not experienced an ACE had 2.59 or greater odds of being highly engaged in school, compared to their peers who had two or more ACEs.²⁵

A study of the pediatric medical records from 2007-2009 of a clinic in California serving youth at high risk of exposure to ACEs found that 3% of participants without ACEs had a learning/behavior problem, while 51% of participants with at least 4 ACEs displayed learning/behavior problems. Additionally, having experienced one or more ACEs was associated with increased odds of having learning/behavior problems as compared to having experienced no ACEs. Having experienced 4 or more ACEs was associated with odds of having a learning/behavior problem 32.6 times higher than having experienced no ACEs.²⁶

The Washington State University Child and Family Research Unit (CFRU) has studied the effects of ACEs on childhood education and development in children in public Head Start programs and schools in Spokane, WA. After adjusting for socio-demographic factors, children's ACE scores were predictive of child developmental status in the areas of social, literacy, language, cognitive, and math development.²⁷ The Spokane Childhood ACEs Study from the same center explored the correlation between ACEs and academic problems in elementary school children (Grades K-6) from the Spokane public schools. Preliminary findings suggested that the level of ACE exposure was the principal predictor of attendance and behavior problems. After participation in special education classes, ACE exposure was the second-highest predictor of academic failure. The higher the number of ACEs, the greater the percentage of students with academic concerns.²⁸

Finally, another study from the same center analyzed the relationship between ACE exposure and students' math and reading competencies, social adjustment, and school attendance in children from in early learning programs to 12th grade enrolled in a state-funded program for students at risk of academic failure for non-academic barriers. Preliminary findings suggest that, after adjusting for socioeconomic characteristics as well as special education enrollment, children with four or more ACEs are five times more likely to have attendance problems, six times more likely to have behavioral problems, twice as likely to experience academic failure, and three times as likely to have school behavior problems.²⁹

In summary, studies of national population and vulnerable populations provide abundant evidence that ACEs are strongly associated with the following school-related outcomes: grade retention, decreased academic performance, disengagement with school, learning problems, behavioral problems at school and attendance problems.

III. HEALTH BARRIERS TO LEARNING

1. UNCONTROLLED ASTHMA

The following section contains: a description of asthma and uncontrolled asthma; prevalence and unmet need for services, with a focus on disparities; and evidence on the learning consequences of uncontrolled asthma.

Definitions

Asthma is a chronic lung disease characterized by inflammation, hyperreactivity, and narrowing of the airways, blocking airflow. Asthma causes recurring periods of wheezing, chest tightness, shortness of breath, and cough. The coughing often occurs at night or early in the morning, and can be highly variable among patients and within patients over time.³⁰



Asthma is classified using categories of severity and control. The term ‘severity’ is used to describe the intensity of the disease in terms of impairment and risk. Those with severe asthma have a high probability of morbidity if asthma is left uncontrolled.³¹ The term ‘control’ is used to describe how well the symptoms of asthma are minimized by therapeutic intervention and the goals of therapy are met. The level of asthma control is categorized as “well controlled,” “not well controlled,” or “poorly controlled.”³² People with asthma can control their symptoms with appropriate treatment.³³

CLASSIFYING ASTHMA CONTROL:

The National Institute of Health has established clear, age-specific criteria to assess asthma control. For example, a child 5-11 years old can only be

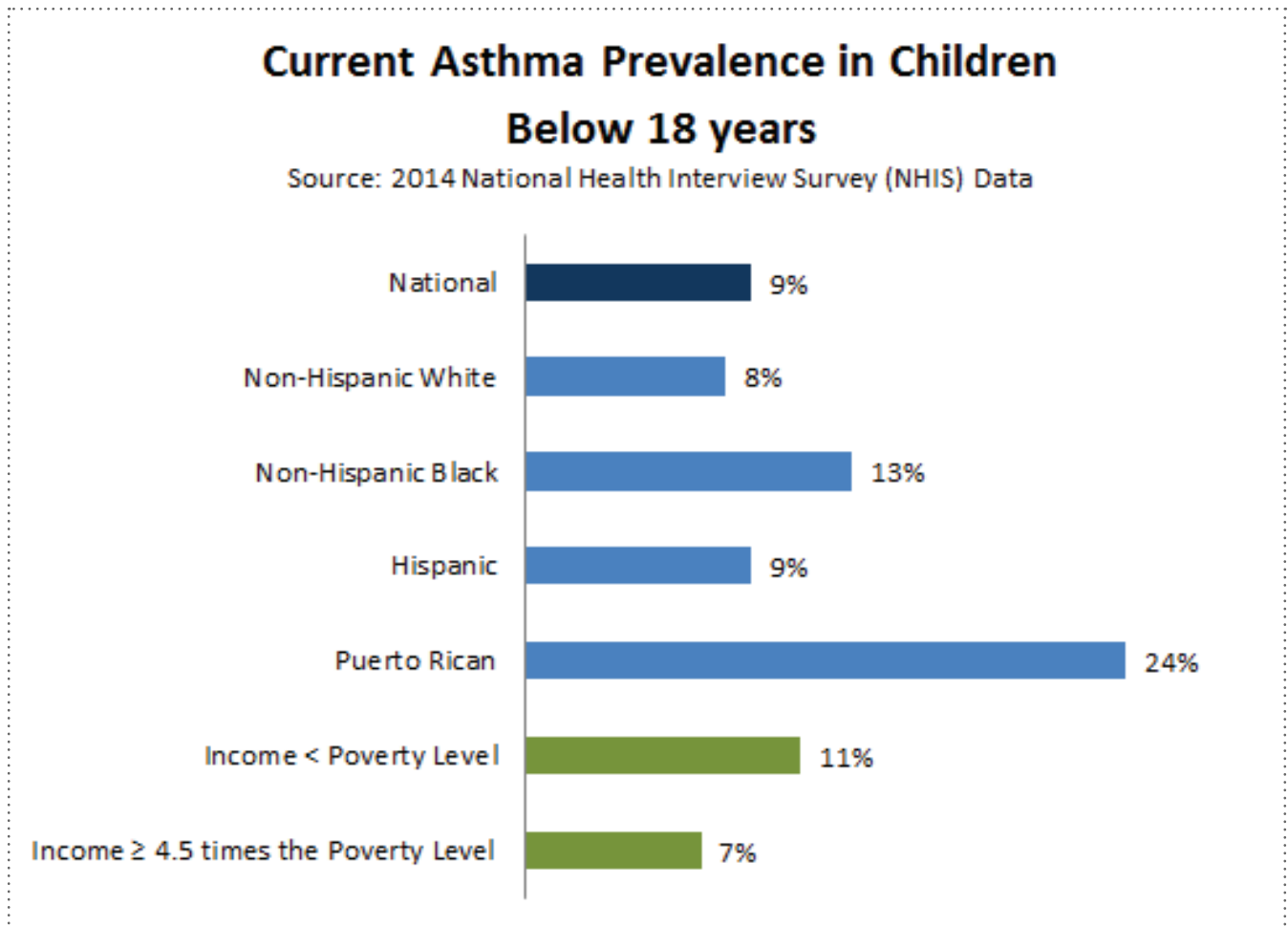
classified as ‘well controlled’ if they are having symptoms (including cough and wheezing) less than 2 times each week, are needing their rescue inhaler no more than 2 times each week, and are waking in the night due to cough no more than one time per month. If a child is having symptoms more frequently than this, they require further assessment and likely adjustment of their medication plan.

Source: National Institute of Health. Guidelines for the Diagnosis and Management of Asthma (EPR-3).

Prevalence

There are 2 ways of discussing asthma prevalence—current prevalence and lifetime prevalence. A person is categorized as having current asthma if they say they have been diagnosed with asthma and they still have asthma at the time they were surveyed.³⁴ Nationally, according to 2014 survey data reported by the CDC, almost 1 in 10 children (9%) under the age of 18 years currently have asthma. Rates are higher in black children (13%) and very high in Puerto Rican children (24%), compared to children who are white (8%) or Hispanic (9%). There are disparities by poverty level as well, with a rate of 11% among children

with family incomes below the poverty threshold versus 7% among children with family incomes at least 4.5 times above the poverty threshold. By age group, the prevalence of children who currently have asthma is: 4% for children 0 to 4 years, 11% in children aged 5 to 11 years, and 10% in children aged 12 to 17 years. In total, an estimated 6.3 million children currently have asthma.³⁵



A person is categorized as having lifetime asthma if they say they have been diagnosed with asthma at any point in their lives, regardless of whether they still have asthma symptoms or require treatment. Lifetime asthma prevalence among children under 18 is 14%. Prevalence in children varies by race and ethnicity, with higher rates for black (19%) and Puerto Rican (31%), children compared to white children (12%) and Hispanic children (14%). By age group, lifetime asthma prevalence is: 6% in children 0 to 4 years, 16% in children 5 to 14 years, 17% in 15 to 19 years.³⁶

Some vulnerable communities have an even higher prevalence of asthma than the national estimates. For example, among children aged 0 to 12 years in Central Harlem, 28.5% have been told by a doctor or nurse that they have asthma, and 30.3% have asthma or asthma-like symptoms (2001–2003 data).³⁷ Two studies in low-income communities in Detroit also found high rates of asthma. One study on preteens (students 10 to 13 years of age) in selected Detroit middle schools in 2003 found that 32% of children surveyed met criteria for probable asthma.³⁸ In a study of a vulnerable population of children aged 2 to 5 years in Detroit Head Start centers, 27% of children whose parents provided information met the criteria for probable asthma.³⁹

THERE ARE TWO MAJOR MEDICATION TYPES USED TO TREAT ASTHMA:

relievers and controllers. All patients should have a reliever (also called a rescue or quick relief medication), which is an inhaled medication such as albuterol, that can be used to rapidly mitigate acute symptoms. Controller medications, such as inhaled corticosteroids, can greatly reduce symptoms and airway sensitivity, but generally require daily preventative use for effectiveness. Under-treated patients are those who need but aren't prescribed or aren't using/correctly using an appropriate controller medication. They typically have more frequent symptoms, need/use their reliever more frequently, and require the Emergency Department (ED) and hospitalization more frequently. Frequent use of a rescue medication without the use of a controller medication is associated with increased risk of death from asthma.

Source: National Institute of Health. Guidelines for the Diagnosis and Management of Asthma (EPR-3).

Unmet need for services

Asthma can be controlled with the appropriate treatment.

Indicators of poorly controlled asthma include Emergency Department (ED) visits, hospitalizations, missing school, nighttime awakenings, experiencing asthma symptoms frequently, experiencing asthma attacks, and using medications for quick relief frequently.

Asthma symptoms, nighttime awakenings, and use of medications for quick relief. Among children who currently have asthma, 38% report uncontrolled asthma, based on experiencing any of the following on a frequent basis: asthma symptoms, nighttime awakenings or use of medications to provide quick relief of asthma symptoms.⁴⁰ An earlier 2003-2004 four-state study on children with current asthma found that the percentage of black children (26%) and Hispanic children (19%) using quick relief medication was significantly higher than that of white children (12%). The same study found that the percentage of children with current asthma who were using medications for long-term control (which is generally the preferred treatment for keeping asthma under control) was low among all demographic groups: black children (21%),

Hispanic children (22%), and white children (33%).⁴¹

ED visits and hospitalizations: According to a study using national data from 2007 to 2009, asthma related ED visits are 10.7 visits per 100 children with current asthma, with rates for children who are black at 15.2 visits per 100 children and Hispanics at 12.5 visits per 100 children.⁴² This study also found that asthma-related hospitalizations are higher for black children than white children (2.2 vs. 1.4 hospitalizations per 100 children with current asthma).⁴³ An earlier study focused on childhood asthma using 2003 to 2005 national data found that compared with white children, black children have an ED visit rate that is 2.6 times higher, a hospitalization rate that is 2.5 times higher and death rate from asthma that is 5 times higher.⁴⁴ Findings were similar in a four-state study using 2003-2004 data on children with current asthma. The percentage of black children with asthma-related ED visits (39%) and asthma-related hospitalizations (12%) were double the rates for white children (18% for ED visits and 5% for hospitalizations).⁴⁵

In some low-income communities, hospitalization rates are higher than the rates for the city. For example, certain neighborhoods in the South Bronx and upper Manhattan have much higher rates of asthma hospitalization than the rest of the city. In Hunts Point and Mott Haven in the Bronx, and in East Harlem, the asthma hospitalization rates are more than double the citywide rate (12.2, 11.4, and 5 per 1,000 children, respectively).⁴⁶ In Michigan children living in low-income areas are hospitalized for asthma 2.9 times as often as children living in high income areas.⁴⁷

Asthma attacks: About 48% of children who currently have asthma had asthma attacks in the past year. Rates by race and ethnicity do not appear to vary much and are as follows: black (52%), white (48%), Hispanic (45%) and Puerto Rican (43%).⁴⁸

Missing school: In 2013, 13.8 million missed school days were reported for children aged 5-17 with current asthma. Half of children (49%) with asthma reported one or more asthma related missed school days during 2013. By race and ethnicity, the rates are: 44% for white children, 53% for black children and 57% for Hispanic children.⁴⁹

Impact on learning

Asthma has a negative impact on a child's school readiness and ability to learn once in school by causing missed school days and sleep disturbance that can affect performance in the classroom. What follows is an overview of the evidence examining the link between asthma and learning. The relationship between asthma and learning was extensively reviewed by Charles E. Basch and this summary relies heavily on his published research on this topic⁵⁰ and a literature review on asthma and school performance by Taras and Potts-Daterma.⁵¹

Missed school days/absenteeism

The CDC measures missed school days as 'the number of reported missed school days among children with asthma' and as the 'percentage of children with asthma who reported one or more asthma-related missed school days.' The information is based on the National Health Interview Survey data gathered in response to a parent question of "During the past 12 months, how many days of daycare or preschool, school, or work did your child miss because of his/her asthma?". In 2013, 13.8 million missed school days were reported for children aged 5-17, up from 10.4 million in 2008. Half of children (49%) with asthma reported one or more asthma related missed school days during 2013.⁵²

Despite varying definitions of asthma and measurements of absenteeism in the literature, the link between asthma and higher rates of absences is well established.⁵³ Research by Taras and Potts-Daterma reviews literature on the effect of asthma on school attendance or academic achievement. Published peer-reviewed literature from 1989 to 2004 that included school-aged children (5-18 years) was reviewed. Taras and colleagues found of 66 studies, virtually all showed a relationship between asthma and higher absenteeism rates.⁵⁴

Another later study by Moonie et al. (published after the review by Taras and Potts-Daterma) included 9000, predominately African American students in grades K-12 in a mid-west urban school district. The study compared general absenteeism (absences for any reason) between children with and without asthma and found that students with asthma were absent 1.5 days more than students without asthma. This study (Moonie et al. 2006) also found that missed school days increased with asthma severity. Children with asthma classified as "mild intermittent" missed on average 8.5 days of school in a year while children with asthma classified as "severe persistent" missed an average of 11.6 days of school in a year. Moonie et al. examined a subset of children who had illness related absences and found that 31% of absences caused by illness were from asthma symptoms.⁵⁵

Sleep disturbance

Negative effects of asthma on learning ability and school attendance can in part be attributed to the impact of asthma on quality and quantity of sleep. Several studies examine the relationship between asthma and disturbed sleep.

A cross sectional survey by Diette et al. (2000) of 438 parents of children with asthma found 40% of asthmatic children had woken up during the night due to their asthma. Parents were also asked about school performance. Compared with children with asthma who did not have night-time awakenings, children who did have night-time awakenings missed more school days and their education suffered more due to asthma.⁵⁶

A study by Stores et al. compared a sample of school aged children with and without asthma to measure the impact of nocturnal asthma symptoms on daytime functioning. In this study, children with asthma had significantly more disturbed sleep (based on measurements of actual sleep time, number of awakenings, number of REM cycles etc.,) and consequently a high rate of reported daytime sleepiness.⁵⁷ Another study by Desager et al. sampled 1,234 children between 6-14 years and found that those who experienced nighttime wheezing, a common symptom of asthma, had significantly more disturbed sleep due to waking up during the night and restless sleep.⁵⁸ Children with asthma have also been shown to be more likely than children without asthma to nap during the day.⁵⁹ One third of children with asthma report at least one nighttime awakening in the past month, although less common in children on controller medications.⁶⁰

Cognition

Asthma is a relapsing disorder; due to high variability in disease control it is difficult to demonstrate the effect of uncontrolled asthma on overall academic achievement. There has been a greater focus on the demonstrating the preventable consequences of uncontrolled asthma on adult work performance, using the term “presenteeism” to describe poor performance while at work due to the direct effects of the disease or the indirect effects from sleep deprivation.⁶¹ Despite the difficulties in investigating the association between asthma and school work, some literature supports a link.

Research conducted by Stores et al. found children with asthma had higher rates of psychological problems and were reported to have more conduct related issues by their parents, compared with children without asthma. Children with asthma also performed less well on some tests of memory and concentration.⁶²

The review of literature by Taras and Potts-Datema included 36 studies addressing school performance in children with asthma. Results were mixed with a third of the literature showed lower academic performance in children with asthma. These studies primarily found this link in children with severe and persistent asthma and in children from lower income families.⁶³ Of interest is a study of kindergarteners that found children with asthma scored lower on school readiness measurements than children without asthma, primarily due to parent reports of asthma related sleep interruption and resulting daytime sleepiness⁶⁴.

A second study by the same research group, Halterman et al. (2006), stratified asthmatic kindergarteners by asthma severity and found children with persistent symptoms scored lower on an assessment of task orientation and shy/anxious behaviors than children with intermittent or no symptoms.⁶⁵

Ability to function in the classroom may also be affected by asthma comorbidities. Compared with children without asthma, children with asthma are more likely to experience developmental, emotional, and behavioral problems. A random selection of over 100,000 children under the age of 18 by Blackman and Gurka found those children with asthma had higher rates of ADHD, depression, behavioral disorders, and learning disabilities. This study also found a dose-response relationship; the more severe the asthma, the higher the rate of these problems. ⁶⁶

Conclusions

Key points:

- Asthma is prevalent in low-income communities. Black children also suffer disproportionately uncontrolled asthma, based on higher rates of asthma-related ED visits, hospitalizations and use of quick-relief medications.
- Poorly controlled asthma impairs a child's ability to learn by causing absenteeism and disrupted sleep. Studies that found a link between uncontrolled asthma and school performance primarily found this link in children with severe and persistent asthma and in children from lower income families. Some studies have also found that asthma is associated with increased rates of behavioral and developmental problems.
- Asthma management programs and high quality medical care can reduce absenteeism, improve quality of life, and improve functioning in children with asthma.

2. UNCORRECTED VISION PROBLEMS

This section presents description of the types of vision problems that affect children, the prevalence of vision problems and disparities in vision screening and access to vision care, and evidence on the learning consequences of uncorrected vision problems.

Definitions

The “Children’s Vision and Eye Health: A Snapshot of Current National Issues” report by The National Center for Children’s Vision and Eye Health (NCCVEH) at Prevent Blindness describes various types of vision disorders that affect children: refractive errors (myopia, hyperopia, and astigmatism), strabismus, and amblyopia.⁶⁷ What follows is a brief, abridged description of each of these disorders, taken directly from the NCCVEH report.



Refractive Errors

Refractive errors include myopia, hyperopia, and astigmatism. They occur when light is not focused on the retina, causing blurred vision. Uncorrected refractive errors in infants and preschool-age children are associated with parental concerns about developmental delay, as well as with deficits in cognitive and visual-motor functions that may in turn affect school readiness. In myopia, visual images come to a focus in front of the retina, resulting in defective vision of distant objects. In hyperopia, visual images come to a focus beyond the retina, resulting in defective vision of near objects. Astigmatism is an irregularity in the shape of the cornea or lens that causes blurry vision at all distances.

Amblyopia

In amblyopia (sometimes called “lazy eye”), vision is impaired due to abnormal development of the neural connections between the brain and the eye during early childhood. The primary causes are misalignment of the eyes (strabismus) and high refractive error or unequal refractive error between eyes. Typically, the vision loss affects only one eye, but people with amblyopia are nearly three times more likely than those without amblyopia to develop vision impairment in their better-seeing eye later in life. Early detection of amblyopia is critical; treatment is most successful when started before the age of 7 years, and less effective at older ages. Left untreated or treated too late, amblyopia can lead to permanent vision loss in one or both eyes.

Strabismus

Strabismus is a misalignment of the eyes that can lead to amblyopia. With the eyes oriented in different directions, the brain receives conflicting visual input, interfering with binocular vision development and depth perception. The effect of the eyes’ misalignment on a child’s appearance may also negatively affect his/her emotional health, social relationships, and self-image.

Prevalence

Estimates of the prevalence of vision problems vary considerably depending on: the types of vision problems included (specific type of vision problem or a range of vision problems); whether these problems are corrected; age group; how the problems were measured (based on report by parent or caregiver, based on eye examination, based on screening, or based on diagnosis information from healthcare records); and demographic and socioeconomic factors (national population, race and ethnicity, poverty status, and vulnerable communities).

Estimates that apply to a range of eye conditions: A comprehensive study on a wide range of eye conditions conducted using 1971-72 National Health and Nutrition Examination found that 22% of children aged 6 to 11 had at least one eye condition identified through ophthalmological examination.⁶⁸ This study covered a wide range of eye conditions, including minor ones unlikely to impair function. A more recent study based on 1996-2001 data using nationally representative Medical Expenditure Panel Surveys (MEPS) data found that approximately 7% of children younger than 18 years old living in the U.S. have a diagnosed eye and vision condition.⁶⁹ Because this estimate is based on diagnosis information which comes from a healthcare encounter, the authors state that this is likely to be close to prevalence of patients diagnosed, as opposed to the actual occurrence in the general population, and thus can be considered as the lower boundary of the true overall prevalence. The study also found that white children and children living in higher-income families were more likely to have a diagnosed condition, suggesting that there may be underdiagnosis and undertreatment in certain groups, in particular Hispanic children and children living in poverty.

Screening failure rates in underserved communities: Several studies in vulnerable communities indicate a high prevalence of unmet vision needs, based on screening failure rates ranging from 22% to 30%. In vision screenings conducted by Children's Health Fund in public elementary schools in underserved communities, just under 1 out of 4 children failed the screening and required follow-up (2014 to 2015 data).⁷⁰ Other vision screenings in schools serving disadvantaged populations have similar screening failure rates. In a study examining school vision screening on preschool through fifth grade children in lower socioeconomic areas in New York City, almost one third (30%) failed the screening and were referred for a comprehensive examination (1992 to 2002 data).⁷¹ In a study of 3 New York City public schools in 1998 -1999, 25% of children screened were referred, based on failure of one or more of the screening tests.⁷² In a study in a school district in Los Angeles, 22% of first graders had 1 or 2 ocular disorders.⁷³ In a screening of students aged 11 to 14 in 4 public intermediate schools located in Washington Heights, Manhattan, 28% had vision of 20/40 or worse in at least one eye. In the majority of cases, follow-up eye examinations confirmed the presence of refractive errors, most of which could be corrected with glasses (1995-96 data).⁷⁴

Refractive errors: Nationally, the prevalence of visual impairment due to uncorrected refractive error is about 18% in the 12 – 17 age group based on 2005 to 2008 National Health and Nutrition Examination Survey (NHANES) data.⁷⁵ A study of the 2005-2008 NHANES data further shows that 1 in 4 adolescents (24%) aged 12 to 19 with correctable refractive error were inadequately corrected and this rate was more than 1 in 3 for Mexican American (37%) and black (37%) children, suggesting barriers to accessing vision care.⁷⁶ Other studies look at specific types of refractive error. About 4% of children aged 6 months to 6 years and 9% of older children aged 5 to 17 years old have myopia, or nearsightedness. Prevalence of hyperopia, or farsightedness (when nearby objects appear blurry) is 21% among children 6 to 72 months of age and 13% among children aged 5 to 17 years. Between 15% to 28% of children aged 5 to 17 years have astigmatism, depending on the diagnostic threshold used.⁷⁷

Amblyopia and strabismus: Amblyopia is found in about 2% of 6- to 72-month-old children, and strabismus is found in between 2% and 4% of children under the age of 6 years.⁷⁸

Uncorrected or under corrected vision problems based on parent report: An estimated 2.6% of children aged 17 and under have trouble seeing, even when wearing glasses or contact lenses according to parents, based on 2014 National Health Interview Survey data.⁷⁹ This estimate is substantially lower than previously mentioned estimates of uncorrected refractive error in 12 to 17 year olds (18%) and of diagnosed vision and eye conditions in below in children younger than 18 years (7%), indicating the possibility that parents may not always know if their child has a problem seeing. This data also shows disparities by poverty, race, and ethnicity. Children from families below the poverty threshold had a rate 3 times that of the children from families earning more than 4 times the poverty threshold (43.3 vs. 14 per 1000, respectively). Hispanic or Latino children had a rate of 31.6 per 1,000 children, and black children had a rate of 29.8 per 1,000, which are 1.3 times and 1.2 times the rate of 24.4 per 1,000 for white children, respectively.

Unmet need for services

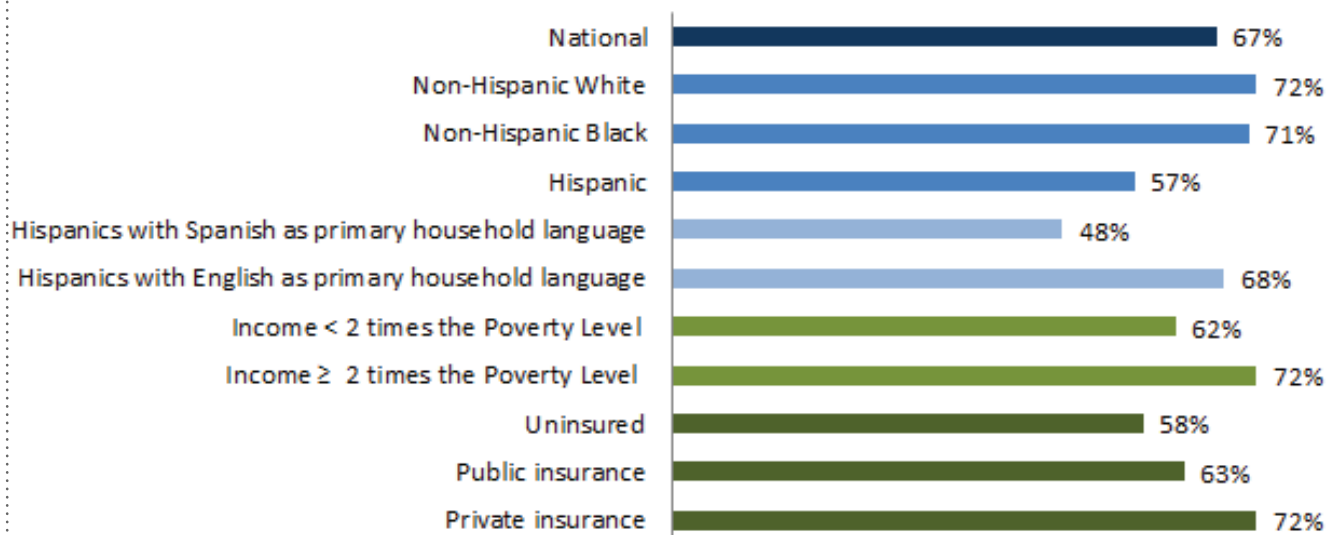
According to clinical guidelines, vision screening should occur annually (best practice) or at least once (acceptable minimum standard) between the ages of 3 and 6 years and every 1-2 years after the age of 5.^{80, 81} Children who fail vision screening should be referred for a comprehensive eye examination performed by an optometrist or ophthalmologist so that they can diagnose and treat eye disorders.⁸²

National data show that there is a significant gap between the recommendations of clinical guidelines and the actual vision testing rates among children. According to the 2011 National Survey of Children's Health, 40% of children aged 5 years and below had their vision tested at some point, 83% of children aged 6 to 11 years had their vision tested within the past two years and 67% of all children aged 0 to 17 had their vision tested in a timely way. Moreover, there are disparities by household income and education levels, insurance coverage, race/ethnicity and primary household language.

As shown in the following chart, receipt of vision testing in children aged 17 years and under varies by household income level (62% for children in households with incomes below twice the Federal Poverty Level versus 72% for children in households with incomes at or above twice the Federal Poverty Level), insurance status (58% for children who were uninsured at time of survey and 63% for children with public insurance, such as Medicaid/SCHIP, compared to 72% for children with private health insurance), race/ethnicity (57% for Hispanic children compared to 72% for white children and 71% black children), and primary language spoken in household (48% Hispanic children for whom Spanish is primary household language versus 68% Hispanic children for whom English is the primary household language).⁸³

Percent of Children Below 18 years who received timely vision testing

Source: 2011/12 National Survey of Children's Health



Another estimate of lack of vision testing comes from the 2009–2010 MEPS (Medical Expenditure Panel Survey) data. This survey found that about 78% of children had their vision checked by a doctor or other healthcare provider by the age of 6. This rate is substantially higher than the previously mentioned 40% rate from the 2011 National Survey for Children's Health because the 78% rate is restricted to children aged 5 years at the time of the MEPS survey whereas the 40% rate includes all children 5 years and younger in the NSCH survey. The 2009-2010 MEPS data also shows similar disparities by: race/ethnicity (70% of Hispanic children compared to 81% for white and 81% for black children), poverty level (69% for children in households with incomes below twice the Federal Poverty Level versus 85% for children in households with incomes at or above twice the Federal Poverty Level), and insurance status (39% for children without insurance and 73% of children with public insurance only, compared to 83% for children with private insurance).⁸⁴

Population-based data on children receiving diagnostic exams and treatment after failed screenings is not easily available.⁸⁵ In a study of vision screening of preschool children in pediatric clinics, less than half of those who failed the screening had documentation that they were referred for diagnostic exams.⁸⁶ In another study, as many as two-thirds of children who received referrals did not obtain the necessary care.⁸⁷ Findings from local studies show various barriers to follow up care, including cost, lack of access to providers, no vision insurance coverage for eye examinations and eyeglasses, parents' lack of awareness about the need for follow up, and inability to contact parents.⁸⁸ Findings from these studies coupled with the previously mentioned prevalence estimate of visual impairment due to uncorrected refractive error at about 18% in the 12 – 17 age group⁸⁹ and high rates of inadequately corrected refractive error among those with correctable refractive error for Mexican Americans (37%) and black (37%) children provide ample evidence of unmet needs for vision care.⁹⁰

Impact on learning

As described by the American Optometric Association (AOA), good vision is key to doing well in school. As much as 80% of learning occurs via the eyes through visual tasks such as reading, writing, and using computers. In order to effectively read and learn, the AOA states that every child needs the following vision skills:

- **“Visual acuity** — the ability to see clearly in the distance for viewing the chalkboard, at an intermediate distance for the computer, and up close for reading a book.
- **Eye focusing** — the ability to quickly and accurately maintain clear vision as the distance from objects change, such as when looking from the chalkboard to a paper on the desk and back. Eye focusing allows the child to easily maintain clear vision over time like when reading a book or writing a report.
- **Eye tracking** — the ability to keep the eyes on target when looking from one object to another, moving the eyes along a printed page, or following a moving object like a thrown ball.
- **Eye teaming** — the ability to coordinate and use both eyes together when moving the eyes along a printed page, and to be able to judge distances and see depth for class work and sports.
- **Eye-hand coordination** — the ability to use visual information to monitor and direct the hands when drawing a picture or trying to hit a ball.
- **Visual perception** — the ability to organize images on a printed page into letters, words and ideas and to understand and remember what is read.”

As the AOA states, undeveloped or poorly developed visual skills make learning difficult and stressful. As a result, children may avoid reading and other near visual work, do the work less efficiently and experience discomfort, fatigue, and a short attention span.

Considerable research on the learning consequences of vision problems has been documented in two literature reviews: i) “Vision and the Achievement Gap Among Urban Minority Youth” by Charles Basch published in 2011 and ii) “Learning-related Vision and Academic Success: A Meta-Analytical Study” by Katherine J. Minton published in 2005. The majority of the research focuses on the impact of vision problems on children’s ability to read. What follows is a summary of findings from these literature reviews as well as other sources. Findings are organized by vision problem or vision skills area.

Refractive Errors

Hyperopia: Though children tend not to require correction of low levels of hyperopia as their eyes can self-adjust, several studies show an association between varying levels of uncorrected hyperopia and poor reading performance. Basch’s literature review cites studies of elementary school children where hyperopia has been associated with poorer performance on standardized measures of literacy, standardized reading test scores and percentile ranking on the Iowa Test of Basic Skills.⁹¹ A small pilot study cited by Basch’s literature reviews compares children with hyperopia and children with ideal vision (emmetropic) and finds that uncorrected hyperopic children, ages 4 to 7 years, perform worse on tests of letter and word recognition, receptive vocabulary, and emergent orthography, despite no difference in selected variables that are known to affect the acquisition of literacy skills (phonological awareness skills, visual cognitive skills, and other family variables known to affect the acquisition of literacy skills).⁹² However, this study cautions that it is unclear if the relationship between hyperopia and the poorer progress in emergent literacy is causal and whether the hyperopes will catch up with the emmetropes in time. A larger more recently published study that also compares the literacy skills of 4- and 5-year-old children with uncorrected hyperopia with the skills of emmetropic children similarly concludes that after adjustment for age, race/ethnicity, and parent/caregiver’s education, children with significant uncorrected hyperopia perform significantly worse on a Test of Preschool Early Literacy (TOPEL), composed of Print

Knowledge, Definitional Vocabulary, and Phonological Awareness subtests.⁹³ In an effort to address the methodological limitations of studies that use cross-sectional or case control design that have found associations between uncorrected hyperopia but cannot prove causality, another study took a novel approach of simulating hyperopia in visually normal children (mean age of 10.9) and studying their academic performance under the conditions of normal vision and simulated hyperopia.⁹⁴ This study found that simulated hyperopia resulted in poorer performance on reading (rate, accuracy, and comprehension), visual information processing (a child's ability to focus attention, quickly scan, discriminate between and sequentially order visual information) and reading-related eye movement performance. Collectively, these studies point to the need to screen and address significant, uncorrected hyperopia as needed in order to maximize children's ability to read to their potential.

Myopia: Evidence of the association between uncorrected myopia and lower academic performance is provided by a randomized controlled trial study that finds the provision of free glasses to Chinese children in rural western China with myopia improves their performance on mathematics testing to a statistically significant degree. Furthermore, the effect on performance was larger for children in classrooms where blackboards were used more regularly.⁹⁵ The authors concluded that the effect of myopia on classroom learning is not well understood and they were not able to find other randomized controlled trials to examine the impact of correcting myopia on school performance.

Astigmatism: A study of pre-kindergarten children in a Head Start program found that children with astigmatism performed consistently lower than their peers without astigmatism in the areas of language and literacy, physical health, and development and communication, though a causal relationship could not be established.⁹⁶ These findings point to the need for research to explore the causal mechanism underlying the association between astigmatism and academic readiness. To understand the impact of uncorrected astigmatism on reading, another study looked at the effect of induced astigmatic refractive error in young adults on a selection of standardized clinical measures of reading performance. This study found that induced astigmatic blur resulted in poor word recognition and slow reading rate.⁹⁷

Amblyopia

Several studies looked at the impact of amblyopia on reading and motor skills. A study investigating reading and associated eye movements in school-age children found that amblyopic children read more slowly compared with non-amblyopic children with treated strabismus and normal controls.⁹⁸ Another study looked at the impact of amblyopia on children's ability to perform a range of standardized age-appropriate tasks that assess motor skills needed in practical, everyday tasks and found that children with amblyopia perform more poorly, particularly on manual dexterity tasks that require speed and accuracy.⁹⁹

Visual motor integration

Both Basch's and Minton's literature reviews cite studies finding that low visual perception and/or visual motor integration was associated with low reading achievement. For example, a study cited by Basch's review on students in kindergarten through third grade finds that visual motor integration skills are significantly related to academic performance (as measured by teachers' ratings of children's ability in reading, math, spelling and writing).¹⁰⁰ Another study that compared children with normal visual integration and children with low visual integration found that low visual integration group made significantly more errors in educational activities that require accurate placement of letters and numbers on a page.¹⁰¹ However, in contrast, a recently published study that looks at how visual motor skills relate to reading achievement when taking into account precursor and reading-related skills finds that the contribution of visual motor integration skills to reading achievement reduces when language-based skills are taken into account.¹⁰²

This study's authors state that prior research on visual-motor performance and reading ability have produced mixed findings, partly because some studies have not taken into account known predictors of early reading skills, particularly language-related predictors.

Tracking

Minton's literature review "Learning-related Vision and Academic Success: A Meta-Analytical Study" concludes that the studies included in the literature review find low tracking skills are associated with low reading achievement. Basch's literature review cites studies showing that the stability of binocular control, which is essential for tracking, is associated with reading and with spelling skills. Another study cited by Basch finds suggests that tracking skills are a risk factor for low levels of reading ability in adolescents.

Other visual skills

Both the literature reviews by Basch and Minton cite studies that find associations between low levels of other visual skills (convergence, stereoacuity, accommodation/focusing), and reading.

Conclusions

Key points:

- Uncorrected vision problems and low rates of timely vision testing are highly prevalent among children from poor families, black children, Hispanic children, uninsured children, and children on public insurance.
- Good vision is key to doing well in school because as much as 80% of learning occurs through visual tasks such as reading, writing, and using computers. Studies provide ample evidence showing that uncorrected vision problems and the lack of certain visual skills undermine a child's ability to read, an ability which is critical to academic achievement.
- These findings clearly underscore the importance of early vision screening and comprehensive vision examinations for children who fail vision screening so that vision problems don't undermine a child's academic readiness and performance.

3. UNADDRESSED HEARING PROBLEMS

This section contains: a description of the types of hearing problems that affect children; the prevalence of hearing problems; unmet needs for hearing screening, diagnosis and treatment; and evidence on the learning consequences of unaddressed hearing problems.



Definitions

Normal hearing was defined in 1965 by the American Academy of Ophthalmology and Otolaryngology (AAOO) as any hearing loss up to 26 dB. This level of hearing loss is the point at which an individual begins to find it difficult to understand typical speech in a quiet environment. The AAOO guidelines around normal hearing have not changed since this cutoff was established and are supported by the American Medical Association and the American Academy of Audiology.

Hearing deficits are categorized and defined in various ways, and there is variation in defining levels of hearing loss across countries, states, and health care providers. There are no widely agreed upon definitions for all types and levels of hearing loss. The American Speech-Language-Hearing Association (ASHA) categorizes and defines hearing loss primarily by type, degree, and configuration.¹⁰³

Type of Hearing Loss (as defined by ASHA)

- **Sensorineural hearing loss (SNHL)** is the most common type of permanent hearing loss and “happens when there is damage to the inner ear (cochlea) or to the nerve pathways from the inner ear to the brain.” Audible speech may be unclear or sound muffled. This type of hearing loss can usually not be corrected with medical treatment or surgery. SNHL can be caused by:
 - Drugs that are toxic to hearing
 - Hearing loss that runs in the family (genetic or hereditary)
 - Head trauma
 - Malformation of the inner ear
 - Exposure to loud noise
- **Conductive hearing loss** “occurs when sound is not sent easily through the outer ear canal to the eardrum and the tiny bones (ossicles) of the middle ear.” Sounds will seem softer and less easy to hear. Conductive hearing loss often can be resolved medically or surgically. Conductive hearing loss can be caused by
 - Fluid in the middle ear from colds or allergies
 - Ear infection (otitis media)
 - Poor eustachian tube function
 - Hole in the eardrum
 - Tumors in the middle ear
 - Too much earwax (cerumen)
 - Swimmer’s ear (external otitis)
 - Foreign body in the ear canal
 - Malformation of the outer ear, ear canal, or middle ear
- **Mixed hearing loss** occurs when a conductive hearing loss happens in combination with an SNHL.

Degree of Hearing Loss (as defined by ASHA)

Degree of hearing loss is measured in decibels (dB).¹⁰⁴ The commonly used categories of degree of hearing loss are shown in the table below.

Degree of Hearing Loss	Range (dB HL)
Normal	-10 to 15
Slight/Minimal	16 to 25
Mild	26 to 40
Moderate	41 to 55
Moderately Severe	56 to 70
Severe	71 to 90
Profound	91+

Other important descriptors of hearing loss

- **Bilateral hearing loss** is hearing loss in both ears. **Unilateral hearing loss** is hearing loss in only one ear.
- **Progressive hearing loss** is hearing loss that worsens over time. **Sudden hearing loss** happens quickly and requires immediate medical attention to determine cause and treatment.
- **Fluctuating hearing loss** is hearing loss (usually conductive) that changes over time, sometime getting better, sometimes getting worse.
- **Symmetrical hearing loss** means the degree of hearing loss is the same in both ears. **Asymmetrical hearing loss** means the degree of hearing loss differs between ears.
- For school-age children, **hearing impairment** is defined as unilateral or bilateral sensorineural and/or conductive hearing loss greater than 20 dB HL in the frequency region most important for speech recognition (approximately 500 to 4000 Hz). **Educationally significant hearing loss** has been defined as “any hearing loss that potentially interferes with access to classroom instruction and impacts a child or youth’s ability to communicate, learn, and develop peer relationships.”¹⁰⁵

Prevalence

Prevalence of congenital hearing loss in newborns ranges between 1 and 6 per 1,000 babies born in the US each year with some degree of permanent hearing loss.¹⁰⁶ Although 95% of newborns receive hearing screening in the US, screening will still miss children who have undetected hearing loss and/or acquired hearing loss at school age.¹⁰⁷ An estimated 9 to 10 children out of every 1000 have identifiable permanent hearing loss in one or both ears by school-age.¹⁰⁸ The Third National Health and Nutrition Examination Survey data shows almost 15% of school aged children in the United States have some degree of hearing loss (more than 7 million in the 6-19 age range).¹⁰⁹ Noise-induced hearing loss is an increasing concern for children and adolescents. In 2001, Niskar et al. (2001) estimated that 12.5% of U.S. children (ages 6 to 19) have evidence of noise-induced hearing threshold change, and concerns exist for loud headphone, stereo, and TV exposure.¹¹⁰

Unmet need for services

The Joint Committee on Infant Hearing (JCIH) outlines guidelines for early hearing detection and intervention programs. Universal newborn hearing screening (UNHS) has become a standard of practice in the United States in the past two decades. JCIH first endorsed the goal of universal detection of newborn hearing loss in a 1994 position statement. In 1999, the American Academy of Pediatrics (AAP) released a statement which officially recommended universal newborn hearing screening (UNHS).¹¹¹ UNHS was also integrated into Healthy People 2010 goals.

The American Academy of Pediatrics (AAP) Bright Futures Guidelines recommend children to be screened at the newborn visit and well child visits at age 4, 5, 6, 8, and 10.¹¹² For school aged children, ASHA recommendations support completion of a hearing screening for all children in grades K, 1, 2, 3, 7, and 11.¹¹³ ASHA lists the following risk factors as warranting the need for a hearing screening in other years:

1. Parent/care provider, health care provider, teacher, or other school personnel have concerns regarding hearing, speech, language, or learning abilities;
2. Family history of late or delayed onset hereditary hearing loss;
3. Recurrent or persistent otitis media with effusion for at least 3 months;
4. Craniofacial anomalies, including those with morphological abnormalities of the pinna and ear canal;
5. Stigmata or other findings associated with a syndrome known to include sensorineural and/or conductive hearing loss;
6. Head trauma with loss of consciousness;
7. Reported exposure to potentially damaging noise levels or ototoxic drugs.

Additionally, ASHA supports hearing screening upon entrance into special education, when a child repeats a grade, or when a child enters a new school system without record of having passed a previous screening.¹¹⁴

Current state of hearing screening

Most children with hearing loss present at birth are identifiable by newborn and infant hearing screening.¹¹⁵ Screening newborns for hearing loss is now standard and occurs for more than 95% of infants born in the US.¹¹⁶ However, despite a 95% screening rate for newborns, many children still reach school age with untreated or undiagnosed hearing deficits. Hearing loss can remain unaddressed in children for the following reasons¹¹⁷:

- Hearing screenings use equipment targeting hearing loss of 30-40 dB or more. ASHA guidelines support a minimal screening level of 20 dB HL for school aged children because literature supports a possible risk for academic and communicative difficulties even from minimal hearing loss (16-25 dB HL).¹¹⁸
- All infants failing a screen do not receive diagnostic services. Nearly half of newborn infants who fail the initial screening do not have the follow up that is needed to confirm hearing loss, and start early intervention as required.¹¹⁹
- Universal newborn hearing screening doesn't identify children with late onset, acquired, or many cases of progressive hearing loss. Hearing loss also can be acquired during infancy or childhood for various reasons. Infectious diseases, especially meningitis and cytomegalovirus, are a leading cause of acquired hearing loss. Trauma to the nervous system, damaging noise levels, and ototoxic drugs can all place a child at risk as well. Otitis media is a common cause of hearing loss, though in this case, often temporary or reversible.¹²⁰

Regulation for child hearing screening, diagnosis, and treatment varies greatly among states. A 2012-2013 review of state Medicaid laws and policies showed most states mandate providers to follow the Bright Futures/AAP schedule for screening, however some states use an outdated version of the guidelines and others use a completely separate schedule. Only half of states have any regulations that guide providers in content of age-appropriate screening and over half of states provide no regulated guidelines at all for how providers should refer children based on results of a screening.¹²¹ Likewise, state governments vary in regulation of hearing screenings in the school setting.¹²²

In addition, monitoring of hearing screening is mostly unregulated and inconsistent across states. In 1999, Centers for Medicaid Services (CMS) eliminated a requirement for states to report on the number of children receiving hearing screening, diagnosis of hearing problems, and treatment services. As a result, there is no longer a good source of data regarding provision of hearing screening services for children.

Impact on learning

The American Academy of Audiology (AAA) released the *Childhood Hearing Screening Guidelines* report in September 2011. A Subcommittee on Childhood Hearing was formed to produce the report outlining recommendations based on current evidence for hearing screening of children age 6 months through high school. The AAA guidelines include the current state of literature linking hearing deficits to educational outcomes. This report is a primary source for information presented here as the content from the AAA related to education outcomes is thorough and accurately based in the current literature.¹²³

A growing body of literature finds that deaf or hard of hearing infants who are identified and receive intervention by no later than 6 months of age perform significantly better on school-related measures than those who don't receive intervention before 6 months of age. School-related measures include vocabulary, articulation, intelligibility, social adjustment, and behavior.¹²⁴ This supports the benefit of early identification and intervention through universal newborn hearing screening as a mitigator of poor academic outcomes later in life for children with hearing loss.

For school aged children, the setting of the classroom is an environment requiring students and teachers to be able to accurately transmit and receive speech in order for effective learning to occur.¹²⁵ Research supports that in a typical classroom, often noisy with poor acoustics, even fluctuating hearing loss interferes with reception of speech.¹²⁶ The effects of hearing loss on students vary depending on type and severity of hearing deficit.

A child with severe hearing loss will most likely be identified by a parent or doctor before the age of school entry. Therefore, the focus of literature for school aged children tends towards hearing loss that is milder, unilateral, late onset (i.e. high frequency hearing loss), or fluctuating (i.e. hearing loss caused by ear infections). The *Childhood Hearing Screening Guidelines* released by the AAA highlights the literature showing educational impact of hearing loss for these categories: (1) Minimal sensorineural hearing loss (2) Unilateral hearing loss (3) Hearing loss due to otitis media with effusion.¹²⁷ Summary of content is presented here.

Minimal sensorineural hearing loss and impact on academics

Milder levels of hearing loss have been a focus of research for several decades. Minimal sensorineural hearing loss (MSHL) can be bilateral, unilateral, or high frequency. A study by Bess, Dodd-Murphy and Parker in 1998 explored outcomes for a group of 1200 3rd, 6th, and 9th grade children with minimal sensorineural hearing loss¹²⁸. The study found that 3rd grade children with MSHL performed lower on education tests. For 6th and 9th graders with MSHL, greater dysfunction in behavior, energy, stress, social support, and self-esteem was found compared to children with normal hearing. Also, the study found 37%

of children with MSHL failed at least one grade.¹²⁹ Another study found children with MSHL were 4.3 times more likely to have speech-language deficits, and higher rates of social emotional difficulties including lower self-esteem and less energy.¹³⁰

Unilateral hearing loss and impact on academics

Historically, it was commonly accepted that unilateral hearing loss (UHL) did not have an impact on a child's language and speech development because it was assumed these would not be influenced if a child had one normal functioning ear. However, research from the 80s and 90s as well as more recent literature, supports the potential for UHL to impact learning.

A study by Bess et. al (1982) explored the link between unilateral hearing loss (UHL) and a child's ability to function well in the classroom setting. Children with hearing loss of 20 dB and greater in one ear were included. Results showed children with UHL had a slightly higher incidence of behavior problems and 37% of children with unilateral hearing loss had repeated a grade. No difference was found in language skills and intelligence between children with UHL and children with normal hearing.¹³¹

In 2004, Lieu and colleagues conducted a literature review of research from 1966 through 2003 that explored UHL and educational outcomes. The review reflected an increased likelihood of children with UHL repeating a grade (rates ranged from 22%-37% in studies). Research also supported some increased need for more educational assistance for children with UHL (rates ranged from 12%-41%). Literature was mixed around language and speech delays, with some studies showing delays for children with UHL.¹³²

In 2010, Lieu et al. conducted a study pairing 74 children aged 6-12 years with UHL with a normal hearing sibling to explore differences in educational outcomes. Siblings with UHL performed worse on language tests than normal hearing siblings. Family income and mother's level of education were found to be independent factors for lower language scores. This study suggests children in poverty with UHL are at an even higher risk of negative impacts on language.¹³³

Hearing loss related to ear infection and impact on academics

Hearing deficits due to ear infections are potentially of special interest for children in poverty. Otitis media with effusion (OME), fluid in the middle ear that does not present signs of an acute ear infection, makes up more than 90% of all middle ear pathology in children.¹³⁴ OME can cause conductive hearing loss. Around 25% of school aged children, primarily in early grades, experience OME sometime throughout the school year.¹³⁵ Literature exploring the link between hearing deficits due to recurrent ear infections (otitis media) and academic outcomes is highly mixed with no clear consensus. There is a breadth of literature from the 1990s that links otitis media to educational outcomes like speech and language delays, reading problems, and attention problems. However, this literature has received much criticism. A 2004 literature review by Roberts et al. concluded that the link between hearing loss caused by OME and outcomes including development of speech and language, auditory processing, academics, attention, and behavior was not clear. However, for children from underserved populations who might receive fewer well child care visits than recommended and therefore potentially experience longer lasting or recurrent episodes of OME, the risk of poor academic outcomes may be higher. Further research is needed in this population to explore the link more closely.

Conclusions

Key points:

- Despite early screening and intervention recommendations, hearing loss is still prevalent in school aged populations. Late onset hearing loss due to exposure to loud sounds in older children (i.e. use of headphones) is also becoming a concern.
- Hearing problems and their consequences are best addressed before school age. However, universal newborn screening and routine hearing screens during well child checks still fail to capture all children with hearing loss. In addition, children who are identified as having hearing loss at an early age frequently do not receive services as early or robustly as needed to minimize the impact of hearing loss on development, particularly lower income populations who have barriers such as lack of access to insurance or transportation.
- Hearing loss can affect a child's ability to speak and learn. Even minimal hearing loss or loss of hearing in one ear can affect school performance. Research is mixed, but also shows a possible link between recurrent ear infections and ability to learn.

4. DENTAL PAIN

The following section contains: a description of dental caries; their prevalence, with a focus on disparities; the unmet need for services; and the learning consequences of dental problems.



Definitions

The most common cause of toothache is dental decay, also known as dental caries.¹³⁶ Dental decay is caused by specific types of bacteria that produce acid that destroys the tooth's enamel and the layer under it, the dentin. As the dentin and enamel break down, a cavity is created. If the decay is not removed, bacteria will continue to grow and produce acid that eventually will get into the tooth's inner layer. This layer contains the soft pulp and sensitive nerve fibers.¹³⁷

Left untreated, tooth decay leads to pain and infection, which, in addition to other health effects, can result in problems with learning, eating and speaking.¹³⁸ Moreover, the incidence of sepsis ranges from 5% to 10% for children with untreated caries, which in rare instances, can lead to fatal systemic infections.¹³⁹

Prevalence

This section summarizes the prevalence of dental caries (treated and untreated) and untreated dental caries.

Dental caries

Dental caries is one of the most common chronic conditions in childhood. Recent national data from 2011-2012 shows that the prevalence of dental caries (treated and untreated) increases with age and is high in black children, Hispanic children and children in poverty.

In young children, about 37% of children aged 2–8 years have caries in primary teeth, with prevalence increasing with age from about 23% of 2 to 5 year olds to 56% of 6 to 8 year olds. Among younger children in the 2 to 8 age group, caries prevalence in primary teeth for Hispanic (46%) and black (44%) children was more than 1.4 times that of white children (31%).¹⁴⁰

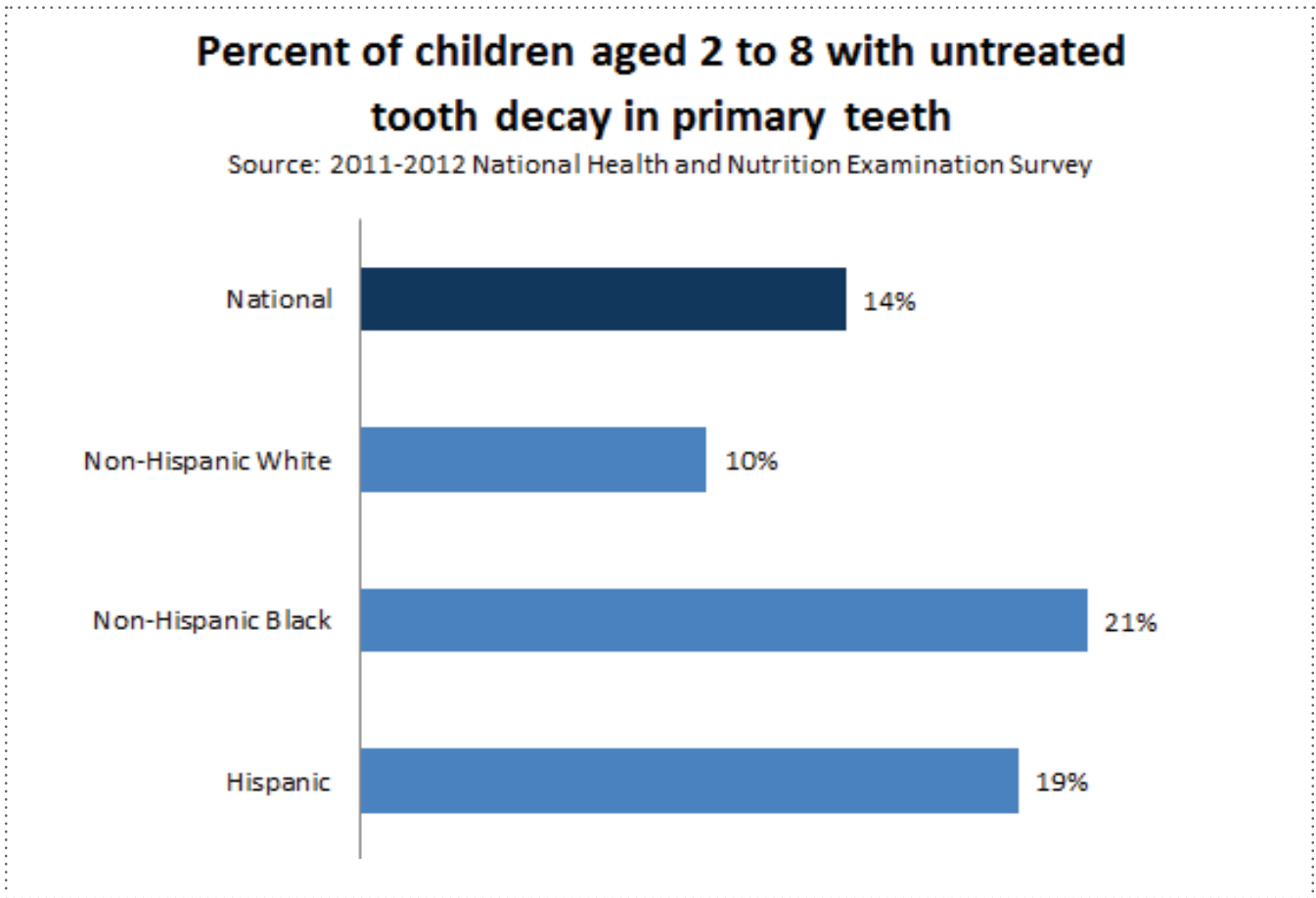
In older children, caries prevalence in permanent teeth increases from 21% in 6 to 11 year olds to 58% in 12 to 19 year olds. Hispanic children aged 6 to 11 (27%) had a higher caries prevalence, compared with white children (19%). Overall, the prevalence of caries did not significantly differ by race and Hispanic origin among adolescents.¹⁴¹

Disparities by poverty status are striking. About 69% of children aged 6 to 9 living in families below the poverty threshold have dental caries, which is almost twice the rate of caries prevalence (37%) in children who are better off (living at least 5 times above the poverty threshold).¹⁴²

Untreated dental caries

Not only do Hispanic children, black children and children in poverty have a greater prevalence of tooth decay, they also tend to have a higher prevalence of untreated tooth decay.

In young children aged 2 to 8, based on 2011-2012 national data, about 14% of children had untreated tooth decay in primary teeth. The rates for black children (21%) and Hispanic children (19%) is about double the rate of white children (10%).¹⁴³



In the 6 to 9 age group, about 22% of children had untreated caries in their permanent and primary teeth, with rates being particularly high in black children (32%), Mexican American children (29%) and children living below the poverty threshold (27%).¹⁴⁴

Overall, 15% of adolescents aged 12 to 19 have untreated caries. While prevalence of caries (treated or untreated) did not differ significantly by race and ethnicity among adolescents, prevalence of untreated caries was significantly higher for black adolescents (21%) compared with white adolescents (13%).¹⁴⁵

Some studies of disadvantaged communities in the US show even higher rates of untreated caries than the national rates, with the caveat that there may be differences in measurement methodology. In a study of under-privileged children in WIC centers (federally-funded Special Supplemental Nutrition Program for Women, Infants and Children), Head Start programs, and elementary and high schools serving high-poverty student populations in Los Angeles, 73% of 2 to 16 year olds had untreated dental caries.¹⁴⁶

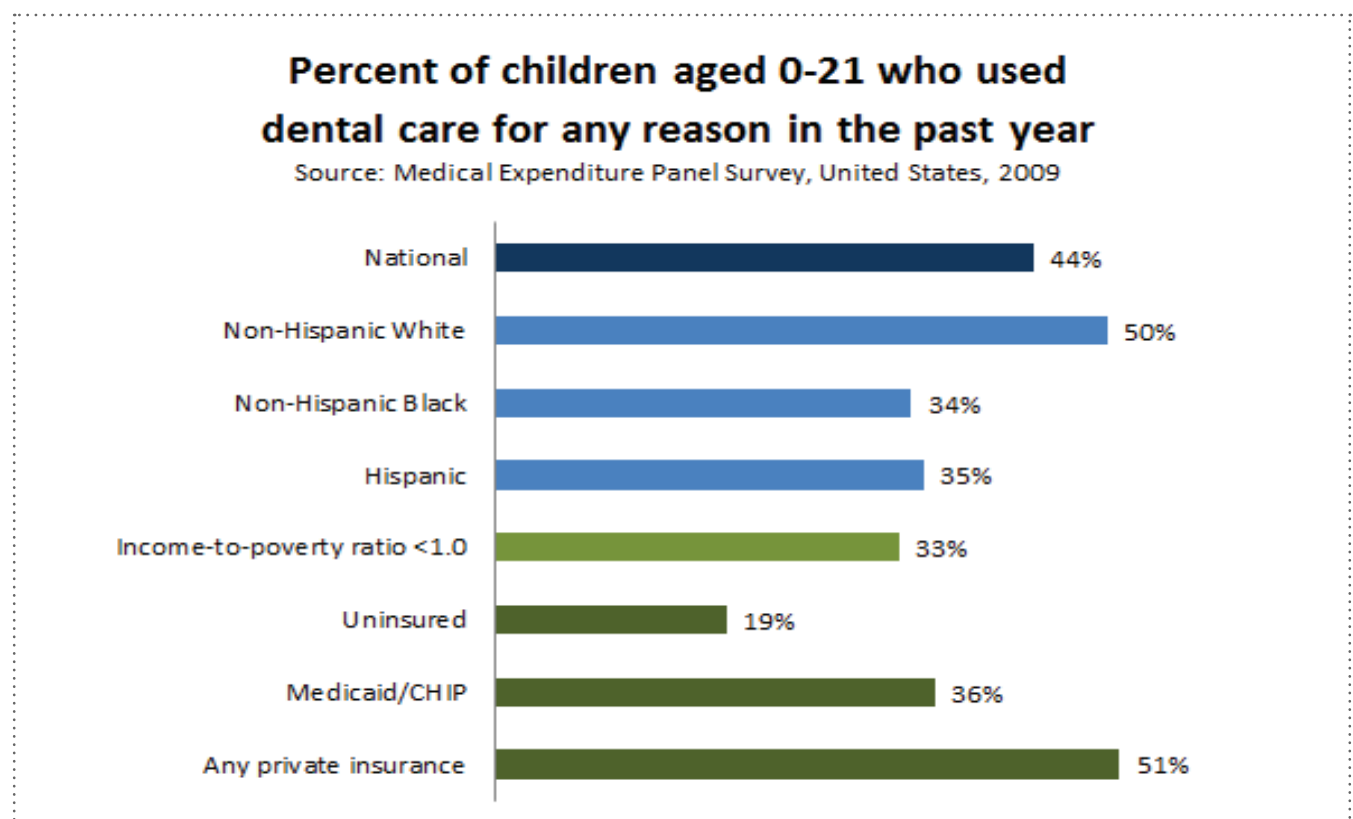
Unmet need for services

In general, the percentage of children with untreated caries has reduced over time,¹⁴⁷ suggesting that children are getting access to treatment or restorative care. However, the prevalence of caries (treated or untreated) remains high over time.¹⁴⁸ Therefore, there is a need to ensure that children receive regular,

preventive dental care, which is key to preventing and identifying dental decay, before it causes pain and infection and interferes with a child’s ability to function. Ideally, as recommended by American Academy of Pediatric Dentistry, families should have access to a dental home by the time their child is 1 year old and a child should be seen by a dentist every 6 months. Furthermore, dental sealants and fluoride are effective in preventing and controlling tooth decay, and these measures are recommended for children at risk of tooth decay.¹⁴⁹

To reduce children’s caries: (1) More than 13 U.S. national institutes, organizations and federal agencies recommend school-based caries prevention, including sealants and fluoride varnish.¹⁵⁰ (2) Healthy People 2010 and 2020 set goals for school-based oral health education and caries prevention.¹⁵¹ (3) Medicaid expenditures for children’s oral health care increased from \$7b to \$15b over the last 10 years.¹⁵² (4) The number of U.S. dentists and hygienists both increased by more than 10%.¹⁵³ As a national health issue, untreated caries is identified as #19 among the Institute of Medicine’s “100 Priority Topics for Comparative Effectiveness Research” and #17 on the Patient Centered Outcomes Research Institute.

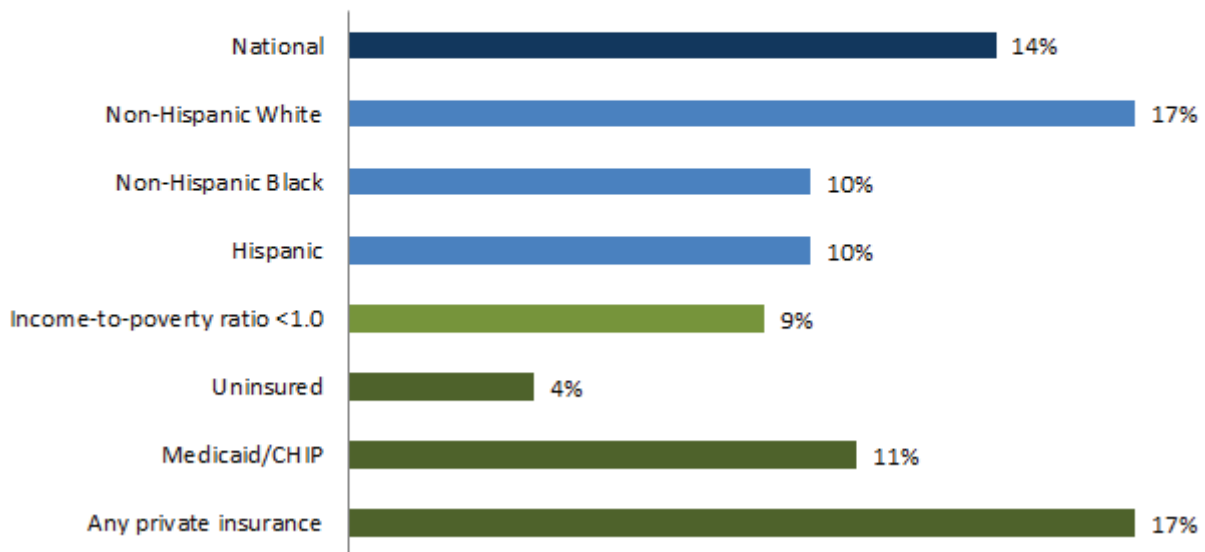
Paradoxically, however, less than 40% of U.S. dentists provide sealants.¹⁵⁴ National data shows that there is a considerable gap between best practice recommendations for dental care and the actual receipt of dental care. According to 2009 data, less than half of children aged 21 years and below (44%) used dental care (for any reason, not just preventive) and only 14% received a preventive dental service (i.e., topical fluoride, sealants, or both) in the past year. Children who were significantly less likely to use dental care and receive preventive services are black (34% for dental care, 10% for preventive services), Hispanic (35% for dental care, 10% for preventive services), and come from low-income families (33% for dental care, 9% for preventive services).¹⁵⁵



Percent of children aged 0-21 who received a preventive dental service* in the past year

Source: Medical Expenditure Panel Survey, United States, 2009

*Preventive dental service refers to topical fluoride, sealants, or both.



More recent 2011-2012 data also shows a shortfall in use of dental sealants. Among 6 to 11 year olds, 41% of children had at least one dental sealant on a permanent tooth, with black and Asian children (each about 31%) having a lower rate compared with white children (44%). Hispanic children (40%) had higher dental sealant prevalence compared with black children (31%).¹⁵⁶

Impact on learning

Research shows that dental problems undermine a child's ability to learn by causing missed school days, loss of sleep and inability to pay attention. Studies also find that dental problems are associated with poor school performance and adverse psychosocial outcomes. What follows is an overview of the evidence examining the link between dental problems and each of these learning consequences.

Missed school days/absenteeism

Findings from several studies quantify the magnitude of missing school specifically due to dental problems in various ways: percentage of children missing school specifically due to dental problems, the number of missed school days per 100 school children and the average number of missed school days per child.

Studies show that between 4% to 7% of students miss school due to dental problems. The percentage of children missing school specifically due to dental problems ranges from 4% missing school due to dental pain or infection in a North Carolina statewide study¹⁵⁷ to 6% missing school due to dental problems in a disadvantaged student population in LA¹⁵⁸ to 7% in a California statewide survey.¹⁵⁹ In a study based in Flint, MI, dental pain kept 13% of children home from school.¹⁶⁰ While there are differences in how dental problems and absences were defined and measured across each of these studies, these estimates suggest that at least 1 to 3 students out of a typical classroom of 20 students¹⁶¹ miss school specifically due to dental problems.

Rates of missing school are higher among children with toothaches, poor access to dental care and lower oral health status. The LA study of a disadvantaged population found that students with a toothache in the past 6 months were nearly 6 times more likely to miss school compared with students who did not. Further students who needed dental care but were unable to access it were 3 times more likely to miss school days because of dental problems than were those with access to dental care.¹⁶² The statewide North Carolina study similarly found a higher likelihood of absences caused by dental pain or infection among uninsured children and publicly insured children (versus privately insured) and children who had lower oral health status (versus those with very good or excellent oral health status).¹⁶³

In terms of number of school days missed, the statewide California study finds that for those who missed school due to a dental problem, 40% missed 2 or more days. Moreover, certain groups tend to miss 2 or more days: children who cannot afford needed dental care (73%) versus children who can afford needed dental care (36%); children without dental insurance (59%) versus children with private dental insurance (33%); children below the Federal Poverty Level (53%) versus children with family incomes at least 3 times the Federal Poverty Level (30%); and Limited English-proficient speakers (52%) versus Native or fluent English speakers (30%).¹⁶⁴ Another study provides a frequently quoted albeit more than 25 year old national statistic of 117 hours per 100 school children (also expressed as 51 million school hours missed).¹⁶⁵ A more reliable, conservative estimate from the recent 2011 study of a disadvantaged population in LA is 58 school hours missed each year per 100 elementary school-aged children and 80 school hours missed each year per 100 high school-aged children.¹⁶⁶ The key point here is that many hours lost due to dental problems can be prevented by routine, preventive dental care.

Poor school performance

Three large observational cross-sectional studies found a statistically significant association between poor dental health and poor school performance. While these studies cannot establish a cause and effect relationship, they provide strong evidence of a statistically significant association, and intuitively and quantitatively support the findings discussed in the previous section.¹⁶⁷

One of the more comprehensive studies, using data from the 2007 National Survey of Children's Health, applies models that adjust for demographic, socioeconomic, health variables that may be related to dental health and the study outcomes of school performance and psychosocial well-being.¹⁶⁸ This study also accounted for differences in dental care availability and quality and children's dental health between states. The study found that children with dental problems are significantly more likely to have problems at school and are less likely to do all the required homework.

The statewide North Carolina study controls for child's gender, race, Hispanic ethnicity, grade in school, highest level of education achieved in the household, and health insurance coverage.¹⁶⁹ The study finds that children with lower oral health status were more likely to perform poorly in school, and this association was independent of absence related to dental pain. The study also finds that school absences caused by dental pain or infection were significantly related to poor school performance whereas school absences for routine dental care were not. The authors state that their findings suggest that a child with poor oral health is more likely to have pain or infection that not only puts them at risk of missing school but also undermines their ability to perform while at school or at home.

The LA study of a disadvantaged student population, which adjusts for type of school, gender and race/ethnicity, finds that high school students with toothaches in the past 6 months were almost 4 times more likely to have a GPA lower than the median of 2.8 compared with students without it.¹⁷⁰

Loss of sleep and inability to pay attention in class

Dental problems can also result in loss of sleep and inability to pay attention in class. In a study of dental problems in kindergarten and elementary schools in Flint and Genesee County, 20% of the children said a toothache kept them up at night, and nearly 20% said a toothache made it difficult for them to pay attention in the classroom.¹⁷¹ In another study of a small outpatient clinic-based sample of children experiencing acute dental pain resulting from dental caries, 66% of children had pain which kept them from sleeping.¹⁷²

Psycho-social outcomes

The previously discussed national study using 2007 National Survey of Children's Health data finds statistically significant associations between dental problems and poor psychosocial outcomes.¹⁷³ Children with dental problems are more likely to feel worthless/inferior, shy, and unhappy/sad/depressed and are less likely to be friendly. The study finds that the link between dental problems and poor psychosocial outcomes is larger for adolescents. This finding underscores the value of intervening early to improve child dental health in order to prevent adverse effects on psychosocial well being later in life.

Conclusions

Key points:

- Black children, Hispanic children and children in poverty have significantly higher rates of dental decay, a higher likelihood that their dental decay is untreated and lower rates of receiving preventive services and dental care, compared with white children and children from higher-income families.
- These disadvantaged groups of children are therefore vulnerable to the learning consequences of dental problems which are missed school days, lost sleep and inability to pay attention. Dental problems are also strongly associated with poor school performance and adverse psychosocial outcomes, with the caveat that a cause-effect relationship cannot be proven by the cross-sectional observational studies that examined these associations.
- Collectively, these findings clearly show the need for disadvantaged children to receive regular preventive services and have access to dental care, so that dental problems don't impede their ability to learn. For at-risk populations, bringing care to kids—such as by bringing preventive services to schools—rather than kids to care reduces barriers to care and offers a greater economy of scale.¹⁷⁴

5. PERSISTENT HUNGER

The following section contains: definitions of food insecurity and hunger; prevalence, with a focus on disparities; the unmet need for services; and the learning consequences of food insecurity and hunger.



Definitions

From the 2014 Household Food Security report: Households are considered “food secure” when all members have access to enough food at all times for an active, healthy life. Thus, household food insecurity means that, at times, households were unable to acquire adequate food for one or more household members because they didn’t have enough money and other resources for food.¹⁷⁵

Similarly, chronic hunger is generally a result of the unavailability of the monetary or community resources needed to access adequate food.

And while hunger in the United States does not normally take the form of starvation, nonetheless its effects have been proven to jeopardize children’s chances to learn and thrive.¹⁷⁶ The concepts of food insecurity and hunger are thus correlated, with persistent hunger being a potential consequence of high levels of food insufficiency. The definition of hunger cited by the USDA is “a potential consequence of food insecurity that, because of prolonged, involuntary lack of food, results in discomfort, illness, weakness, or pain that goes beyond the usual uneasy sensation.”¹⁷⁷

Food security is routinely assessed by the FDA Economic Research Service, analyzing the CFSM data collected by the Current Population Survey of the Census Bureau. The scale explores a broad range of experiences of food insecurity, ranging from anxiety that the food would run out, to instances of reduced food intake by children.^{178,179}

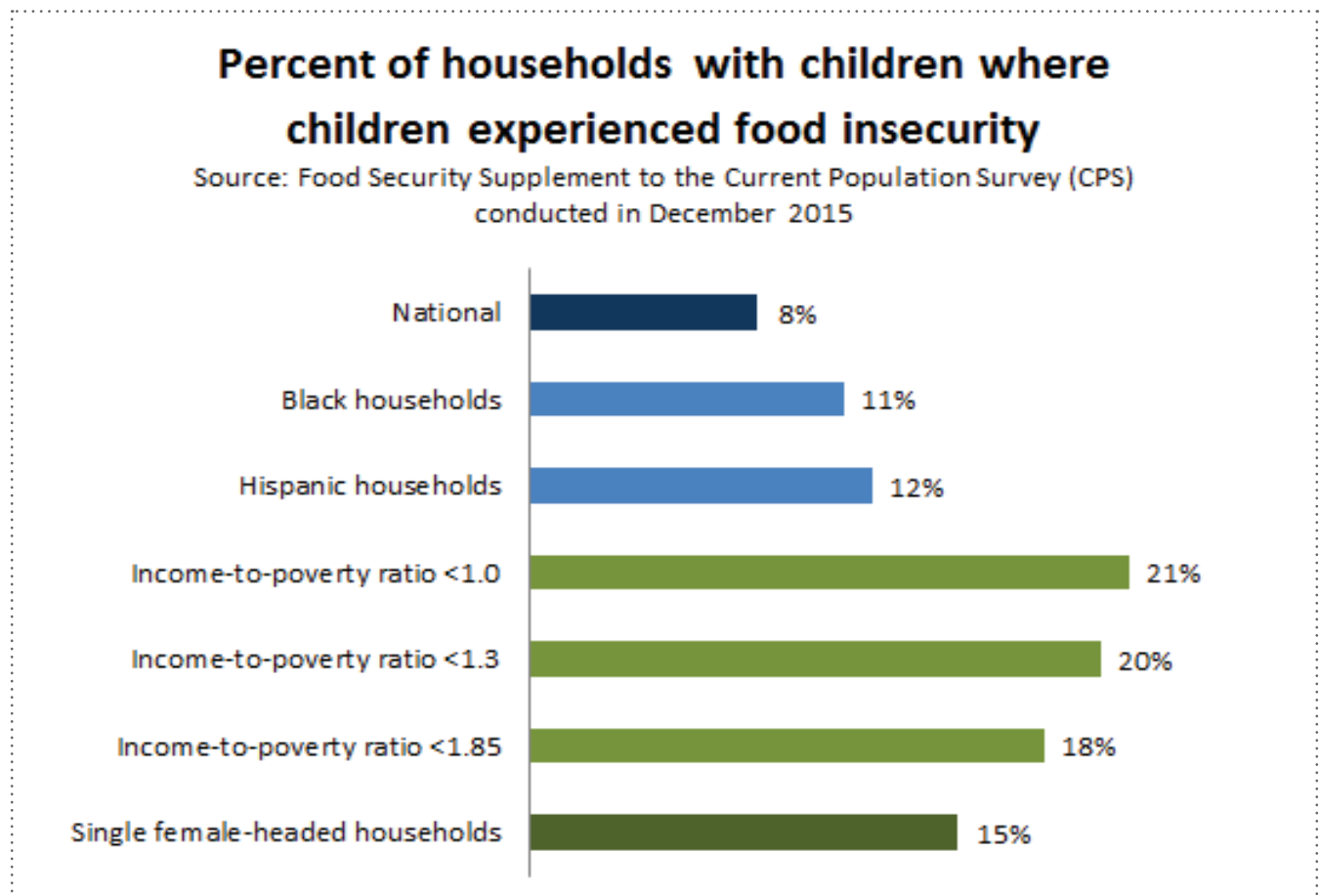
Food Insecurity is further divided into two categories:

- **Low food security:** reports of reduced quality, variety, or desirability of diet. Little or no indication of reduced food intake. Before the CNSTAT recommendations of 2006 this was labeled as food insecurity without hunger.
- **Very low food security:** Reports of multiple indications of disrupted eating patterns and reduced food intake. Before the CNSTAT recommendations of 2006 this was labeled as food insecurity with hunger.¹⁸⁰

Often, when a household is food insecure, parents give up their food so that their children don’t experience hunger. However, there are instances in which even that does not allow parents to provide adequate, nutritious food for their children. In instances of very low food insecurity in households with children, food insecurity can be so severe that children are hungry, or skip a meal, or cannot eat for a whole day. These households are described as having very low food security among children.¹⁸¹

Prevalence

According to recent national data, 13% (15.8 million households) of US households were food insecure in 2015. This includes about 5% of U.S. households (6.3 million households) with very low food security, i.e. households where one or more members experienced disrupted eating patterns and reduced food intake because they could not afford enough food. Among households with children, about 17% of households experienced food insecurity during the year. In about half of these food-insecure households (9%), only adults were food insecure, meaning they were able to maintain normal diets for their children. In the remaining half (8%, 3 million households), even children experienced food insecurity. This includes 274,000 households where food insecurity among children was so severe that caregivers reported that children were hungry, skipped a meal, or did not eat for a whole day because there was not enough money for food.¹⁸² Certain types of households have higher rates of food-insecure children than the national rate of 8% as shown in the following chart: single female-headed households (15%); black households (11%); Hispanic households (12%); and poor households with an income-to-poverty ratio of less than 1.00 (21%), less than 1.30 (20%) and less than 1.85 (18%).



Similar trends apply to households with very low food security among children.¹⁸³

Teachers in public schools also express concerns about children coming to school hungry. In a national survey commissioned by the No Kid Hungry campaign, 73% of teachers say they teach students who regularly come to school hungry because there isn't enough food at home.¹⁸⁴

HUNGER/FOOD INSECURITY AND IRON DEFICIENCY ANEMIA

Children and adolescents in food-insecure households are at greater risk of iron deficiency (including iron deficiency anemia), compared to those in food-secure households.¹⁸⁵ Anemia is a reduction in red blood cells below a normal level, the threshold of which varies by gender and age. Iron is a critical component in the production of red blood cells. Iron deficiency is a state in which there is insufficient iron to maintain normal physiologic functions. In children in the US, iron deficiency is among the most common nutritional deficiencies and a common cause of anemia.¹⁸⁶

An article by the American Academy of Pediatrics Committee on Nutrition summarizes the prevalence of Iron Deficiency and Iron Deficiency Anemia in children aged 12 to 35 months using data from the 1999–2002 National Health and Nutrition Examination Survey. Iron Deficiency occurs in 9% of children aged 12 to 35 months, with higher rates among children enrolled in the Special Supplemental Program for Women, Infants, and Children (WIC) program (11%) and Mexican American children (14%). Rates of Iron Deficiency by poverty status were close to the national rate and were similar (8.6% for children from families below the poverty line versus 8.9% for children from families above the poverty line). Black children had an Iron Deficiency rate of 6.6%, which is lower than the national rate; however, black children had the highest rate of anemia (due to any cause, not just Iron Deficiency Anemia) among the different race and ethnicity groups (8% in black children versus the national rate of 5%). About 2% of children aged 12 to 35 months have Iron Deficiency Anemia. Estimates of Iron Deficiency Anemia by race, ethnicity and poverty status in this age group are statistically unreliable.¹⁸⁷

As stated by the American Academy of Pediatrics, research shows that Iron Deficiency Anemia and Iron Deficiency without anemia during infancy and childhood can have long lasting detrimental effects on neurodevelopment.¹⁸⁸ In fact, studies have shown an association between iron deficiency anemia in infants and later cognitive deficits,¹⁸⁹ and that iron deficiency without anemia may also adversely affect long term neurodevelopment and behavior, and some of these effects may be irreversible.¹⁹⁰ School aged children with iron deficiency were also found to have greater than twice the odds of scoring below average in math than did children with normal iron status.¹⁹¹

Unmet need for services

As described by The Aspen Institute's report "Advancing Health through Food Security: A Multi-Sector Approach to Address the Disease Burden and Costs of U.S. Food Insecurity on our Health System,"¹⁹² solutions to the problem of food insecurity require actions by policymakers, the food industry, healthcare organizations, nonprofit organizations and philanthropy, and food security researchers. In particular, pediatricians can play an important role in solving this problem. AAP's recent policy statement "Promoting Food Security for All Children" published in 2015 calls on pediatricians to identify children at risk of food insecurity, connect families in need to community resources and advocate for federal and local policies that support food security. Specifically, the AAP recommends that pediatricians incorporate the following into their practice: 1) systematically screen for food insecurity at scheduled health maintenance visits or sooner if needed; 2) know the community resources that are available (e.g. WIC, SNAP, school nutrition programs, local food pantries, summer and child care feeding programs) so that referral mechanisms can be put in place for families to be connected to these resources; 3) be aware of the nutritional content of the food offered by community resources; and 4) be aware of the factors that make food-insecure populations vulnerable to obesity and factors that disproportionately burden food-insecure families (cost of healthy food, media messaging promoting unhealthy food, stress of decision-making related to food), so that these issues can be addressed at clinic visits. While national data on the extent to which children are being screened and referred to resources is not currently available, the fact that children experienced food insecurity in an estimated 3 million households indicates a sizable unmet need.¹⁹³

Impact on learning

The impact of childhood food insecurity and hunger on children's health and social outcomes has been studied in depth by several reviews of the literature, including Feeding America and the ConAgra Foods Foundation in their report "Child Food Insecurity: The Economic Impact on our Nation."¹⁹⁴ Research on this topic suggests two main pathways for the association between food insecurity and hunger and negative developmental outcomes in children. Food insecurity may cause households to choose quantity over quality, thus leading to micronutrient deficiencies, which in turn affect the ability of a child to learn and thrive. Another pathway may be that the stress and anxiety that caregivers experience in situations of food insecurity negatively impact children's well being.

The section below describes a number of studies that Feeding America and The ConAgra Foods Foundation highlighted in their report published in 2009, the 2012 review by Perez-Escamilla et al. from the Yale School of Public Health,¹⁹⁵ and a 2012 study on the mental health impact of food insecurity on adolescents.¹⁹⁶ Review of these sources suggests that while there is strong evidence of the impact of hunger and food insecurity on a variety of child emotional and behavioral outcomes, the impact of hunger and food insecurity on educational outcomes varies largely by child characteristics, outcomes measured, level of food insecurity, and study design. Other important factors that play a role in the association between hunger and negative childhood outcomes are the influence of poverty and the role of caregivers. This field is still under study; so far, evidence suggests that household material (income) and non-material (maternal personality, household organizations) indicators may—to varying degrees—confound or mediate the effects of household food insecurity on child outcomes.¹⁹⁷

Emotions and behavior

A cross-sectional study of the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K)¹⁹⁸ conducted by the Institute for Research on Poverty indicated that, after controlling for potential confounders, household food insecurity negatively impacted the emotional state of the child, as described by measures of self-control, sadness, loneliness, impulsivity and over-activeness, as evaluated by parents. Household food insecurity also negatively impacted children's interactive abilities and social skills, as rated by both parents and teachers. The authors of the study add that the cross-sectional nature of this analysis is a major limitation to the interpretation of the results, given that such study methodology can infer association, but not causation. The results are nonetheless consistent with the author's hypothesis as well as prior data exploring the association of household food insecurity with emotional and social functioning in children.¹⁹⁹

Similarly, a small study group of 328 parents and children from a Community Childhood Hunger Identification Project (CCHIP) study explored the connection between hunger and behavioral outcomes for children aged 6 to 12 years in households with income at or below the 185% of poverty living in the city of Pittsburgh and in the surrounding Allegheny County. Hunger status and child mental health status were reported by the parents, and measured respectively with the 8 food-insufficiency questions of the CCHIP hunger scale, and the Pediatric Symptoms Checklist (PSC), a screening questionnaire used to identify cognitive, emotional, and behavioral problems in children. Higher scores indicate higher risk of cognitive, emotional and behavioral problems. The study found that hunger status was significantly related to PSC score, with the mean PSC score being 18.0 for hungry children, 13.4 for children who were at-risk for hunger, and 8.4 for not-hungry children. Of the children in the hungry category, 21% were classified as dysfunctional by the PSC (score 28 or above) compared with 6% of at risk children and 3% of not-hungry children. Hungry children were also significantly more likely to have a history of past or current mental health counseling. Hungry children were 7 to 12 times more likely to have symptoms of conduct disorders than their not-hungry counterparts.²⁰⁰

A study of school and pre-school children of homeless and low-income housed mothers in Massachusetts explored the relationship between childhood hunger and internalizing behavior problems which cover symptoms of withdrawn behavior, somatic complaints, depression, and anxiety. For both school-aged and preschool-aged children severe child hunger was a moderate predictor of internalizing problems, after controlling for potential covariates in the model. School-aged children with severe child hunger (having multiple signs of child hunger) had parent-reported anxiety scores that were double the scores of children with no hunger. They also had significantly higher internalizing behavior problems than children with no hunger. Preschool children in the study also had significantly higher levels of internalizing behavior problems than their counterparts with no hunger, though depression/anxiety scores were not measured for this group of children.²⁰¹

Finally, a study of a representative sample of US adolescents (aged 13 to 17 years) explored the association between food insecurity (as measured by the USDA Scale) and mental health disorders, grouped into four classes: mood, anxiety, behavior, and substance disorders. The study found that, after controlling for numerous indicators of socioeconomic status, food insecurity was associated with all four categories of disorders. Food insecurity was furthermore even more strongly related to mental health disorders than traditional socioeconomic indicators such as parental education and income. Finally, controlling the analysis for extreme poverty did not decrease the strength of the associations between food insecurity and mental health disorders, thus suggesting that food insecurity reflects a form of economic strain that has more negative effects on adolescents' mental health than living in a family with very low-income.²⁰²

Learning

A number of studies have found significant associations between hunger and food insecurity and academic outcomes such as test scores, school engagement, and enrollment in special education.

Hunger and food insecurity are associated with a child's cognitive development. A study investigated the relationship between caregiver reported food insecurity and developmental risk in a sample of an urban clinical population of children aged less than 36 months from low-income families. Children in food insecure households had higher odds of being at developmental risk, and the association was significant even after controlling for a series of confounding factors—including previous hospitalizations, low birth weight, and current weight-for-age—that usually would be identified by clinicians as markers of physiologic risk. A statistically significant relationship of nearly identical magnitude was observed when households that reported having food insecurity with hunger (defined as households that reported reducing their food intake three or more times over the past 12 months) were removed from the analysis, suggesting that developmental risk is also present with low food security (i.e. food insecurity without hunger).²⁰³

Data from the NHANES 1988-1994 was analyzed by a study that investigated the relationship between food insufficiency and school-aged children's cognitive, academic, and psychological development. A child was classified as food insufficient if the respondent reported that the family either sometimes or often did not have enough food to eat. After adjusting for potential confounders, children aged 6 to 11 years who were classified as food insufficient had significantly poorer math scores and higher chances of having repeated a grade and having seen a psychologist. They were not found to be at higher risk of poorer cognitive outcomes, reading scores, school days lost, or other psychological outcomes.²⁰⁴

A study of a nationally representative sample of children aged 6 to 11 years from the National Survey of American Families found a negative association between food insecurity and school engagement, among other outcomes, after adjusting for covariates. School engagement is a measure of participation in classroom and school activities and the child's feeling that he or she belongs to the school setting and values school-relevant outcomes. Receiving public assistance for the purchase of food was used as a measure of food insecurity.²⁰⁵

A study of data from the ECLS-K analyzed the impact of food insecurity on academic performance in kindergartners. This study found that, after adjusting for potential socioeconomic confounding factors, food insecurity affects children's math scores, both at the beginning of the school year and throughout the year.²⁰⁶ The Pittsburgh CCHIP study that found association between hunger and emotional/behavioral problems, revealed also that children who are hungry are at double the risk of being enrolled in special education and are more likely to repeat a grade, although the association with grade retention was only marginally significant.²⁰⁷ Some studies, however, found less evidence of association between food insecurity and hunger and similar academic outcomes, or found that the association was only true for certain subgroups of children.

An ECLS-K study by Jyoti et al. of food insecurity and its impact on kindergartener's academic performance and social skills among other outcomes found less conclusive evidence on the impact of food insecurity on these outcomes, finding statistically significant associations between food insecurity and math and social skills among girls at third grade only. Likewise, girls from households who were food insecure at both measurement times had smaller increases in reading score than those who were persistently food secure.²⁰⁸

The Massachusetts study referred to earlier in this section, which looked at childhood hunger as measured by the CCHIP measures, and internalizing behavior problems and anxiety/depression as measured by the Child Behavior Checklist (after adjusting for relevant correlates), found no association between hunger and academic achievement as directly assessed by a reading, spelling, and math test.²⁰⁹

Similarly, the study by the ECLS-K by the Institute for Research on Poverty referred to earlier in this section, which found significant association between food insecurity and social outcomes in kindergartners, found no association between food insecurity and cognition as measured directly by math, reading, and general knowledge competence, or teachers' assessed children's cognition.²¹⁰

Conclusions

Key points:

- Amongst the households with children, the percentage of households with food insecure children was considerably higher than the national rate in single-headed households, black households and Hispanic households, households in poverty, and households in Southern states.
- These disadvantaged groups of children are therefore vulnerable to the learning-related consequences of hunger and food insecurity. While there is strong evidence of their impact on a variety of child emotional and behavioral outcomes, the impact of hunger and food insecurity on educational outcomes vary largely by child characteristics, outcomes, level of food insecurity, and study design.
- Collectively, these findings clearly show the need for disadvantaged children and their families to access programs that will increase their access to adequate food, so that food insecurity and/or hunger don't impede their ability to learn.

6. CERTAIN MENTAL HEALTH AND BEHAVIORAL PROBLEMS

The following section contains: definitions of certain types of mental health and behavioral problems; prevalence, with a focus on disparities; the unmet need for services; the learning consequences of mental health and behavioral problems; and a special section on ADHD, given its prevalence and strong evidence of impact on learning.

Definitions

Mental disorders are described as serious changes in the ways children typically learn, behave, or handle their emotions.²¹¹ The most common mental health problems in children aged 3 to 17 years are attention deficit disorders, behavioral problems, anxiety, and depression.²¹²

Attention deficit and behavioral disorders, such as Oppositional Defiant Disorder (ODD) and Conduct Disorders, are externalizing disorders, which refers to a grouping of behavior problems that are expressed in children's outward behavior and characterized by the child negatively acting on his/her external environment.²¹³ Definitions of the following behavioral problems are taken from a CDC surveillance report on mental health disorders in children.²¹⁴ Children with ADHD have "levels of inattention, hyperactivity, impulsivity, or a combination of these that are inappropriate for their stage of development and impair their functioning in multiple settings" (see Section 8.3 for detailed description of ADHD). Children with ODD have "a pattern of developmentally inappropriate, negative, aggressive, and defiant behavior that occurs for at least 6 months." They "frequently lose their temper, argue with adults, defy or refuse to comply with rules and requests, deliberately annoy others, blame their behavior on others, are easily annoyed, and are spiteful or vindictive." Children with conduct disorder "consistently ignore the basic rights of others and violate social norms and rules." To meet criteria for conduct disorder, children must have displayed three or more behaviors, such as "aggression to persons and animals, destruction of property, deceitfulness or theft, and serious violations of rules" in the past 12 months, with at least one behavior shown in the past 6 months. When occurring with ADHD, ODD and Conduct Disorder often predict later antisocial personality disorder, psychoactive substance use disorders, smoking, and bipolar disorder.

Anxiety and depression, on the other hand, can be grouped together as internalizing disorders that affect the child's internal psychological environment rather than the external world.²¹⁵ Definitions of anxiety and depression are taken from the US federal government agency Substance Abuse and Mental Health Services Administration. Depression is characterized by "a sad, hopeless, empty, or irritable mood, and somatic and cognitive changes that significantly interfere with daily life." A major depressive disorder (MDD) is defined as "having a depressed mood for most of the day and a marked loss of interest or pleasure, among other symptoms present nearly every day for at least a two-week period." Anxiety disorders are characterized by "excessive fear or anxiety that is difficult to control and negatively and substantially impacts daily functioning." These disorders can "range from specific fears (called phobias) to more generalized feelings of worry and tension."²¹⁶

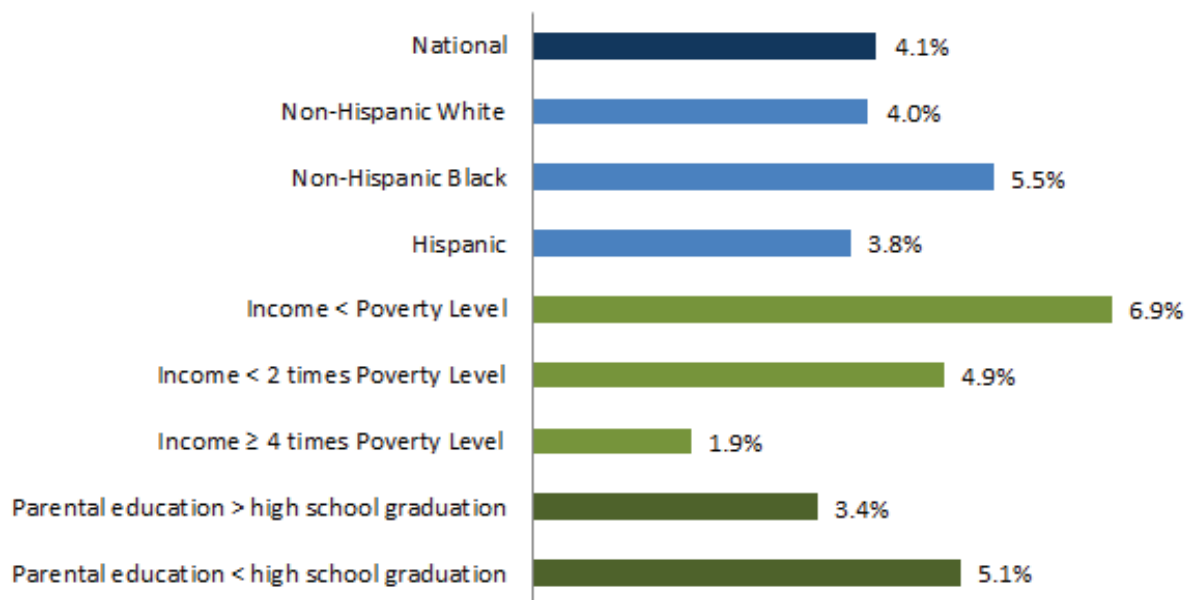
Prevalence

According to a CDC report, a total of 13% to 20% of children aged 3 to 17 years living in the United States experience a mental disorder in a given year. These include internalizing and externalizing disorders, as well as other disorders such as Tourette syndrome, or autism spectrum disorders.²¹⁷ What follows is a summary of the prevalence of three of the most prevalent disorders in children aged 3 to 17 years, with a focus on disparities by race, ethnicity, and poverty.²¹⁸

It is important to note that in recent literature a growing concern has emerged, of inaccuracy in the diagnosis of mental health problems due to racial bias. Two important examples of this issue are: the over diagnosis of Conduct Disorders and the under diagnosis of ADHD in black children and Hispanic children. Conduct Disorder has been over diagnosed in urban, low-income, adolescents of Hispanic and African American race. In contrast, white children with comparable behaviors tend to be diagnosed with mood, anxiety, or developmental disorders.²¹⁹ Recent literature has pointed out that black children and Hispanic children are less likely to be diagnosed with ADHD compared with white children^{220,221} and black children are more likely to receive a diagnosis of Conduct Disorder than that of ADHD.²²² Furthermore, black children and Hispanic children with ADHD are less likely to be using medication, compared with white children.^{223,224}

Lifetime prevalence of diagnosed behavioral disorders in children aged 2-17 in 2011/12

Source: 2011/2012 National Survey of Children's Health



Behavioral disorders: According to the 2011/12 National Survey of Children's Health, the "lifetime prevalence" of behavioral disorders in children aged 2 to 17 years (as reported by a parent or caregiver) was 4.1%, including 3.2% of children who had the disorder at the time of the survey ("current prevalence") and an additional 0.9% of children who had had the disorder at some point in the past, but not at the time of the survey. The prevalence rates for black children (5.5% for lifetime prevalence and 4.4% for current prevalence) were higher than the rates for Hispanic children (3.8% for lifetime prevalence and 3.0% for current prevalence) and white children (4% for lifetime prevalence and 3.1% for current prevalence). The prevalence of lifetime diagnosis and current diagnosis were also at least 50% higher for children who came from households where the highest education level of the adult was less than high school compared with households where the education level was more than high school (lifetime 5.1 vs. 3.4%, current 4.2% vs. 2.6%). Finally, the lifetime prevalence was 6.9% for children in households below the Federal Poverty Level (FPL), 4.9% for children in household between 100-200% FPL, 3.5% for children

in households above 200% FPL and 1.9% for children in households that are at least 4 times the FPL. A similar trend appears in the current prevalence with the three groups having a current prevalence of 5.9%, 3.8%, and 2.6% respectively.²²⁵

Depression: According to the 2011/12 National Survey of Children's Health, lifetime prevalence of depression was 3.8% and current prevalence was 2.2% in children aged 2-17. The lifetime prevalence of depression was slightly higher for white children (4.0%) than for black (3.6%). The current prevalence was the same at 2.3% for both white and black children. Hispanic children had the lowest prevalence for both lifetime and current prevalence (3.4% and 1.7% respectively). The lifetime and current prevalence of depression diagnosis were higher for children from households where the highest education level of the adult was less than high school compared with households where the education level was more than high school (lifetime 4.5 vs. 3.4%, current 2.7% vs. 1.9%). Finally, the lifetime prevalence was 5.6% for children in households below the FPL, 4.2% for children in household between 100-200% FPL, and 3.5% for children in household above the 200% FPL. A similar trend appears in the current prevalence with the three groups having a prevalence of 3.5%, 2.5%, and 2.0% respectively.²²⁶

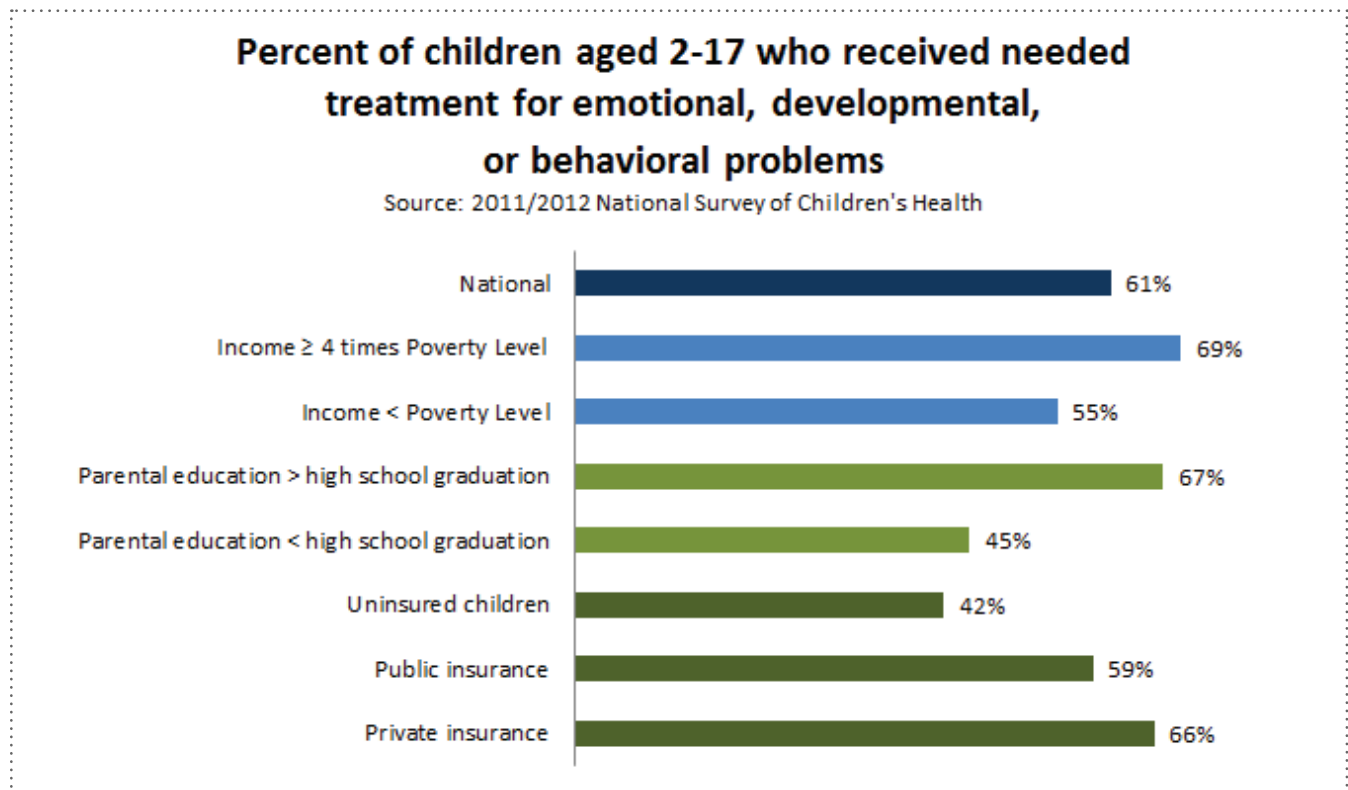
Anxiety: According to the 2011/12 National Survey of Children's Health, lifetime prevalence of diagnosed anxiety was 5.0%, and current prevalence was 3.3% in children aged 2-17. The proportion white children who ever received a diagnosis of anxiety (6.6%) was higher than that of black children (3.2%) and Hispanic children (3.4%). The current prevalence of anxiety was higher for white children (4.4%), than for while Hispanic (2.0%), and black children (2.3%). When looking at level of household education, the prevalence of lifetime and current diagnosis was higher for children whose highest educational level in the household was more than high school compared to less than high school (lifetime 5.6% vs. 3.4%, current 3.7% vs. 2.3%). Finally, the lifetime prevalence was 5.5% for children in households below 100% FPL, 5.5% for children in household between 100-200% FPL, and 4.5% for children in household above 200% FPL. For the current prevalence, the three groups have a prevalence of 3.9%, 3.6%, and 3.0%, respectively.²²⁷

In summary, the diagnoses of behavioral disorders, depression, and anxiety are more prevalent in children from poorer families. Children from families with lower educational attainment have higher rates of behavioral problems and depression, while the prevalence of anxiety is higher for children from families with higher educational attainment. The prevalence of these conditions varies by race and ethnicity. The rate of diagnosis of behavioral or conduct problems are highest among black children. For depression, while rates don't vary much among white, black and Hispanic children, white children have the highest rate. For anxiety, white children have a substantially higher rate, compared with black children and Hispanic children.

Unmet need for services

Childhood mental disorders can be treated and managed through the use of mental health services and, in some instances, medication. However, often, their impact on vulnerable children is magnified due to poor access to services. According to a study of a nationally representative sample of children aged 6 to 17 years who need mental health services, after adjusting for other sociodemographic factors, Hispanic children are significantly less likely to receive mental health care, compared with white children.²²⁸ Furthermore, a study on trends in children's mental health care access from 2002 to 2007 finds persistent racial/ethnic disparities in three measures of access to mental health care: any mental health care, any outpatient mental health care, and any psychotropic drug use.²²⁹ According to the 2011/2012 National Survey of Children's Health, as shown in the following chart, only 61% of children with emotional, developmental, or behavioral problems for which they needed treatment actually received treatment.

Access to needed mental health care was greater among children of families with higher income, and progressively diminished as income level decreased; 69% of children who needed and received mental health care were from families with incomes at least 4 times the Federal Poverty Level versus 55% of children from families with incomes below the Federal Poverty Level. Parental education was another indicator of the likelihood of receiving mental health care for a child in need of it; 67% of children of families where the highest level of education was more than high school graduation vs. 45% for the child of families where the highest level of education was less than high school graduation). Finally, uninsured children are also less likely to receive care than those who have insurance. Children in need of mental health care who had private (66%) or public (59%) insurance had higher rates of receiving care, compared with the uninsured (42%).²³⁰



In addition to the problem of children with emotional, developmental, or behavioral problems not receiving the treatment they need, these problems are also not being reliably identified in pediatric primary care settings. The AAP Task Force on Mental Health recommends that all children and adolescents in primary care settings receive age-appropriate screenings: to identify socio-emotional problems in children aged 0 to 5 years of age; symptoms of mental illness and impaired psychosocial functioning in school-aged children aged 5 through adolescence; and substance abuse problems in adolescents.²³¹ However, studies in pediatric practices indicate that high proportions of patients with behavioral and emotional problems are not being identified, with one study finding that only 50% of those with clinically significant behavioral and emotional problems were identified.²³²

As long as vulnerable children lack access to mental health services that are pivotal for them to thrive, disparities in educational and life outcomes will persist.

Impact on learning

A number of studies have concluded that some mental and behavioral problems impact academic outcomes, even after controlling for socio-economic status and ACEs. Achievement as well as high school completion are both affected by some mental health and behavioral disturbances, and externalizing behaviors, such as ADHD and ODD, have the most proven impact on children's academic success. Internalizing disorders, on the other hand, appear to have less direct consequences on educational attainment.

A study examined the contributions of attention, internalizing, and externalizing problems at school entry to reading and math achievement at the end of high school in an ethnically and socioeconomically diverse sample of the Detroit student population who were following longitudinally. After adjusting for IQ and socioeconomic status, the study found that attention, internalizing and externalizing behavior problems at age 6 significantly predict achievement at age 17 to 18. When the different problems were analyzed simultaneously, the influence of externalizing and internalizing problems becomes non-significant, while attention problems significantly predicted math and reading scores.²³³

An earlier prospective study of the impact of childhood emotional and behavioral problems on academic outcomes in a nationally representative sample found that, after adjusting for socio-economic indicators, when considered separately, both internalizing and externalizing problems were inversely related to the likelihood of receiving a high school degree. However, after analyzing the two simultaneously, externalizing problems were negatively associated with the likelihood of graduating high school, while internalizing problems were not.²³⁴

A cross-sectional study of a nationally representative sample of the US population examined the relationship of early onset mental health disorders (any disorder that started before 18 years of age) and educational milestones (primary school graduation, high school graduation, college entry, college graduation). Seventeen disorders were examined: mood disorders (major depressive disorder, dysthymia, bipolar disorder I and II studied together), anxiety disorders (generalized anxiety disorder, specific phobia, social phobia, panic disorder, separation anxiety, and posttraumatic stress disorder), substance disorders (alcohol and drug abuse and dependence), and impulse control disorders (intermittent explosive disorder, conduct disorder, oppositional defiant disorder, and attention deficit disorder). The analysis controlled for demographic characteristics and ACEs. The only statistically significant associations with failing to complete elementary school are for oppositional defiant disorder and alcohol abuse. Having three or more disorders at the same time is associated with higher odds of failing to complete elementary school. Externalizing behavior disorders were found to be more consistently associated with termination of schooling across the four milestones than internalizing disorders. Neither major depression nor generalized anxiety disorders were associated with subsequent termination of schooling at any of the milestones examined. Twelve of the seventeen disorders examined affected high school graduation in a statistically significant way, and having two or more disorders is associated with higher odds of not completing high school. The study also calculated that the proportion of people dropping out of high school would decrease by 10.2% in the absence of mental health disorders, and the proportion failing to complete primary school would decrease by 3.9%.²³⁵

Another cross-sectional study of a nationally representative sample examined the association of failure to graduate high school by age 18 with individual early onset psychiatric disorders and also adjusted for co-occurring disorders. Disorders included in the analysis were depression, dysthymia, mania, panic, specific phobia, social phobia, PTSD, and generalized anxiety disorders (GAD) for internalizing disorders, and conduct disorder, ADHD (attention type, hyperactive type, and combined type analyzed separately) for the externalizing disorders. After adjusting for ACEs, relevant socio-demographic characteristics and

co-existing disorders, failure to graduate from high school on time was significantly associated with all externalizing disorders, but not the internalizing disorders alone.²³⁶

However, a similar study was conducted amongst a nationally representative sample of the Australian population. The study analyzed the relationship between completing the tenth year of education by age 16 and the early onset of depressive disorders and anxiety disorders. The study concluded that, after adjusting for effects of prior trauma experiences, not completing the tenth year of education was significantly associated with early onset (<16 years of age) of major depressive disorders for females and bipolar and obsessive compulsive disorders for males. However it is important to note that attention deficit disorders were not amongst the disorders analyzed in the study.²³⁷

Review of the scientific evidence on the link between mental health and behavioral disturbances and academic outcomes indicates that externalizing disorders appear to have the strongest impact on academic outcomes. Among the externalizing disorders, attention problems have strong evidence of impact on both math and reading scores, and on high school dropout. Other externalizing disorders, such as conduct disorder, appear to be associated mainly with high school dropout. A meta-analysis of mental health disorders and high school dropout amongst adolescents also found that, after cannabis use, externalizing disorders were the most significant predictors of failing to graduate from high school, and that the association was even stronger when the disorder occurred early in life. There is currently less evidence supporting direct consequences of internalizing disorders, such as mood and anxiety disorders, on high school dropout, compared with substance use and disruptive behavior disorders. Finally, socioeconomic background, academic achievement and family support were identified as significant mediating factors of the association between mental disorders and subsequent educational attainment.²³⁸

ADHD

Attention-deficit/hyperactivity disorder (ADHD) is the most prevalent of mental health disturbances amongst children, and as such, will be discussed in more depth. As discussed in the previous section on mental and behavioral disorders, it has strong evidence of association with negative educational outcomes, among the other examined mental health disorders.

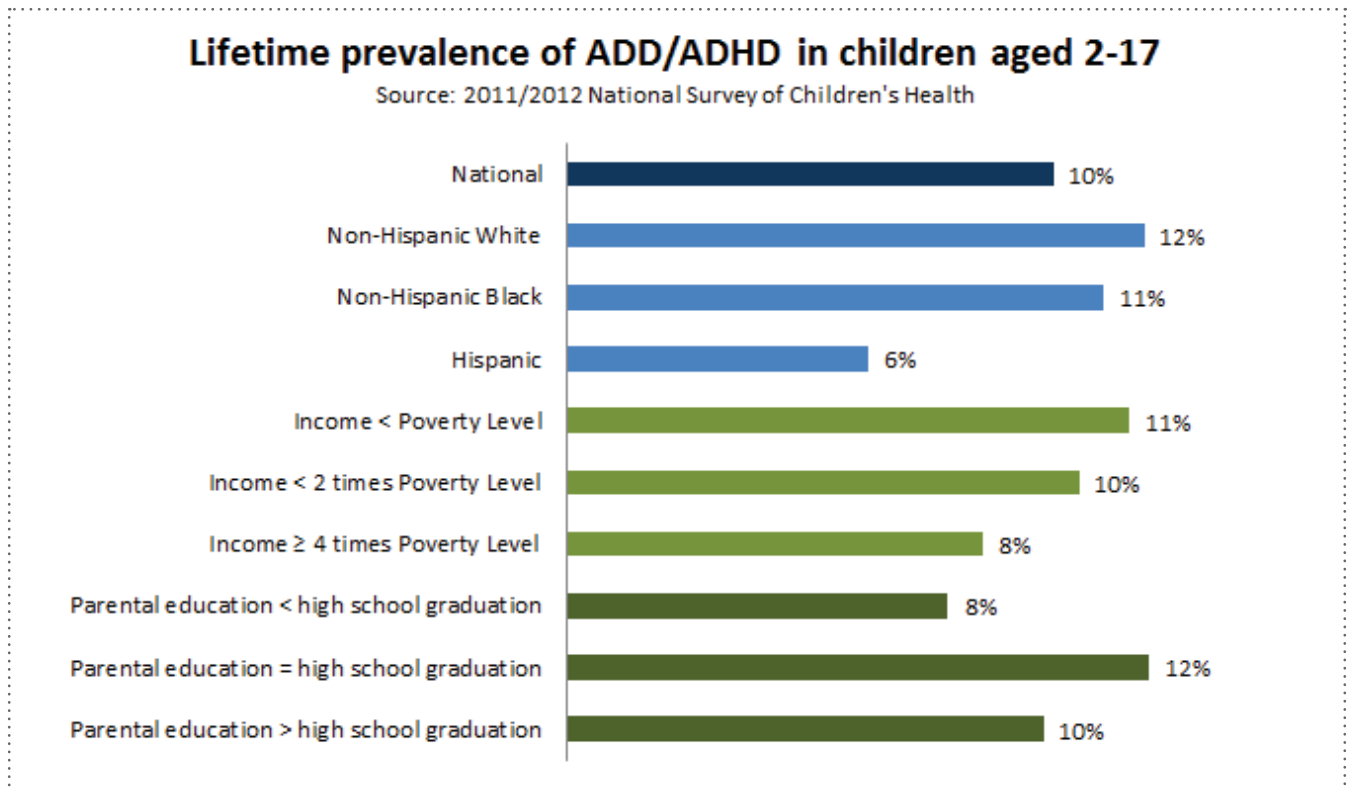
Definitions

ADHD is a neurobehavioral disorder that begins in childhood. Symptoms of ADHD fall into three groups: inattentiveness, hyperactivity, and impulsivity. Some people with ADHD have mainly inattentive symptoms, some have mainly hyperactive and impulsive symptoms, and some have a combination of different symptom types. There is no test that can make or exclude a diagnosis of ADHD. The diagnosis is based on a pattern of symptoms examined in a clinical diagnostic evaluation, incorporating information from multiple respondents (e.g., parents, child, teachers, child care staff) and across multiple settings (e.g., home, school, child care), and an evaluation of co-occurring or confounding conditions. ADHD medication has long been used to effectively treat ADHD symptoms. High-quality behavioral interventions have also been shown to improve functional outcomes of many children with ADHD.^{239,240}

Prevalence & Unmet Need for Services

Based on parents reporting whether their child received a diagnosis of ADHD from a healthcare provider, the 2011/12 National Survey on Children's Health estimates that about 1 in 10 (10%) children aged 2 to 17 received an ADHD diagnosis at some point in their lives. This represents over 6.3 million children nationally. Prevalence was higher for black (11%) and white children (12%) compared with Hispanics

(6%).²⁴¹ Another national survey (the 2011 National Health Interview Survey) found that ADHD lifetime prevalence was 8% nationally in children aged 3 to 17, and prevalence was highest among white children (10%), followed by black children (9%), while Hispanic children had a significantly lower prevalence rate (6%).²⁴² Recent literature has pointed out that black children and Hispanic children are less likely to be diagnosed with ADHD compared with white children^{243,344} and black children are more likely to receive a diagnosis of Conduct Disorder than that of ADHD.²⁴⁵



The prevalence of ADHD was highest among children with family incomes below the Federal Poverty Level (11%) versus children from families at least 4 times the poverty level (8%).²⁴⁶ Children with ADHD also have higher rates of ACEs, compared with children without ADHD. About 45% of children with ADHD have two or more ACEs versus 23% of children without ADHD.²⁴⁷ Only 69% of children who currently have ADHD are taking medication for their condition.²⁴⁸ Furthermore, black children and Hispanic children with ADHD are less likely to be using medication, compared with white children.^{249,250}

Impact on learning

Attention-related disorders and ADHD have been proven to negatively impact learning, among many other life outcomes. A study compared the adaptive functioning of children diagnosed as hyperactive to a control group of children without the diagnosis. Researchers followed them into adulthood, looking at major life events. The hyperactive group had significantly lower educational attainment, compared with the control group. The hyperactive group was more likely to be working exclusively (not while in college), unemployed, or not in school, and less likely to be college students exclusively or students who work while in college. A significantly higher proportion of the hyperactive group had been retained in a grade at least once, suspended from high school, or placed in special education. A significantly smaller proportion of the hyperactive group graduated from high school. Members of this group had significantly fewer years of completed education, had a lower grade point average in the final years of their schooling, and ranked

lower in their class in high school. Furthermore, the study identified severity of childhood hyperactivity (along with being retained in a grade and greater lifetime conduct disorder symptoms) as a predictor of failure to graduate from high school.²⁵¹

A meta-analysis of ADHD and achievement evaluated 72 studies on child, adolescent, and adults to determine presence, direction, and magnitude of achievement effects for individuals with ADHD. Fifty-four studies in the meta-analysis are of children. In this analysis, individuals with ADHD had significantly lower levels of achievement compared to controls. The effect of ADHD on achievement is larger in children, than it is adolescents or adults.²⁵²

A review of the literature on academic and educational outcomes of children with ADHD also found that children with ADHD are at risk of significant academic underachievement, poor academic performance, and educational problems. They are at risk of scoring significantly lower on reading and arithmetic tests than controls, are more likely to be expelled, suspended, or repeat grades, and they are more likely to use special education services than controls.²⁵³

Conclusions

Key points:

- Behavioral disorders, ADHD, depression, and anxiety are more prevalent in children from poorer families.
- Children from families with lower educational attainment have higher rates of depression and behavioral problems other than ADHD, while the prevalence of anxiety and ADHD is higher for children from families with higher educational attainment.
- The prevalence of these conditions vary by race and ethnicity. The rate of diagnosis of behavioral or conduct problems is highest among black children. The rate of diagnosis of depression is similar across the 3 groups. White children have a significantly higher rate of anxiety, than black or Hispanic children. For ADHD, white children and black children have significantly higher rates of diagnosis compared with Hispanic children.
- Recent literature has noted a growing concern of inaccuracy in the diagnosis of mental health problems due to racial bias. Two important examples of this issue are: the over diagnosis of conduct disorders and the under diagnosis of ADHD in black children and Hispanic children.
- The impact of childhood mental disorders on vulnerable children is magnified by poor access to services; children who are poor, uninsured or whose parents have low levels of education tend to have less access to the mental health care they need.
- Disadvantaged groups of children are therefore vulnerable to the learning consequences of untreated behavioral problems (particularly ADHD), which are lower likelihood of completing college, high school dropout, grade retention, suspension, decreased academic performance, and placement in special education. An important caveat is that only some of the studies examined were longitudinal, and could therefore prove a cause-effect relationship.
- Collectively, these findings clearly show the need for disadvantaged children to have access to appropriate mental health care services, so that untreated mental health and behavioral problems don't impede their ability to learn.

7. EFFECTS OF LEAD EXPOSURE

Definitions

Lead is a soft, dense, ductile blue-gray metal.²⁵⁴ Due to its properties, its use has been common for centuries and greatly increased with the Industrial Revolution. According to a World Health Organization report, “the widespread occurrence of lead in the environment is largely the result of human activity, such as mining, smelting, refining and informal recycling of lead; use of leaded petrol (gasoline); production of lead-acid batteries and paints; jewelry making, soldering, ceramics and leaded glass manufacture in informal and cottage (home-based) industries; electronic waste; and use in water pipes and solder.”²⁵⁵

The decline in childhood blood lead levels has been primarily due to major policy decisions, including the ban on lead in gasoline that was fully implemented in the US by 1996, removal of lead solder from food cans, and the ban on lead paint that was fully implemented in 1978.²⁵⁶ However, lead from previous uses persists in the environment. For most children in the United States, the main source of exposure is deteriorating lead-based paint in older, poorly maintained homes. Lead from the paint becomes part of the dust in the home which children may then ingest as part of hand to mouth behaviors.²⁵⁷ Adults and other children in the same environment may not be exposed unless dust is generated through renovation or repair work.²⁵⁸

Other potential sources of lead in a child’s environment derive from its previous use as an additive in gasoline, in plumbing, and in imported products contaminated with lead.²⁵⁹ The ban on lead in gasoline was fully implemented in the US by 1996, and had led to significant declines in blood lead levels. However, lead in soil is in part due to its past use and can still be a source of exposure for children when they play outdoors or when the outdoor soil contributes to lead dust indoors.²⁶⁰ Lead solder use for plumbing was eliminated by 1988, and public drinking water systems are now required to monitor for lead and to implement measures to decrease water corrosivity to prevent the leaching of lead from the pipes into the water.^{261,262} However, exposure can and does still occur through water systems that are more than 20 years old and that use acidic water, which may cause corrosion of lead in the pipes.²⁶³ Other sources of lead exposure in the US are imported items that can include clay pots, candy, make-up, jewelry, and home remedies.²⁶⁴

Children are more vulnerable to lead poisoning than adults because they are more likely to have hand to mouth behavior after contact with contaminated surfaces, such as deteriorating paint from walls in their homes. Furthermore, children absorb larger fractions of ingested lead than adults, and their developing nervous system is especially susceptible to lead toxicity. Children can be exposed to lead prenatally, absorbing the lead contained in their mother’s body, or environmentally by drinking contaminated water or swallowing or breathing lead in dirt, dust, or sand while they play on the floor or ground. Children with significant lead poisoning may develop anemia, kidney damage, abdominal pain, muscle weakness, brain damage, seizures, coma, and even death. Fetuses exposed to lead in the womb may be born prematurely and have lower weights at birth. Even at low levels of exposure and without other clinical symptoms, lead can affect a child’s mental and physical growth, and his or her ability to thrive.^{265,266,267}

Blood lead measurement is the primary screening method for lead exposure. Blood lead measurement is a reliable, inexpensive and readily available method. Although it is a reflection of recent exposure, methods that more accurately reflect overall body lead burden, such as bone x-ray techniques, are not widely available.²⁶⁸ The CDC and other public health agencies have published guidance for the interpretation of blood lead results, all with the understanding that no safe blood lead level (BLL) in children has been identified. To address this and to encourage the implementation of primary prevention

interventions (i.e. preventing exposures before they occur), the CDC moved from using the term “level of concern” which was defined as BLLs ≥ 10 $\mu\text{g}/\text{dL}$ in 1991 to use of the term “reference level” defined as 5 $\mu\text{g}/\text{dL}$ in 2012. The reference level of 5 $\mu\text{g}/\text{dL}$ is used to identify children with blood lead levels that are significantly higher than most children’s levels. This new level is based on the U.S. population of children aged 1 to 5 years who are in the highest 2.5% of children when tested for lead in their blood.²⁶⁹

Prevalence

Based on national 2007 to 2010 data analyzed in a CDC report, about 2.6% of children aged 1 to 5 years have blood lead levels at or above the reference value of 5 $\mu\text{g}/\text{dL}$, which is an estimated 535,000 children. According to CDC data, black children had significantly higher mean Blood Lead Levels than white or Mexican American children. Mean blood lead levels were also higher in children enrolled in Medicaid, compared to those with private insurance. The CDC report concludes that the differences in the mean blood lead levels across the different race, ethnicity and income groups arise from differences in housing quality, environmental conditions, nutrition, and other factors.²⁷⁰

Data at the local level show considerably higher prevalence rates for some vulnerable communities. In Detroit in 2012, 8.5% of children under 6 years old who were tested had high blood lead levels (≥ 5 $\mu\text{g}/\text{dL}$).²⁷¹ In Providence, Rhode Island, a study on children attending public kindergarten where more than 90% of students qualified for the federal free or reduced-price school lunch program, 69% had at least 1 previously reported BLL that was high (≥ 5 $\mu\text{g}/\text{dL}$).²⁷²

Lead-based paint hazards are the primary source of childhood exposure to lead in the US.²⁷³ Of an estimated 16.8 million homes with children under the age of 6, 3.6 million homes (21%) have lead-based paint hazards, based on 2005-2006 data. In 5.8 million households earning less than \$30,000 per year with children under age 6, 1.1 million (20%) have lead-based paint hazards.²⁷⁴

The situation in the city of Flint, Michigan has brought water-borne lead exposure back to public attention, after a 2014 change in the city water system dramatically increased the levels of lead in drinking water. The number of children with elevated blood lead levels increased from 2.6% to 4.9% for the entire city of Flint and from 4.0% to 10.6% in the most affected area, compared to a non-significant increase from 0.7% to 1.2% outside the city in the same time period.²⁷⁵

Unmet need for services

The critical ‘intervention’ for lead poisoning is actually primary prevention—preventing it from happening in the first place through mitigation or elimination of environmental. Blood lead screening provides critical information that can be used to guide interventions for individual patients, and provides critical data to guide population level primary prevention efforts. Children who have been exposed to lead often have other challenges to learning and behavior, and lead poisoning may only be one of the factors influencing those outcomes. If those other factors can be modified, and special effort made to enrich the intellectual development of the child, the detrimental effects can potentially be overcome.²⁷⁶

The duration and effects of lead poisoning when children are exposed can be minimized through screening, early identification, and removal of the source of exposure. The Bright Futures guidelines, adopted by the American Academy of Pediatrics (AAP) in 1998 and endorsed by the Health Resources and Services Administration (HRSA), recommend that a clinical risk assessment for lead exposure be performed for infants (at ages 6 and 9 months and annually from the ages of 1 to 6 years), with blood lead testing to follow if positive. The Bright Futures guidelines also recommend that children who receive services from public assistance programs (e.g. Medicaid) or live in a high-risk area should be screened at 12 and 24

months. The AAP, in its policy statement on lead exposure in children, recommends that pediatricians measure blood lead concentrations in Medicaid-eligible children in accordance with state Medicaid regulations, apply guidance from city or state health department about screening children not eligible for Medicaid, and if there is none, consider screening all children.²⁷⁷ Because lead risk varies across the United States, CDC lead screening recommendations request state and local health departments to use local data on lead risks as the basis for developing lead screening recommendations for health-care providers that target children at risk in their areas, focusing on children aged 1 to 2 years.²⁷⁸ In 2012, the Centers for Medicare and Medicaid Services revised its policy on screening Medicaid eligible children for lead poisoning to align with the CDC recommendation of adopting targeted screening in states that have sufficient data to demonstrate that universal screening is not the most effective method of identifying exposure to lead. CDC and CMS have developed criteria and guidance that States should consider when requesting to shift to a targeted screening plan for individuals covered by Medicaid. CDC and CMS will review the information provided to determine if it is sufficient to support the State's request.²⁷⁹

Despite these recommendations, an analysis conducted by the Centers for Medicare and Medicaid Services indicated that approximately 67% of Medicaid-enrolled children aged 2 years were tested for lead by their second birthday during 2014,²⁸⁰ potentially missing opportunities to identify and mitigate the risk of permanent neurologic damage and behavioral disorders in hundreds of thousands of young children across the United States.

Impact on Learning

The bulk of the scientific literature indicates that there are persistent and deleterious effects of environmental lead exposures on a variety of outcomes related to the ability to learn, such as decreased IQ, diminished school performance, and behavioral problems. While in 2012 the CDC changed the definition of high blood lead level to lead level at or above 5 µg/dL²⁸¹ (lowering the threshold from the previous one of 10 µg/dL),²⁸² the majority of the examined studies on learning-related outcomes were conducted prior to 2012 and therefore describe blood lead levels as below or above the 10 µg/dL. What follows is a summary of findings organized by learning outcome.

Decreased IQ

Increases in blood lead levels have been shown to be associated with significant decreases in IQ. A systematic review of 26 studies that collects evidence from 1979 to 1994 concludes that the great majority of the studies examined showed an inverse association between lead and IQ, with the overall synthesis of the evidence indicating that a typical doubling of body lead burden (from 10 to 20 micrograms/dl blood lead or from 5 to 10 micrograms/g tooth lead) is associated with a mean deficit in full scale IQ of around 1-2 IQ points.²⁸³

In a study on internationally pooled data, the estimated IQ decrements associated with an increase in blood lead from 2.4 to 10 µg/dL, 10 to 20 µg/dL, and 20 to 30 µg/dL were 3.9, 1.9, and 1.1, respectively. The study also concluded that there is evidence of lead-related intellectual deficits among children who had maximal blood lead levels < 7.5 µg/dL, and that indeed there is no evidence of a lower threshold for harmful blood lead levels.²⁸⁴

These results are in line with that of a study conducted by the University of Rochester, that found that each increase of 10 µg per deciliter in the lifetime average blood lead concentration was associated with a 4.6-point decrease in IQ, whereas for a subsample of children whose maximal lead concentrations remained below 10 µg, IQ declined by 7.4 points as lifetime average blood lead concentrations increased from 1 to 10 µg per deciliter.²⁸⁵

In a call for primary prevention of exposure to lead, a CDC report cautions that low level lead exposure can have a significant impact on the distribution of IQ in an entire population, by decreasing the number of children with IQs above 130 and increasing the number of children with IQs below 70.²⁸⁶

Diminished School Performance

Increases in blood lead levels have been consistently found to negatively impact academic performance, and blood lead has been identified as one of the contributors to the achievement gap. A study of a national sample representative of the US population of children of aged 6 to 16 years looked at the impact of blood lead concentrations below 10 µg/dL. The research found, after adjusting for potential confounders, a 0.70 point decrement in math scores and an approximate 1 point decrement in reading scores for every 1 µg/dL. The analysis showed also a 0.10 decrement in non-verbal reasoning score and a 0.05 point decline in short-term memory score for each 1 µg/dL increase in blood lead concentration. The study also found an inverse relationship for math and reading scores with blood lead concentrations lower than 5.0 µg/dL.²⁸⁷

A similar study reported a decline in math scores of -0.50 per unit increase in blood lead for 3rd grade examinations in Chicago public school children, after adjusting for relevant confounders. Furthermore, the study found that there was a 32% increased risk in both reading and math failure associated with each 5 µg/dL increase in blood lead concentration. The study also found that 13% of reading failure and 14.8% of math failure can be attributed to exposure to blood lead concentrations of 5 to 9 µg/dL vs. 0-4 µg/dL.²⁸⁸

A statewide study of North Carolina public school children found that lead exposure is associated with lower performance on reading End Of Grade (EOG) test scores in a clear dose-response pattern at all blood lead levels, with the effects increasingly more pronounced for children with the lowest academic attainment.²⁸⁹ A similar study conducted in Connecticut uncovered that blood lead levels as low as 3-4 µg/dL are negatively associated with third, fourth, and fifth grade reading scores, and blood lead levels as low as 4-5 µg/dL are negatively associated with math scores.²⁹⁰

Reading scores are affected by blood lead levels as early as in kindergarten. In a study of children attending public kindergarten in Providence (RI), compared with children with blood lead levels < 5 µg/dL, there were 21% and 56% more children failing to achieve the national benchmark for reading readiness with blood lead levels of 5 to 9 and >10 µg/dL respectively. Furthermore, on average, reading readiness scores decreased by 4.5 and 10.0 points for children with blood lead levels of 5 to 9 and 10 mg/dL, respectively, compared with children of blood lead levels below 5 µg/dL.²⁹¹

A similar study in North Carolina found that, after adjusting for potential confounders, going as low as 2 µg/dL, every 1 µg/dL increase in blood lead reduces the likelihood of children being placed in advanced and intellectually gifted programs. Also, blood lead levels as low as 4 µg/dL increase the likelihood that a child will be designated to the category for children with learning and behavioral issues. Furthermore, blood lead levels as low as 8 µg/dL significantly increase the likelihood that a child will be designated to the exceptionality category group containing students with visual, hearing, or speech impairments, physical or health handicaps, autism, or trainable or severe mental handicaps.²⁹²

Speech and language deficits

Lead exposure is also associated with speech and language deficits. A study of 11 to 14 year olds found that higher bone lead concentrations were associated with poorer performance on certain language measures. Another study on the influence of childhood lead exposure on language processing in a group of young adults found that higher childhood blood lead levels were significantly associated with reduced activity in a region of the brain known for speech production. Some studies have also found an

association between High Blood Lead Levels and small but significant deficits in hearing and central auditory processing.²⁹³

Behavioral Problems

A recent study examining the relationship between blood lead levels and ADHD among children 4-15 years of age found that blood lead concentration was a significant predictor of ADHD, and that there was a significant dose-response relationship between lead exposure and ADHD. When the sample was restricted to children with blood lead concentrations below 5 µg/dL, there was still a significant association between higher blood lead levels and ADHD.²⁹⁴

A previous study that looked at blood lead levels and behavior found significant, albeit small, relationship. The study, conducted amongst preschool children in Yugoslavia, found that blood lead explained 1% and 4% change of the variance on the Destructive and Withdrawn Subscales of the Child Behavior Checklist.

²⁹⁵

Studies have also found links between increased blood lead and destructive and aggressive behaviors in children. A study of a nationally representative sample of children aged 8 to 15 years found that those with blood lead levels ≥ 1.5 µg/dL had a 8.6-fold increased odds of having symptoms of conduct disorder, compared with children with levels from 0.2 to 0.7 µg/dL. Studies have also found that lead exposure in childhood increases the likelihood of antisocial behaviors in later childhood, adolescence, and young adulthood.²⁹⁶

Conclusions

Key points:

- Primary prevention by addressing sources including lead based paint hazards in older, poorly maintained housing, along with screening, education of parents/caregiver and health care providers are necessary to address childhood lead exposure.
- Underserved children have significantly higher rates of high blood lead levels. At the population level, black children had significantly higher mean blood lead levels than white or Mexican American children. Mean blood lead levels were also higher in children enrolled in Medicaid and in children from poorer families. Children living in communities with older, poorly maintained housing are at greatest risk for exposure.
- These disadvantaged groups of children are therefore vulnerable to the learning consequences of lead exposure, which are decreased IQ, decreased score in academic performance tests, decreased designation as exceptionally gifted and increased designation as having learning or behavioral issues or severe handicaps. Other consequences included increased rates of ADHD and behavioral problems. Moreover, children in poverty face other factors that can increase the harmful effects of lead exposure, including exposure to other neurotoxicants (e.g. pesticides, tobacco smoke), poorer nutrition (e.g. inadequate calcium and iron intake), lack of medical coverage, increased stress, and fewer opportunities for stimulation.²⁹⁷
- Collectively, these findings clearly show the need to prevent exposure, ensure that children at risk have access to appropriate lead screening and follow up services, and provide an enriched intellectual environment and educational interventions for lead-exposed children to overcome the adverse learning effects.

IV. DISCUSSION AND RECOMMENDATIONS

Discussion

A strong body of evidence shows that these seven health conditions, when left untreated or undermanaged, impair learning. The prevalence of most of these Health Barriers to Learning is higher in children of color and in poverty, and these same groups bear more burden of disease—in part due to poor access to the services needed to identify, manage, and treat these conditions. Many children are affected by more than one Health Barrier to Learning, which only compounds the effects of other barriers to educational success faced by children in poverty. The following table provides a snapshot.

Health Barriers to Learning	Prevalence & Unmet Need for Services	Impact on learning
Adverse Childhood Experiences Contextual Factor	<ul style="list-style-type: none"> Nearly half (48%) of US children 17 years and below experienced one or more ACEs. Rates are high in black children (60%) and Hispanic children (51%), compared with white children (44%). About two-thirds of children from families in poverty (67%) experience at least one ACE, 2.5 times the rate in children from families that are at least 4 times above the poverty level (27%). A national survey of pediatricians showed that only about 1 in 3 pediatricians regularly ask about any ACE, illustrating the many missed opportunities to connect children and families to the support they need. 	<ul style="list-style-type: none"> Grade retention Decreased academic performance Disengagement with school Learning problems Behavioral problems at school Attendance problems
Uncontrolled Asthma	<ul style="list-style-type: none"> Nationally, 9% of children have asthma. Rates are higher in black children (13%) & Puerto Rican children (24%). Nationally, the rate of ED visits in children with asthma is 10.7 ED visits per 100 children, indicating the need for additional treatment. Rates in Black children are 15.2 ED visits per 100 children. Rates for Hispanic children are 12.5 ED visits per 100 children. 	<ul style="list-style-type: none"> Disrupted sleep Missed school days Poor academic performance Emergency Department visits Hospitalizations

Health Barriers to Learning	Prevalence & Unmet Need for Services	Impact on learning
Uncorrected Vision Problems	<ul style="list-style-type: none"> • Uncorrected refractive errors affect 18% of 12 to 17 year olds. • Amblyopia affects 2% of children aged 6 months to 6 years old. • Strabismus affects 2% to 4% of children below 6 years old. • In some underserved communities, 22% to 30% of children fail vision screening, indicating high unmet need for services. 	<ul style="list-style-type: none"> • Adverse effects on visual tasks such as reading, writing and using computers • Poor school performance • Adverse effects on motor skills needed in practical, daily tasks
Uncorrected Hearing problems	<ul style="list-style-type: none"> • 9 to 10 children out of every 1000 will have permanent hearing loss by school-age. • Although 95% of newborns receive hearing screening, newborn screening will still miss children who develop hearing loss later. 	<ul style="list-style-type: none"> • Inability to understand speech in the classroom • Grade repetition • Speech and language deficits • Social emotional issues including low self-esteem, less energy, & behavior problems • Poor educational performance
Dental pain	<ul style="list-style-type: none"> • Caries are common, with more than half of 6 to 8 year olds (56%) experiencing caries. • Untreated caries are also common. Nationally, about 22% of children aged 6 to 9 had untreated caries, with particularly high rates in black children (32%), Mexican American children (29%), and children living in poverty (27%). • Nationally, only 44% received dental care in the past year. Rates are even lower in black children (34%), Hispanic children (35%), and children in low-income families (33%). 	<ul style="list-style-type: none"> • Missed school days • Lost sleep • Difficulty with paying attention • Poor school performance: problems at school, falling behind in homework & lower grades • Psychosocial problems: Feeling worthless, shy and unhappy. Less likely to be friendly.
Persistent Hunger	<ul style="list-style-type: none"> • Nationally, children experience food insecurity in 8% of households with children. Rates are higher in single female-headed households (15%), black households (11%), Hispanic households (12%), and poor households (21%). 	<ul style="list-style-type: none"> • Emotional state of the child • Interaction abilities & social skills • Anxiety and depression • Lower levels of school engagement • Greater risk of being placed in special education • Poorer test scores

Health Barriers to Learning	Prevalence & Unmet Need for Services	Impact on learning
<p>Certain Mental Health and Behavioral Problems</p>	<ul style="list-style-type: none"> Behavioral disorders affect 4% of children and are most commonly diagnosed in black children (6%) and children in poverty (7%). Attention-deficit/hyperactivity disorder (ADHD) is the most common mental health problem with about 10% of children diagnosed at some point in their lives. Children who are poor, uninsured or whose parents have low levels of education tend to have less access to the mental health care they need. 	<ul style="list-style-type: none"> Lower likelihood of completing college Failure to graduate from high school Grade repetition Suspension Decreased academic performance (low reading and math test scores) Placement in special education
<p>Effects of Lead Exposure</p>	<ul style="list-style-type: none"> About 1.1 million low-income homes with children under the age of 6 still contain lead-based paint hazards. Average blood lead levels are higher in black children, children enrolled in Medicaid, and children from poorer families. About 67% of Medicaid-enrolled children were tested for lead by the age of 2, potentially missing opportunities to identify and mitigate the risk of permanent neurologic damage and behavioral disorders. 	<ul style="list-style-type: none"> Decreased IQ Decreased academic performance Speech and language deficits Behavioral problems, including ADHD and destructive and aggressive behaviors

Given that education and graduation from high school are critical to achieving good health, well-being, and social stability in adulthood, a child's ability to attend school, concentrate in the classroom, and perform academically are paramount. Windows of opportunity for children to achieve critical milestones, such as reading proficiency in 3rd grade, pass quickly. Thus, the pervasive problem of children with unidentified and untreated Health Barriers to Learning needs to be urgently addressed.

Each of these health barriers has treatments or interventions that have been proven to work. Many well-designed clinical screening and treatment guidelines and protocols include some or all of these HBLs. Additionally, there is a growing recognition that children in poverty are at higher risk. For example, the American Academy of Pediatrics' Bright Futures recommends screening for vision at ages 3,4,5,6,8,10,12, and 15—but adds the caveat that screening should be done annually for children who are at risk, which includes poverty and other high risk demographic and social factors.²⁹⁸ Similarly, the AAP recommends blood testing for children at specific ages, but also recommends that all children ages 0-6 receive an annual risk assessment for lead exposure.²⁹⁹ In 2015, the AAP added screening for hunger,³⁰⁰ and in 2016 added screening for poverty³⁰¹ to the recommended protocol for well child visits. Moreover, there is an increasing awareness of the impact of Adverse Childhood Experiences on health and brain development, and promising interventions continue to develop to mitigate their impact by building resilience.

However, to make a real difference at both an individual and a population level, children who need any or all of these interventions must be identified early, which requires longitudinal, systematic screening. Approximately 15 million children still have barriers to receiving routine primary care,³⁰² and many others do not routinely access it. To reach these children, solutions require an integrated, broad-based public health approach—one that ties together the often-siloed institutions of education, health care, and social services; and that better integrates parents into the circle of knowledge and care plan for the child.

Recommendations

To empower at-risk communities and to keep children healthy and ready to learn, the healthcare and education sectors, parents, and other community agencies need to work together to create an integrated safety net. To be effective, this requires coordination and collaboration among the medical and education sectors, parents, and other community agencies that provide support services for children. Shared messaging about the importance and interdependence of health, attendance, and school success will be important.

Annual Screening and the Medical Home Model of Care: In addition to uninsured and underinsured children, many children who have coverage are not yet accessing optimal care in the medical home model. Conceptually coined in the 1960s by the American Academy of Pediatrics, the term medical home refers to 'delivery of advanced primary care with the goal of addressing and integrating high quality health promotion, acute care and chronic condition management in a planned, coordinated, and family-centered manner.'³⁰³ Continuity is a key feature, particularly important in the management of children's health as they progress through different mental and physical developmental stages and challenges. The relationship developed over time allows for more consistent screening, targeted preventative guidance, and management of chronic conditions. As discussed, from a clinical standpoint, there are varying recommendations for the specific periodicity of some screenings, but clearly from the evidence presented above, children—especially those in poverty or with other risk factors—are being missed, which is subsequently impacting their ability to learn and succeed in school. Clinical teams need to prioritize age-appropriate annual screening for Health Barriers to Learning and ensure treatment in the medical home model, which includes coordination of care.

HBL Screening Required by Schools: To create a safety net for children who aren't engaged in regular, ongoing healthcare, additional screening systems need to exist in places where children can be reached—like schools—to identify and connect them with a medical home for comprehensive services and preventative care. Currently, there is little consistency across districts or states as to what health screenings are offered or required for attendance, or with what frequency.³⁰⁴ Some require as little as an immunization record, and many that do require a more comprehensive screening don't require it on an annual basis. Some districts and states do require vision screening at school, but not all require the screenings to be done annually. Though it is unlikely that schools could realistically provide comprehensive screening on site annually for all of the HBLs, a set of age-appropriate annual HBL screenings required by the school could be a driving factor to influence parents and community clinics to work together to make this approach succeed, better integrating children into medical home care. Screening at other agencies caring for children, such as preschool, afterschool programs, and homeless shelters—when integrated and supported for follow up services—could also help complete this safety net for the most at-risk children. These multiple access points can serve as doorways into the medical home and comprehensive healthcare.

Family Service Agencies and Organizations: Many families may require assistance or support from court, foster care, housing, or other social service agencies. An accurate understanding of a child's health and educational needs are fundamental components in each assessment. Similarly, referrals, further diagnostic studies, treatment, and plans for services at school may be needed and should be integrated into the placement or care plan. Agencies and workers need to fully understand the issues which children and their families may be experiencing. Appropriate training, protocols, and access to materials on HBLs and trauma-informed care need to be developed and offered to social service agencies and family court officials.

Parent Engagement: Parent education and engagement needs to be a high priority, as coordination of the health and education needs of a child comes from the home. Additionally, many services, even if offered through schools, still require specific parental consent and participation in needed follow-up. This could be, in part, facilitated by increased public awareness of the importance and impact of Health Barriers to Learning. Outreach, unified messaging, and coordination between the medical and education sectors is also key.

Communication: While required or recommended screening forms at school could bring more children into comprehensive medical home care, in turn, the clinical teams must also communicate needs of individual children effectively with the parents and school, so that appropriate care and services are provided for children in all of their daily environments. To do this, relevant care plans must be available and understood by caretakers and teachers. It is critical for clinical care teams to prioritize age-appropriate annual screening and treatment of Health Barriers to Learning, but also to ensure that parents and schools have access to and understanding of the information. This will require significant commitment by providers, parents, and school systems.

Use of technology and information systems, like web-based immunization registries, could be leveraged to securely store and share critical information on a child's screening status, identified Health Barriers to Learning, and associated needs. Creating an online repository for HBL-related information may be an excellent way to ease the data collection burden and improve accessibility for use in the development of supporting interventions, education for parents, and evolving policies that ensure every child has the greatest opportunity to be healthy and ready to learn. As with any vital information system, especially those that have health or educational personal information and direct impact on children, various regulations that guide the protection and use of sensitive data must be followed. Systems seeking to

leverage technology for innovation should be certain to define clear rules for accessing and using the collected information, as well as a clear governance process to ensure all parties have a voice in how these vital information tools are used.

Policy and Funding: For each of these things to happen, accessible and sustainable funding streams need to be made available. Parents need to be able to access and afford any screening and treatment required by school. Clinics need to be reimbursed for staffing necessary to complete multiple screenings at patient visits, and to provide for the necessary case management and health education often needed for children with identified Health Barriers to Learning. Potential new alternative reimbursement models such as value based payment to providers driven by outcomes may better allow for incorporation of these vital but traditionally non-reimbursable services. Schools, which are already struggling and painfully understaffed with school nurses, require protected funding to be able to support additional school nurses and services directed towards screening and referral.

Passed in late 2015, the Every Student Succeeds Act (ESSA) offers an expanded set of tools to plan and operationalize program initiatives to identify and address Health Barriers to Learning. It includes important provisions that allow states and school districts to use Title I and Title IV funds to supplement screening, health, wellness, and mental health services. States and school districts must be informed and encouraged to fully leverage the potential opportunities presented within the ESSA. However, even with resources provided through ESSA, many schools—especially those with high rates of children in poverty—face severe challenges, with many competing priorities to cover with this funding. One emergent and extremely promising option, the 2015 reinterpretation of the Free Care act, would permit school districts and schools to engage Medicaid providers, who would be newly enabled to bill for health-related services offered to school-based Medicaid-eligible populations.

Further Research: Further research needs to be done and assimilated to drive screening requirements and policy changes, in particular focusing on the potential cost savings that these early interventions could produce, both in health care costs saved by keeping children out of the Emergency Department and hospital; and also by increased earning potential, contribution to the workforce, and lower disease burden in adulthood.

CONCLUSION: In summary, Children’s Health Fund makes the following recommendations to empower at-risk communities and to increase identification, management, and treatment of Health Barriers to Learning for all children, with a particular focus on those living in poverty:

Healthcare Sector

All children should have an affordable, accessible medical home. Clinicians should:

- Prioritize annual, age-appropriate, systematic screening and management of the Health Barriers to Learning;
- Ensure effective communication of the results, importance to educational success, and relevant management considerations to schools and parents; and
- Promote the utilization of tools and inter-agency, cross-sector communication systems to consistently identify and track HBLs.

Education Sector

Schools should be supported as points of influence and access for annual screening and referral for Health Barriers to Learning, to ensure children who haven't been engaged with a medical home are screened and connected to health care. School systems/educational professionals should:

- Ensure teachers and other school personnel receive adequate training on the importance of Health Barriers to Learning and relevant school/classroom support to mitigate any potential effects on children's educational success; and
- Require annual screening for age-appropriate Health Barriers to Learning, either onsite, or in collaboration with children's primary care providers.

Family Service Agencies and Organizations

Children with documentable HBLs may need medical attention, health services, and social services that are relevant to their status and critical to meet their needs and coordinate care and intervention. Court and family service agencies should:

- Receive appropriate training on the relevance of HBLs to children in their care; and
- Ensure HBLs are appropriately addressed in their decision-making and care plans.

Parents and Caretakers

Public awareness campaigns and aligned messaging from the medical and educational sectors are ways to engage and empower parents to become informed advocates for their children. Parents should:

- Proactively request screening of their children for HBLs; and
- Ensure communication between their child's clinical team and school on any HBLs.

Policymakers

Resources and systems need to be in place to support services for screening, treatment, and mitigation of HBLs. Policymakers should:

- Ensure coverage of services such as case management and health education in the clinical environment.
- Make provisions to cover screening and referral of HBLs in schools and other settings.
- Ensure that as regulatory guidance for states and school districts is developed, the identification and amelioration of HBLs are encouraged and incentivized as a priority within Title I and other categorical funding streams in federal education legislation.

V. REFERENCES

INTRODUCTION

1. Center on Reinventing Public Education, University of Washington (2015). Authors: Michael DeArmond, Patrick Denice, Betheny Gross, José Hernández, Ashley Jochim, and Robin Lake. Measuring Up: Educational Improvement and Opportunity in 50 Cities. Retrieved on 10/21/16 from: <http://crpe.org/publications/measuring-educational-improvement-and-opportunity-50-cities> NOTE: From Page 16 of the report: “51% or less of students in Toledo and Minneapolis graduated from high school in four years.”
2. Brito, Arturo et al.(2008). The Enhanced Medical Home: The Pediatric Standard of Care for Medically Underserved Children. *Advances in Pediatrics* , Volume 55 , Issue 1 , 9-28. Retrieved from: <http://www.childrenshealthfund.org/category/tags/medically-underserved>
3. National Center for Education Statistics (NCES). Statistical Standards > Development of Concepts and Methods > SUBJECT: DEFINING RACE AND ETHNICITY DATA > STANDARD 1-5-4. Link: https://nces.ed.gov/statprog/2002/std1_5.asp
4. The Annie E. Casey Foundation. (2016). *2016 KIDS COUNT Data Book* . Baltimore, MD: Author. Retrieved from: <http://www.aecf.org/m/resourcedoc/aecf-the2016kidscountdatabook-2016.pdf>
5. Ou,Suh-Ruu., Reynolds, A.J.(2008,June) Predictors of Educational Attainment in the Chicago Longitudinal Study. *School Psychology Quarterly*, v23 n2 p199-229. Retrieved on 06/14/2016 from: <http://eric.ed.gov/?id=EJ802106>
6. Basch, C.E. (2010,March). Healthier Students are Better Learners: A Missing Link in School Reforms to Close the Achievement Gap. Teachers College, Columbia University. Retrieved on 06/14/2016 from: http://www.equitycampaign.org/i/a/document/12557_EquityMattersVol6_Web03082010.pdf
7. Michael, S. L., Merlo, C. L., Basch, C. E., Wentzel, K. R. and Wechsler, H. (2015), Critical Connections: Health and Academics. *Journal of School Health*, 85: 740–758. doi: 10.1111/josh.12309. Retrieved on 06/14/2016 from: <http://onlinelibrary.wiley.com/doi/10.1111/josh.12309/full>

BACKGROUND: ADVERSE CHILDHOOD EXPERIENCES

8. American Academy of Pediatrics (AAP). *Adverse Childhood Experiences and the Lifelong Consequences of Trauma*. NOTE: This report is part of the Trauma Toolbox for Primary Care developed by AAP. Link: <https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/healthy-foster-care-america/Pages/Trauma-Guide.aspx?nfstatus=401&nf-token=00000000-0000-0000-0000-000000000000&nfstatusdescription=ERROR%3a+No+local+token>
9. American Academy of Pediatrics (AAP). *Adverse Childhood Experiences and the Lifelong Consequences of Trauma*. NOTE: This report is part of the Trauma Toolbox for Primary Care developed by AAP. Link: <https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/healthy-foster-care-america/Pages/Trauma-Guide.aspx?nfstatus=401&nf-token=00000000-0000-0000-0000-000000000000&nfstatusdescription=ERROR%3a+No+local+token>
10. Child Welfare Information Gateway Children’s Bureau/ACYF/ACF/HHS. Long-Term Consequences of Child Abuse and Neglect. Available at: https://www.childwelfare.gov/pubPDFs/long_term_consequences.pdf. Accessed April 27, 2016.
11. Administration for Children and Families, Office of Planning, Research and Evaluation.(2011). NSCAW II baseline report: Child well-being. Retrieved from http://www.acf.hhs.gov/sites/default/files/opre/nscaw2_child.pdf. Accessed on April 28, 2016. See Page 5.

12. National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved 05/31/16 from www.childhealthdata.org. Topic: Family Health and Activities. Question: Indicator 6.11: Adverse childhood experiences. Link to specific query: <http://www.childhealthdata.org/browse/survey/results?q=2257&r=1>
13. Committee on Psychosocial Aspects of Child and Family Health, Committee on Early Childhood, Adoption, and Dependent Care, and Section on Developmental and Behavioral Pediatrics, Andrew S. Garner, Jack P. Shonkoff, Benjamin S. Siegel, Mary I. Dobbins, Marian F. Earls, Andrew S. Garner, Laura McGuinn, John Pascoe, David L. Wood (2012). Early Childhood Adversity, Toxic Stress, and the Role of the Pediatrician: Translating Developmental Science Into Lifelong Health. *Pediatrics* Jan 2012, 129 (1) e224-e231; DOI: 10.1542/peds.2011-2662. Retrieved from: <http://pediatrics.aappublications.org/content/129/1/e224.full?sid=23890cdd-dd37-48d6-9b5a-3c15ea20510b#ref-23>
14. Kerker BD, Storfer-Isser A, Garner A, Szilagyi M, O'Connor K, Hoagwood K, Stein REK, Horwitz SM. Identifying Adverse Childhood Experiences (ACEs) in Pediatric Primary Care. Presented at the 2015 Pediatric Academic Societies Annual Meeting. Retrieved from: <https://www.aap.org/en-us/professional-resources/Research/research-findings/Pages/Identifying-Adverse-Childhood-Experiences-ACEs-in-Pediatric-Primary-Care.aspx>
15. National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved 05/31/16 from www.childhealthdata.org. Topic: Family Health and Activities. Question: Indicator 6.11: Adverse childhood experiences. Sub Group: Emotional, behavioral or developmental issues. Link to data query: <http://childhealthdata.org/browse/survey/results?q=2257&r=1&g=463>
16. Administration for Children and Families, Office of Planning, Research and Evaluation. (2011). NSCAW II baseline report: Child well-being. Retrieved from: http://www.acf.hhs.gov/sites/default/files/opre/nscaw2_child.pdf. Accessed on April 28, 2016. See Page 11.
17. Administration for Children and Families, Office of Planning, Research and Evaluation. (2011). NSCAW II baseline report: Child well-being. Retrieved from: http://www.acf.hhs.gov/sites/default/files/opre/nscaw2_child.pdf. Accessed on April 28, 2016. Internalizing Problems combines the Social Withdrawal, Somatic Complaints, and Anxiety/Depression scales, while Externalizing problems combines the Delinquent Behavior and Aggressive Behavior scales. See Pages 7 to 8.
18. Administration for Children and Families, Office of Planning, Research and Evaluation. (2011). NSCAW II baseline report: Child well-being. Retrieved from: http://www.acf.hhs.gov/sites/default/files/opre/nscaw2_child.pdf. Accessed on April 28, 2016. NOTE: . The three most common health conditions reported by caregivers were Attention-Deficit/Hyperactivity Disorder (ADHD; 16.4%), asthma (16.1%), and emotional problems (14.4%). See Page 3.
19. National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved 05/31/16 from www.childhealthdata.org. Link to specific query: <http://childhealthdata.org/browse/survey/results?q=2388&r=1>
20. Kerker, B.D., Zhang, J., Nadeem, E., Stein, R.E., Hurlburt MS, Heneghan A, Landsverk J, McCue Horwitz S. (2015, September). Adverse Childhood Experiences and Mental Health, Chronic Medical Conditions, and Development in Young Children. *Acad Pediatr.*;15(5):510-7. NOTE: This finding applies to children who are not in out of home care.
21. Except for those in group homes or residential programs.
22. Administration for Children and Families, Office of Planning, Research and Evaluation. (2011). NSCAW II baseline report: Child well-being. Retrieved from http://www.acf.hhs.gov/sites/default/files/opre/nscaw2_child.pdf. Accessed on April 28, 2016. See Page 9.

23. Administration for Children and Families, Office of Planning, Research and Evaluation. (2011). NSCAW II baseline report: Child well-being. Retrieved from http://www.acf.hhs.gov/sites/default/files/opre/nscaw2_child.pdf. Accessed on April 28, 2016. See Pages 10 to 11.
24. CDC-Kaiser Permanente. Adverse childhood experience (ACE) study. Summary of findings available at: <http://www.cdc.gov/violenceprevention/acestudy/about.html>. Accessed April 14, 2016. Full study: Felitti, Vincent J et al. Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults. *American Journal of Preventive Medicine* , Volume 14 , Issue 4 , 245 - 258.
25. Bethell, C., Newacheck, P., Hawes, E. and Halfon, N. (2014). Adverse Childhood Experiences: Assessing The Impact On Health And School Engagement And The Mitigating Role Of Resilience. *Health Aff* vol. 33 no. 12 2106-2115. See Page 6, section “ASSOCIATION WITH SCHOOL SUCCESS FACTORS.”
26. Burke, N.J., Hellman, J.L., Scott, B.G., Weems, C.F, Carrion, V.G. (2011 June). The impact of adverse childhood experiences on an urban pediatric population. *Child Abuse Neglect*; 35(6):408-13. NOTE: As explained in the Methods section, the study used logistic regression to calculate the risk (Odds ratio) of having learning/behavior problems in association with an ACE score $\geq 1 \geq 4$, compared to ACE score = 0. This procedure allowed them to control for demographic variables that may covary with ACE scores and outcome variables including age, gender, ethnicity, and two different groupings of ACE score (ACE ≥ 1 and ≥ 4 as compared to ACE score = 0).
27. Blodgett, C. ACEs in Head Start children and Impact on Development. Washington State University, CLEAR Trauma Center. January 2014. Available at: <http://ext100.wsu.edu/cafru/research/>. Accessed on 06/06/2016.
28. Blodgett, C., Harrington, R. Adverse Childhood Experience and Developmental Risk in Elementary Schoolchildren. Washington State University, CLEAR Trauma center. Available at: <http://ext100.wsu.edu/cafru/research/>. Accessed on 06/06/2016
29. Blodgett, C., Harrington R. Working Paper 7/30/12 Adopting ACEs Screening and Assessment in in Child Serving Systems. See Study 2: Readiness to Learn Adversity Study by Blodgett C, Turner N, and Winikoff J (p. 10). Washington State University, CLEAR Trauma center. Available at: <http://ext100.wsu.edu/cafru/research/>. Accessed on 06/06/2016

UNCONTROLLED ASTHMA

30. National Institute of Health. Guidelines for the Diagnosis and Management of Asthma (EPR-3). Accessed from <http://www.nlm.nih.gov/health-pro/guidelines/current/asthma-guidelines>
31. National Institute of Health. Guidelines for the Diagnosis and Management of Asthma (EPR-3). Accessed from <http://www.nlm.nih.gov/health-pro/guidelines/current/asthma-guidelines>
32. National Institute of Health. Guidelines for the Diagnosis and Management of Asthma (EPR-3). Accessed from <http://www.nlm.nih.gov/health-pro/guidelines/current/asthma-guidelines>
33. Moorman, J.E. Person, S.J. and Zahran, H.S. (2001–2010). Asthma Attacks Among Persons with Current Asthma — United States. *Supplements. Division of Environmental Hazards and Health Effects, National Center for Environmental Health, CDC*. November 22, 2013/62(03);93-98. Link: http://www.cdc.gov/mmwr/preview/mmwrhtml/su6203a16.htm?s_cid=su6203a16_e Retrieved on 05/19/2016. This report in turn cites from: National Institutes of Health. National Heart, Lung, and Blood Institute. Expert panel report 3: guidelines for the diagnosis and management of asthma. Bethesda, MD: US Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute, National Asthma Education Program; 2007.
34. CDC. (2014). Asthma Prevalence in the U.S.: Slide set. Retrieved from CDC website: http://www.cdc.gov/asthma/surveillance_summaries.htm

35. National Health Interview Survey. (2014). Current Asthma Prevalence Percents by Age, United States. See the following tables: 1) National Current Asthma* Prevalence (2014). Retrieved on 06/10/16 from: http://www.cdc.gov/asthma/most_recent_data.htm 2) Table 4-1 Current Asthma Prevalence Percents by Age, United States: National Health Interview Survey, 2014. Retrieved on 11/04/16 from: <https://www.cdc.gov/asthma/nhis/2014/table4-1.htm>
36. National Health Interview Survey. (2014). Table 2-1 Lifetime Asthma Prevalence Percents by Age, United States: National Health Interview Survey, 2014. Retrieved from: <https://www.cdc.gov/asthma/nhis/2014/table2-1.htm>
37. Nicholas, S. W., Jean-Louis, B., Ortiz, B., Northridge, M., Shoemaker, K., Vaughan, R., and Hutchinson, V. (2005). Addressing the childhood asthma crisis in Harlem: the Harlem Children's Zone Asthma Initiative. *American Journal of Public Health*, 95(2), 245-249.
38. Clark, N.M., Shah, S., Dodge J, A., Thomas, L. J., Andridge, R.R., Roderick J.A and Little, R.J.A., (2010,February) An Evaluation of Asthma Interventions for Preteen Students, *Journal of School Health*, 80(2), 80–87.
39. Nelson. B.W., Awad, D., Alexander, J and Clark, N. (2009). The continuing problem of asthma in very young children: a community-based participatory research project. *J Sch Health*.79, 209-215.
40. CDC. Factsheet "Uncontrolled Asthma among Persons with Current Asthma." Source: Behavioral Risk Factors Surveillance System (BRFSS)—Child and Adult Asthma Call-back survey Data, 2006-2010. Retrieved on 05/20/2016 from: http://www.cdc.gov/asthma/asthma_stats/Uncontrolled_Asthma.pdf Criteria for measuring uncontrolled asthma is reported any of the following: in past 30 days, asthma symptoms more than two days a week; nighttime awakenings (more than one times a month in ages 0-4 years and two or more times a month in ages 5-11 years, and one to three times a week in ages 12 years and older); and in past three months, short-acting β 2-agonists use more than two days a week.
41. Crocker, D., Brown, C., Moolenaar, R., Moorman, J., Bailey, C., Mannino, D and Holguin, F. (2009, October). "Racial and Ethnic Disparities in Asthma Medication Usage and Health-Care Utilization: Data From the National Asthma Survey." *Chest*, Volume 136, Issue 4, 1063–1071.
42. Moorman, J.E., Akinbami, L.J., Bailey C.M., et al. (2012). National Surveillance of Asthma: United States, 2001–2010. *National Center for Health Statistics. Vital Health Stat 3(35)*. See: "Table 15. Rate of emergency department visits with asthma as the first-listed diagnosis per 100 persons with current asthma, by detailed age group and selected patient characteristics: United States, average annual 2007–2009." Retrieved from: http://www.cdc.gov/nchs/data/series/sr_03/sr03_035.pdf
43. Moorman, J.E., Akinbami, L.J., Bailey, C.M., et al. (2012). National Surveillance of Asthma: United States, 2001–2010. *National Center for Health Statistics. Vital Health Stat 3(35)*. See: "Table 18. Rate of hospital discharges with asthma as the first-listed diagnosis per 100 persons with current asthma, by detailed age group and selected patient characteristics: United States, average annual 2007–2009." Retrieved from: http://www.cdc.gov/nchs/data/series/sr_03/sr03_035.pdf
44. Akinbami, L.J. (2006). *The State of childhood asthma, United States, 1980–2005. Advance data from vital and health statistics; no 381*, Hyattsville, MD: National Center for Health Statistics. See Page 9.
45. Crocker, D., Brown, C., Moolenaar, R., Moorman, J., Bailey, C., Mannino, D and Holguin, F. (2009, October), "Racial and Ethnic Disparities in Asthma Medication Usage and Health-Care Utilization: Data From the National Asthma Survey." *Chest* Volume 136, Issue 4, 1063–1071.
46. Citizens' Committee for Children in New York. "Concentrations of Risk: Asthma and Poor Housing Conditions." Uses 2010 data on Asthma Hospitalizations Per 1,000 Children (0 -15). February 28, 2013. Retrieved from: <http://www.cccnewyork.org/blog/concentrations-of-risk-asthma-and-poor-housing-conditions/>

47. Strane, D., Wahl, R. and Garcia E. (2013). Disparities in Michigan's Asthma Burden. Lansing, MI: Bureau of Disease Control, Prevention, and Epidemiology, Michigan Department of Community Health, 2. Retrieved from: http://www.michigan.gov/documents/mdch/Disparities-in-Michigan-Asthma-Burden_424786_7.pdf
48. CDC. Asthma Attack Prevalence Percents among those with Current Asthma by Age, United States: National Health Interview Survey, 2014. Table 6-1. Retrieved on 05/25/2016 from: <http://www.cdc.gov/asthma/nhis/2014/table6-1.htm>
49. CDC. "Asthma-related Missed School Days among Children aged 5–17 Years." Source: 2013 National Health Interview Survey (NHIS). Parents of children with current asthma were asked question, "During the past 12 months, how many days of [daycare or preschool, school, school or work] did child miss because of his/her asthma?" Retrieved on 05/25/2016 from the following link: http://www.cdc.gov/asthma/asthma_stats/default.htm
50. Basch, C.E. (2010, March). Healthier Students are Better Learners: A Missing Link in School Reforms to Close the Achievement Gap. Teachers College, Columbia University. Retrieved on 06/14/2016 from: http://www.equitycampaign.org/i/a/document/12557_EquityMattersVol6_Web03082010.pdf
51. Taras, H and Potts-Daterma, W. (2005). Childhood asthma and student performance at school. *Journal of School Health*.75:296-312
52. CDC. "Asthma-related Missed School Days among Children aged 5–17 Years." Source: 2013 National Health Interview Survey (NHIS). Parents of children with current asthma were asked question, "During the past 12 months, how many days of [daycare or preschool, school, school or work] did child miss because of his/her asthma?" Retrieved on 05/25/2016 from the following link: http://www.cdc.gov/asthma/asthma_stats/default.htm
53. Taras, H and Potts-Daterma, W. (2005). Childhood asthma and student performance at school. *Journal of School Health*.75:296-312
54. Taras, H and Potts-Daterma, W. (2005). Childhood asthma and student performance at school. *Journal of School Health*.75:296-312
55. Moonie, S.A., Sterling, D.A., Figgs, L and Castro M. (2006) Asthma status and severity affects missed school days. *Jan*;76(1):18-24. Retrieved on 05/25/2016 from the following link <http://www.ncbi.nlm.nih.gov/pubmed/16457681>
56. Diette, G.B., Markson, L., Skinner, E.A., Nguyen, T.T., Algatt-Bergstrom, P., Wu AW. (2000, September). Nocturnal asthma in children affects school attendance, school performance, and parents' work attendance. *Arch Pediatr Adolesc Med*. 154(9):923-8.
57. Stores, G., Willis, A.J., Wiggs, L., Crawford, C., and Thomson, A. (1998). Sleep and psychological disturbance in nocturnal asthma. *Archives of Disease in Childhood*, 78, 413-419.
58. Desager, K.N., Nelen, V., Weyler, J.J., & De Backer, W.A. (2005). Sleep disturbances and daytime symptoms in wheezing school-aged children. *Journal of Sleep Research*, 14, 77-82.
59. Lo C and Chiang, LC. (2006). The sleep problems among children with asthma. *Ju LI Za Zhi*, 53, 24-30
60. Strunk, R.C., Sternberg, A.L., Bacharier, L.B and Szeffler, SJ (2002, September). Nocturnal awakening caused by asthma in children with mild-to-moderate asthma in the childhood asthma management program. *J Allergy Clin Immunol*. 110(3):395-403.
61. Sadatsafavi, M. Rousseau, R., Chen, W., Zhang, W., Lynd, L., FitzGerald, J and Chest, M. (2014, Apr). The preventable burden of productivity loss due to suboptimal asthma control: a population-based study. 145(4):787-93.

62. Stores, G., Willis, A.J., Wiggs, L., Crawford, C., and Thomson, A. (1998). Sleep and psychological disturbance in nocturnal asthma. *Archives of Disease in Childhood*, 78, 413-419.
63. H Taras and W Potts-Daterma. (2005). Childhood asthma and student performance at school. *Journal of School Health*. 75:296-312
64. Halterman, J.S., Montes, G., Aligne, C.A., Kaczorowski, J.M., Hightower, A.D and Szilagyi, P.G. (2001, Jul-Aug) School readiness among urban children with asthma. *Ambul Pediatr*. 1(4):201-5. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11888401>
65. Halterman, J.S., Conn, K.M., Forbes-Jones, E., Fagnano, M., & Hightower, A.D. (2006). Behavior problems among inner-city children with asthma: Findings from a community-based sample. *Pediatrics*, 117, e192-e199.
66. Blackman, J.A., and Gurka, M.J. (2007) Developmental and behavioral comorbidities of asthma in children. *Journal of Developmental and Behavioral Pediatrics*, 28(2), 92-99.

UNCORRECTED VISION PROBLEMS

67. Ruderman, M. (2016). *Children's Vision and Eye Health: A Snapshot of Current National Issues* (1st ed.). Chicago, National Center for Children's Vision and Eye Health at Prevent Blindness. NOTE: Descriptions were slightly altered and some details were excluded for brevity.
68. Ganley, J.P. and Roberts J. (1983). Eye conditions and related need for medical care among persons 1-74 years of age: United States, 1971-1972. *Vital Health Stat* 11(228). Table 1, 21.
69. Ganz, M., Xuan, Z., & Hunter, D.G. (2006). Prevalence and correlates of children's diagnosed eye and vision conditions. *Ophthalmology*, 113, 2298-2306. Diagnoses were grouped into: Potentially blinding disorders; Refractive disorders; Visual disturbances; Blindness and low vision; Disorders of conjunctiva; Disorders of the orbit, eyelids, and/or lacrimal system; Strabismus; Eye disorders not otherwise classified; and Trauma and/or injury. The prevalence in 0-8 year olds is about 8%, and about 6% in 9-17 year olds.
70. CHF Healthy and Ready to Learn Initiative data. Screenings implemented in 2014 to 2015.
71. Bodack, M.I., Chung, I & Krumholtz, I. (2010, Sep). An analysis of vision screening data from New York City public schools. *Optometry*; 81(9):476-84. doi: 10.1016/j.optm.2010.05.006. Epub 2010 Jul 8.
72. Krumholtz, I. (2000). Results from a pediatric vision screening and its ability to predict academic performance. *Optometry*, 71, 426-430.
73. Choi, T.B., Lee, D.A., Oelrich, F.O., Amponash, D., Bateman, J.B and Christensen, R.E.(1995, August). A retrospective study of eye disease among first grade children in Los Angeles. *J Am Optom Assoc*. 1995 Aug; 66(8), 484-8.
74. Pizzarello, L., Tilp, M., Tiezzi, L., Vaughn, R., & McCarthy, J. (1998). A new school-based program to provide eyeglasses: ChildSight. *Journal of American Association for Pediatric Ophthalmology and Strabismus*, 2(6), 372-375.
75. Healthy People 2020 Vision Objective: [V-5.1 Reduce visual impairment due to uncorrected refractive error](#) . Data source was 2005 to 2008 National Health and Nutrition Examination Survey (NHANES); Centers for Disease Control and Prevention, National Center for Health Statistics (CDC/NCHS). This estimate is based on distance visual acuity test, with usual correction if any. Prevalence in the 12 to 17 age group is 17.7% (176.8 per 1000 people). Available at: <http://www.healthypeople.gov/2020/data-search/Search-the-Data?nid=5379>

76. Ruderman, M. (2016). *Children's Vision and Eye Health: A Snapshot of Current National Issues* (1st ed.). Chicago, IL: National Center for Children's Vision and Eye Health at Prevent Blindness. This study in turn cites: Qiu, M., Wang, S.Y., Singh, K.L. (2014). Racial Disparities in Uncorrected and Undercorrected Refractive Error in the United States. *Investigative Ophthalmology & Visual Science*, 55(10):6996-7005. See TABLE 4. Joint Effect of Race/Ethnicity and Other Risk Factors on Inadequate Refractive Correction in Subjects With Correctable Refractive Error.
77. Prevalence of myopia, hyperopia and astigmatism is taken from: Ruderman, M. (2016). *Children's Vision and Eye Health: A Snapshot of Current National Issues* (1st ed.). Chicago, IL: National Center for Children's Vision and Eye Health at Prevent Blindness.
78. Ruderman, M. (2016). *Children's Vision and Eye Health: A Snapshot of Current National Issues* (1st ed.). Chicago, IL: National Center for Children's Vision and Eye Health at Prevent Blindness.
79. National Health Interview Survey, CDC/NCHS. Data retrieved from Healthy People 2020 website. Objective-Vision V-2 Reduce blindness and visual impairment in children and adolescents aged 17 years and under. This estimate is based on response by parent or other knowledgeable adult in the family on behalf of the child to the question: "Does [name of child] have any trouble seeing, even when wearing glasses or contact lenses?". Link: <https://www.healthypeople.gov/2020/data-search/Search-the-Data?nid=5373>
80. Ruderman, M. (2016). *Children's Vision and Eye Health: A Snapshot of Current National Issues* (1st ed.). Chicago, IL: National Center for Children's Vision and Eye Health at Prevent Blindness. On Page 17, the report refers to the guidelines issued by a National Expert Panel convened by the National Center for Children's Vision and Eye Health (NCCVEH).
81. AAPOS (American Association of Pediatric Ophthalmology and Strabismus). Vision Screening Recommendations. Available at: http://www.aapos.org/client_data/files/2014/1076_aapos_visscreen.pdf
82. Ruderman, M. (2016). *Children's Vision and Eye Health: A Snapshot of Current National Issues* (1st ed.). Chicago, IL: National Center for Children's Vision and Eye Health at Prevent Blindness. On Page 18, the report describes eye examinations.
83. Ruderman, M. (2016). *Children's Vision and Eye Health: A Snapshot of Current National Issues* (1st ed.). Chicago, IL: National Center for Children's Vision and Eye Health at Prevent Blindness. Pages 12-13. This report uses: National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved 05/16/2016 from www.childhealthdata.org.
84. Center for Surveillance, Epidemiology, and Laboratory Services, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services. "Use of Selected Clinical Preventive Services to Improve the Health of Infants, Children, and Adolescents — United States, 1999–2011. Pages 43 to 46.
85. Ruderman, M. (2016). *Children's Vision and Eye Health: A Snapshot of Current National Issues* (1st ed.). Chicago, IL: National Center for Children's Vision and Eye Health at Prevent Blindness. See Page 14.
86. Ruderman, M. (2016). *Children's Vision and Eye Health: A Snapshot of Current National Issues* (1st ed.). Chicago, IL: National Center for Children's Vision and Eye Health at Prevent Blindness. This report in turn cites: Kemper, A.R., Helfrich, A., Talbot, J., Patel, N., Crews, J.E. (2011). Improving the Rate of Preschool Vision Screening: An Interrupted Time-Series Analysis. *Pediatrics*, 128(5), 1279-1284.
87. "Children's Vision and Eye Health: A Snapshot of Current National Issues" report by The National Center for Children's Vision and Eye Health at Prevent Blindness. This report in turn cites: Zhang, X., Elliott, M.N., Saaddine, J.B. et al. (2012). Unmet Eye Care Needs Among U.S. 5th-Grade Students. *American Journal of Preventive Medicine* 43(1):55-58, 14.

88. Studies examining barriers to follow up care: i) Zhang, X., Elliott, M.N., Saaddine, J.B., Berry, J.G., Cuccaro, P., Tortolero, S., Franklin, F., Barker, L.E., Schuster, M.A., Am, J. (2012, July). 43(1):55-8. doi: 10.1016/j.amepre.2012.01.032. Unmet eye care needs among U.S. 5th-grade students. ; ii) Su, Z., Marvin, E.K., Wang, B.Q., van Zyl T, Elia MD, Garza EN, Salchow DJ, Forster SH. Identifying barriers to follow-up eye care for children after failed vision screening in a primary care setting. J AAPOS. 2013 Aug;17(4):385-90. doi: 10.1016/j.jaapos.2013.05.008. Link: <http://www.ncbi.nlm.nih.gov/pubmed/23993718>; iii) "Children's Vision and Eye Health: A Snapshot of Current National Issues" report by The National Center for Children's Vision and Eye Health at Prevent Blindness. This report in turn cites: a) Chu, R., Huang, K., Barnhardt, C., Chen, A. (2015). The Effect of an On-Site Vision Examination on Adherence to Vision Screening Recommendations. The Journal of School Nursing, 31(2):84-90. and b) Traboulsi EI, Cimino H, Mash C, et al. Vision First, A Program to Detect and Treat Eye Diseases in Young Children: The First Four Years. Transactions of the American Ophthalmological Society, 2008;106:179-186.
89. Healthy People 2020 Vision Objective: [V-5.1 Reduce visual impairment due to uncorrected refractive error](#) . Data source was 2005 to 2008 National Health and Nutrition Examination Survey (NHANES); Centers for Disease Control and Prevention, National Center for Health Statistics (CDC/NCHS). Available at: <http://www.healthypeople.gov/2020/data-search/Search-the-Data?nid=5379> This estimate is based on distance visual acuity test, with usual correction if any. Prevalence in the 12 to 17 age group is 17.7% (176.8 per 1000 people).
90. Ruderman, M. (2016). Children's Vision and Eye Health: A Snapshot of Current National Issues (1st ed.). Chicago, IL: National Center for Children's Vision and Eye Health at Prevent Blindness. This study in turn cites: Qiu, M., Wang, S.Y., Singh, K., Lin, S.C. (2014). Racial Disparities in Uncorrected and Undercorrected Refractive Error in the United States. Investigative Ophthalmology & Visual Science, 55(10), 6996-7005.
91. Basch, C. E. (2011). Vision and the Achievement Gap Among Urban Minority Youth. Journal of School Health, 81: 599–605. doi: 10.1111/j.1746-1561.2011.00633.x
92. Shankar, S., Evans ,M.A and Bobier, W.R. (2007, November). "Hyperopia and emergent literacy of young children: pilot study." Optom Vis Sci.84(11):1031-8.
93. Kulp, M.T., Ciner, E., Maguire, M., Moore, B, Pentimonti, J., Pistilli, M., Cyert, L., Candy, T.R., Quinn, G and Ying, G.S. (2016, April). Uncorrected Hyperopia and Preschool Early Literacy: Results of the Vision in Preschoolers-Hyperopia in Preschoolers (VIP-HIP) Study. VIP-HIP Study Group. [Ophthalmology](#);123(4):681-9. doi: 10.1016/j.ophtha.2015.11.023. Epub 2016 Jan 27.
94. Narayanasamy S, Vincent SJ, Sampson GP, Wood JM (February 2015). Impact of simulated hyperopia on academic-related performance in children. Optometry and Vision Science, Vol. 92, No. 2.
95. Ma Xiaochen, Zhou Zhongqiang, Yi Hongmei, Pang Xiaopeng, Shi Yaojiang, Chen Qianyun et al. Effect of providing free glasses on children's educational outcomes in China: cluster randomized controlled trial BMJ 2014.
96. Orlansky,G., Wilmer,J., Taub, M.B., Rutner, D., Ciner, E. and Gryczynski, J. (2015). Astigmatism and Early Academic Readiness in Preschool Children. Optom Vis Sci 92:279Y285.
97. Wills, J., Gillett, R., Eastwell, E., Abraham, R., Coffey, K., Webber, A and Wood, J. (2012). Effect of Simulated Astigmatic Refractive Error on Reading Performance in the Young. 1040-5488/12/8903-0271/0 VOL. 89, NO. 3, PP. 271–276.
98. Kelly, K.R. et al. Amblyopic children read more slowly than controls under natural, binocular reading conditions. Journal of American Association for Pediatric Ophthalmology and Strabismus {JAAPOS} , Volume 19 , Issue 6 , 515-520. Epub 2015 Nov 20.
99. Webber, A.L., Wood, J.M., Gole, G. A and Brown, B. (2008, February). The effect of amblyopia on fine motor skills in children. Invest Ophthalmol Vis Sci.49(2):594-603. doi: 10.1167/iovs.07-0869.

100. Basch, C. E. (2011). Vision and the Achievement Gap Among Urban Minority Youth. *Journal of School Health*, 81:599–605. doi: 10.1111/j.1746-1561.2011.00633.x. Study cited: Taylor Kulp, M. (1999, March). Relationship between visual motor integration skill and academic performance in kindergarten through third grade. *Optom Vis Sci*. Mar;76(3):159-63.
101. Barnhardt, C., Borsting, E., Deland, P., Pham, N and Vu, T. (2005,February). Relationship between visual-motor integration and spatial organization of written language and math. *Optom Vis Sci*. 2005 Feb;82(2):138-43.
102. Barnhardt, C., Borsting, E., Deland, P., Pham, N and Vu, T. (2005,February). Relationship between visual-motor integration and spatial organization of written language and math. *Optom Vis Sci*. 2005 Feb;82(2):138-43. Language-based skills are letter sound knowledge, rapid naming of letters, phonological awareness, vocabulary, decoding skills and word reading fluency.

UNADDRESSED HEARING PROBLEMS

103. American Speech-Language-Hearing Association, “Type, Degree and Configuration of Hearing Loss” Retrieved from: <http://www.asha.org/uploadedFiles/AIS-Hearing-Loss-Types-Degree-Configuration.pdf>
104. Clark, J. G. (1981). Uses and abuses of hearing loss classification. *Asha*, 23, 493–500
105. American Speech-Language-Hearing Association. Guidelines for Audiologic Screening ASHA Panel on Audiologic Assessment. Retrieved from <http://www.asha.org/policy/GL1997-00199/>
106. American Speech-Language-Hearing Association. Guidelines for Audiologic Screening ASHA Panel on Audiologic Assessment. Retrieved from <http://www.asha.org/policy/GL1997-00199/>.
107. American Speech-Language-Hearing Association. Guidelines for Audiologic Screening ASHA Panel on Audiologic Assessment. Retrieved from <http://www.asha.org/policy/GL1997-00199/>
108. American Academy of Audiology. Childhood Hearing Screening Guidelines. September 2011. Retrieved from: https://www.cdc.gov/ncbddd/hearingloss/documents/aaa_childhood-hearing-guidelines_2011.pdf
109. Niskar, A. S., Kieszak, S. M., Holmes, A., Esteban, E., Rubin, C., and Brody, D. J. (1998). Prevalence of Hearing Loss Among Children 6 to 19 Years of Age. The Third National Health and Nutrition Examination Survey. *Journal of the American Medical Association*, 279(4), 1071-1075.
110. Niskar AS, Kieszak SM, Holmes AE, Esteban E, Rubin C, Brody DJ. Estimated prevalence of noise-induced hearing threshold shifts among children 6 to 19 years of age: the Third National Health and Nutrition Examination Survey, 1988–1994, United States. *Pediatrics*. 2001;108:40–43.
111. Year 2007 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs. (2007, October). VOLUME 120/ISSUE 4. Retrieved from: <http://pediatrics.aappublications.org/content/120/4/898>.
112. Bright Futures/American Academy of Pediatrics. Recommendations for Preventive Pediatric Health Care. These guidelines represent a consensus by the American Academy of Pediatrics (AAP) and Bright Futures. The AAP continues to emphasize the great importance of continuity of care in comprehensive health supervision and the need to avoid fragmentation of care. Refer to the specific guidance by age as listed in Bright Futures guidelines (Hagan JF, Shaw JS, Duncan PM, eds. *Bright Futures Guidelines for Health Supervision of Infants, Children and Adolescents*. 3rd ed. Elk Grove Village, IL: American Academy of Pediatrics; 2008).
113. American Speech-Language-Hearing Association. Guidelines for Audiologic Screening ASHA Panel on Audiologic Assessment. Retrieved from <http://www.asha.org/policy/GL1997-00199/>

114. American Speech-Language-Hearing Association. Guidelines for Audiologic Screening ASHA Panel on Audiologic Assessment. Retrieved from <http://www.asha.org/policy/GL1997-00199/> .
115. Buz Harlor, A. and Bower, C. (2009, October). Hearing Assessment in Infants and Children: Recommendations Beyond Neonatal Screening. Pediatrics. VOLUME 124/ISSUE 4.
116. William A. Rutala, Ph.D., M.P.H.1,2, David J. Weber, M.D., M.P.H.1,2, and the Healthcare Infection Control Practices Advisory Committee (HICPAC) Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008 http://www.cdc.gov/hicpac/pdf/guidelines/disinfection_nov_2008.pdf
117. Year 2007 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs. (2007, October). VOLUME 120/ISSUE 4. Retrieved from: <http://pediatrics.aappublications.org/content/120/4/898>.
118. American Speech-Language-Hearing Association. Guidelines for Audiologic Screening ASHA Panel on Audiologic Assessment. Retrieved from <http://www.asha.org/policy/GL1997-00199/> .
119. National center for Hearing Assessment and management. Utah State University. Retrieved from: www.infanthearing.org.
120. Buz Harlor, A.D and Bower, C. (2009, October). Hearing Assessment in Infants and Children: Recommendations Beyond Neonatal Screening. Pediatrics, VOLUME 124/ISSUE 4.
121. Perkins, J and McKeeon, C. (2004). Issue Brief: Hearing Services for Children on Medicaid: A Review of EPSDT Services. Accessed from : <http://www.healthlaw.org/publications/Issue-brief-hearing-services-for-children-on-medicaid#.V4kH2fkrLct>
122. Sekhar, Zalewski, Paul (2013). Variability of State School-Based Hearing Screening Protocols in The United States. J Community Health (2013) 38:569–574 DOI 10.1007/s10900-013-9652-6
123. American Academy of Audiology Childhood Hearing Screening Guidelines(2001, September). Accessed from: http://www.cdc.gov/ncbddd/hearingloss/documents/AAA_Childhood%20Hearing%20Guidelines_2011.pdf
124. Yoshinaga-Itano, C. (1995). Efficacy of early identification and early intervention. Semin Hear.16. 115– 123.
125. Yoshinaga-Itano, C., Coulter, D., Thomson, V.(2000). The Colorado Newborn Hearing Screening Project: effects on speech and language development for children with hearing loss. J Perinatol. 20(8 pt 2) :S132– S137
126. Blumsack and Anderson, 2004 <http://www.hearingreview.com/2004/09/back-to-school-13-facts-revisited/>
127. Yoshinaga-Itano, C. (2004). Levels of evidence: universal newborn hearing screening (UNHS) and early hearing detection and intervention systems (EHDI). J Commun Disorder. 37 :451– 465.
128. Bess, F., Dodd-Murphy. And Parker, R. (1998). Minimal hearing loss in children: Prevalence, education progress and functional status. Ear and Hearing 19: 339-354.
129. Bess, F., Dodd - Murphy, J., and R. Parker. (1998). Minimal hearing loss in children: Prevalence, educational progress and functional status. Ear and Hearing 19: 339 - 35.
130. Bess, F., Dodd-Murphy. And Parker, R. (1998). Minimal hearing loss in children: Prevalence, education progress and functional status. Ear and Hearing 19: 339-354.
131. Bess, F. (1982). Children with unilateral hearing loss. Journal of the Academy of Rehabilitative Audiology 15:131-144.

132. Lieu, J. (2004). Speech-Language and Educational Consequences of Unilateral Hearing Loss in Children. *Arch Otolaryngol Head Neck Surg.* 130(5):524-530. doi:10.1001/archotol.130.5.524
133. Lieu, J.E., Tye-Murray, N., Karzon and R.K., Piccirillo, J.F. (2010, June). Unilateral hearing loss is associated with worse speech-language scores in children. *Pediatrics.*125(6). e1348-55. doi: 10.1542/peds.2009-2448. Epub 2010 May 10
134. Brooks, D. 1978. Impedance screening for school children: State of the art. In *Impedance Screening for Middle Ear Disease in Children*, edited by E. Harford and others . New York: Grune & Stratton, Inc.
135. Lous, J. and M. Fiellau Nikolajsen. 1981. Epidemiology of middle ear effusion and tubal dysfunction. A one year study comprising monthly tympanometry in 387 non selected seven year old children. *International Journal of Pediatric Otorhinolaryngology* 3: 303-317.

DENTAL PAIN

136. Lewis, C. and Stout, J. (2010 Nov). Toothache in US children. *Arch Pediatr Adolesc Med.* 164(11) 1059-63. doi: 10.1001/archpediatrics.2010.206. PMID: 21041599. This study in turn cites from: Matthews RW, Peak JD, Scully C. (1994). The efficacy of management of acute dental pain. *Br Dent, J.* (1994). 176(11):413-416.
137. The description of the process of dental decay is described by Colgate Oral Care Center. Retrieved on 02/23/2016 from: <http://www.colgate.com/en/us/oc/oral-health/conditions/cavities/article/dental-caries-cavities> Website states that description has been reviewed by the Columbia University College of Dental Medicine.
138. Center for Surveillance, Epidemiology, and Laboratory Services, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services. "Use of Selected Clinical Preventive Services to Improve the Health of Infants, Children, and Adolescents — United States, 1999–2011. We have drawn from the subsection: "Use of Dental Care and Effective Preventive Services in Preventing Tooth Decay Among U.S. Children and Adolescents — Medical Expenditure Panel Survey, United States, 2003–2009 and National Health and Nutrition Examination Survey, United States, 2005–2010."
139. Pine CM, Harris RV, Burnside G, Merrett MC. An investigation of the relationship between untreated decayed teeth and dental sepsis in 5-year-old children. *Br Dent J.* 2006 Jan 14;200(1):45-7; discussion 29. PubMed PMID:16415836.
140. Dye, B.A., Thornton-Evans, G., Li X, Iafolla TJ. Dental caries and sealant prevalence in children and adolescents in the United States, 2011–2012. NCHS data brief, no 191. Hyattsville, MD: National Center for Health Statistics. 2015. This study uses 2011-2012 National Health and Nutrition Examination Survey data.
141. Dye, B.A., Thornton-Evans, G., Li, X., Iafolla, T.J. Dental caries and sealant prevalence in children and adolescents in the United States, 2011–2012. NCHS data brief, no 191. Hyattsville, MD: National Center for Health Statistics. 2015. Retrieved on 02/23/2016 from: <http://www.cdc.gov/nchs/data/databriefs/db191.pdf>. Note that rate for dental caries in the 2 to 5 years olds is referring to primary teeth, while the rates for the older age groups of 6 to 11 year olds and 12 to 19 year olds are referring to permanent teeth.
142. Data Source: National Health and Nutrition Examination Survey (NHANES), CDC/NCHS. Healthy People 2020. OH-1.2: Children with dental caries in their primary and permanent teeth (percent, 6–9 years). Disparities Overview by Income. Retrieved from: <https://www.healthypeople.gov/2020/data/disparities/summary/Chart/4993/6.1>
143. Dye, B.A., Thornton-Evans, G., Li X, Iafolla TJ. Dental caries and sealant prevalence in children and adolescents in the United States, 2011–2012. NCHS data brief, no 191. Hyattsville, MD: National Center for Health Statistics. 2015. This study uses 2011-2012 National Health and Nutrition Examination Survey data.

144. National Health and Nutrition Examination Survey (NHANES), CDC/NCHS. Healthy People 2020. OH-2.2 Reduce the proportion of children aged 6 to 9 years with untreated dental decay in their primary and permanent teeth. Retrieved from: <https://www.healthypeople.gov/2020/data-search/Search-the-Data#objid=5017>
145. Dye, B.A., Thornton-Evans, G., Li X, Iafolla T.J. Dental caries and sealant prevalence in children and adolescents in the United States, 2011–2012. NCHS data brief, no 191. Hyattsville, MD: National Center for Health Statistics. 2015. This study uses 2011-2012 National Health and Nutrition Examination Survey data. Retrieved on 02/23/201 from: <http://www.cdc.gov/nchs/data/databriefs/db191.pdf>.
146. Mulligan, R., Seirawan, H., Faust, S and Barzaga, C. Dental caries in underprivileged children of Los Angeles. J Health Care Poor Underserved. 2011; 22(2):648–662 [PubMed].
147. National Center for Health Statistics. Health, United States, 2015: With Special Feature on Racial and Ethnic Health Disparities. Hyattsville, MD. 2016. Table 60. Untreated dental caries, by selected characteristics: United States, selected years 1988–1994 through 2011–2012. Page 224. Link: [http://www.cdc.gov/nchs/data/15.pdf](http://www.cdc.gov/nchs/data/hus/15.pdf)
148. Source: Data supporting Healthy People 2020 Oral Health Objectives. Caries prevalence by age group over time. Children aged 3 to 5 years: 1999-2004: 33.3% & 2011-2012: 27.9%. Children aged 6 to 9 years: 1999-2004: 54.4% & 2011-2012: 57.7%. Children aged 13 to 15 years: 1999-2004: 53.7% & 2011-2012: 53.4%.
149. Prevention recommendations are taken from the following CDC study: Center for Surveillance, Epidemiology, and Laboratory Services, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services. “Use of Selected Clinical Preventive Services to Improve the Health of Infants, Children, and Adolescents — United States, 1999–2011. See subsection: “Use of Dental Care and Effective Preventive Services in Preventing Tooth Decay Among U.S. Children and Adolescents — Medical Expenditure Panel Survey, United States, 2003–2009 and National Health and Nutrition Examination Survey, United States, 2005–2010.”
150. School-Based Oral Health Services: A Select Bibliography. Link: <http://www.healthinschools.org/Health-in-Schools/Health-Services/School-Based-Dental-Health/Dental-Health-Bibliography.aspx>
151. See Healthy People 2020 Oral Health Objectives at: <https://www.healthypeople.gov/2020/topics-objectives/topic/oral-health/objectives>
152. Centers for Medicaid & Medicare Services. (CMS). National Health Expenditure Projections 2011-2021. 2011.
153. Solomon, E.S. The past and future evolution of the dental workforce team. J Dent Educ, 2012. 76(8): p. 1028-35.
154. Tellez, Marisol et al. Sealants and dental caries. The Journal of the American Dental Association , Volume 142 , Issue 9 , 1033 – 1040.
155. National 2009 data is taken from the following CDC study: Center for Surveillance, Epidemiology, and Laboratory Services, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services. “Use of Selected Clinical Preventive Services to Improve the Health of Infants, Children, and Adolescents — United States, 1999-2011. We have drawn from the subsection: “Use of Dental Care and Effective Preventive Services in Preventing Tooth Decay Among U.S. Children and Adolescents — Medical Expenditure Panel Survey, United States, 2003–2009 and National Health and Nutrition Examination Survey, United States, 2005-2010. Retrieved on 11/01/16 from: <https://www.cdc.gov/mmwr/preview/mmwrhtml/su6302a9.htm>
156. -2012 data is taken from: Dye, B.A., Thornton-Evans, G., Li X., Iafolla, T.J. (2015). Dental caries and sealant prevalence in children and adolescents in the United States, 2011–2012. NCHS data brief, no 191. Hyattsville, MD: National Center for Health Statistics. Retrieved on 02/23/201 from: <http://www.cdc.gov/nchs/data/databriefs/db191.pdf>.

157. Jackson, S.L., Vann, W.F., Kotch, J.B, Pahel, B.T and Lee, J.Y. (2011). Impact of Poor Oral Health on Children's School Attendance and Performance. *American Journal of Public Health*.101(10):1900-1906. doi:10.2105/AJPH.2010.200915.
158. Seirawan, H., Faust, S and Mulligan, R.(2012, September). "The impact of oral health on the academic performance of disadvantaged children." *Am J Public Health*.;102(9):1729-34. doi: 10.2105 /AJPH.2011. 300478. Epub 2012 Jul 19.5.
159. Pourat, N. and Nicholson G. (2009). *Unaffordable Dental Care Is Linked to Frequent School Absences*. Los Angeles, CA: UCLA Center for Health Policy Research. This report uses data from the 2007 California Health Interview Survey. Respondent (parent or legal guardian) was asked to specifically not count time missed for cleaning or a checkup.
160. School of Dentistry and the Department of Pediatric Dentistry at Mott Children's Health Center in Flint. Unable to find study report or journal article. Findings of study described in article posted on University of Michigan website. "More vigilance needed in children's oral health." Jerry Mastey. University of Michigan School of Dentistry. February 8, 2006. Retrieved on 02/23/16 from: http://www.ur.umich.edu/0506/Feb06_06/20.shtml
161. Fast Facts by National Center for Education Statistics says: "The average class size in 2011–12 was 21.2 pupils for public elementary schools and 26.8 pupils for public secondary schools."
Link: <http://nces.ed.gov/fastfacts/display.asp?id=28>
162. Seirawan, H., Faust, S and Mulligan, R. (2012, September). "The impact of oral health on the academic performance of disadvantaged children." 102(9):1729-34. doi: 10.2105/AJPH.2011.300478. Epub 2012 Jul 19.
163. Jackson, S.L., Vann, W.F., Kotch, J.B., Pahel, B.T and Lee, J.Y. (2011). Impact of Poor Oral Health on Children's School Attendance and Performance. *American Journal of Public Health*. 101(10):1900-1906. doi:10.2105/AJPH.2010.200915.
164. Pourat, N and Nicholson, G. (2009). *Un-affordable Dental Care Is Linked to Frequent School Absences*. Los Angeles, CA: UCLA Center for Health Policy Research. This report uses data from the 2007 California Health Interview Survey. Respondent (parent or legal guardian) was asked to specifically not count time missed for cleaning or a checkup.
165. Gift, H.C., Reisine, S.T and Larach D.C. (1992). The social impact of dental problems and visits. *Am J Public Health*. 82:1663–8.
166. Seirawan, H., Faust, S. and Mulligan, R.(2012, September). "The impact of oral health on the academic performance of disadvantaged children." *Am J Public Health*. 102(9):1729-34. doi: 10.2105/AJPH.2011.300478. Epub 2012 Jul 19.
167. The studies vary in terms of how dental health or dental problems are defined and measured, which variables that influence school performance are controlled for in the model, and study populations.
168. Guarnizo-Herreño, C.C and Wehby, G.L. (2012, December). "Children's Dental Health, School Performance and Psychosocial Well-Being" *J Pediatr*. 161(6): 1153–1159.e2. Published online 2012 June 23. doi: 10.1016/j.jpeds.2012.05.025.
169. Jackson, S.L., Vann, W.F., Kotch, J.B., Pahel, B.T and Lee, J.Y. (2011), Impact of Poor Oral Health on Children's School Attendance and Performance. *American Journal of Public Health*.101(10):1900-1906. doi:10.2105/AJPH.2010.200915.
170. Seirawan, H., Faust, S. and Mulligan, R. (2012, September). "The impact of oral health on the academic performance of disadvantaged children." *Am J Public Health*. 102(9):1729-34. doi: 10.2105/AJPH.2011.300478. Epub 2012 Jul 19.

171. Study by School of Dentistry and the Department of Pediatric Dentistry at Mott Children's Health Center in Flint. Unable to find study report or journal article. Findings of study described in article posted on University of Michigan website. "More vigilance needed in children's oral health." By Jerry Mastey. UNiversity of Michigan School of Dentistry. February 8, 2006. Retrieved on 02/23/16 from: http://www.ur.umich.edu/0506/Feb06_06/20.shtml

172. Thikkurissy, S., Glazer, K., Amini, H., Casamassimo, P.S., Rashid, R. (2012). The comparative morbidities of acute dental pain and acute asthma on quality of life in children. *Pediatric Dentistry*. 34(4):e77– e80.

173. Guarnizo-Herreño, C.C and Wehby, G.L. (2012 December). "Children's Dental Health, School Performance and Psychosocial Well-Being" *J Pediatr*. 161(6): 1153–1159.e2. Published online 2012 June 23. doi: 10.1016/j.jpeds.2012.05.025.

174. Richard Niederman. Bringing Care to People Rather Than People to Care. *American Journal of Public Health*: September 2015, Vol. 105, No. 9, pp. 1733-1733. doi: 10.2105/AJPH.2015.302746

PERSISTENT HUNGER

175. Coleman-Jensen, A., Gregory, C and Singh, A. (2015, September). Household Food Security in the United States in 2014, ERRN-194, U.S. Department of Agriculture, Economic Research Service.

176. Lewit, E.M., Kerrebrock, N. Childhood Hunger. *The Future of Children WELFARE TO WORK* Vol. 7 • No. 1 – Spring 1997. Available at: Accessed on May 19, 2016. https://www.princeton.edu/futureofchildren/publications/docs/07_01_Indicators.pdf.

177. United States Department of Agriculture Economic Research Service. Definitions of Food Security. Available at: <http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security.aspx>. Accessed on May 18, 2016.

178. This scale consists of 18 questions: three questions about food conditions of the household as a whole; seven questions about food conditions of adults in the household; and, if there are children present in the household, an additional eight questions about their food conditions. Each question asks whether the condition or behavior occurred at any time during the previous 12 months and specifies a lack of money and other resources to obtain food as the reason. Respondents are classified as food insecure if they report three or more food-insecure conditions. Households are classified as having food-insecure children if they report two or more food-insecure conditions among the children in response to questions 11-18.

179. Coleman-Jensen, A. Gregory, C. and Singh, A. (2015, September). Household Food Security in the United States in 2014, ERRN-194, U.S. Department of Agriculture, Economic Research Service.

180. United States Department of Agriculture Economic Research Service. Definitions of Food Security. Available at: <http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security.aspx>. Accessed on May 18, 2016.

181. Coleman-Jensen, A., (2015, September). Gregory, C and Singh, A. Household Food Security in the United States in 2014, ERRN-194, U.S. Department of Agriculture, Economic Research Service. Page 8. NOTE: The latest study from USDA Economic Research Services' report.

182. Within a food-insecure household, each household member may be affected differently by the household's food insecurity. Some members—particularly young children—may experience only mild effects or none at all, while adults are more severely affected.

183. Alisha Coleman-Jensen, Matthew P. Rabbitt, Christian A. Gregory, and Anita Singh. Household Food Security in the United States in 2015, ERR-215, U.S. Department of Agriculture, Economic Research Service, September 2016. Retrieved on 11/01/16 from: <http://www.ers.usda.gov/webdocs/publications/err215/err-215.pdf>

184. No Kid Hungry Campaign. Share our strengths teachers report 2013: Hunger in our schools. 2013. Page 2. Available at: http://www.nokidhungry.org/pdfs/NKH_TeachersReport_2013.pdf
185. National Institutes of Health. Updated: February 11, 2016. Iron: Dietary Supplement Fact Sheet. The factsheet in turn cites from: 1) Brotanek, J.M., Gosz, J., Weitzman, M and Flores, G.(2007). Iron deficiency in early childhood in the United States: risk factors and racial/ethnic disparities. *Pediatrics* 2007;120:568-75. [[PubMed abstract](#)]; 2) Eicher-Miller HA, Mason AC, Weaver CM, McCabe GP, Boushey CJ. Food insecurity is associated with iron deficiency anemia in US adolescents. *Am J Clin Nutr* 2009;90:1358-71. [[PubMed abstract](#)]. Factsheet retrieved on 06/21/2016 from: <https://ods.od.nih.gov/factsheets/Iron-HealthProfessional/#h6>
186. Baker, R.D., Greer, F.R. and The AAP Committee on Nutrition. (2010). Diagnosis and Prevention of Iron Deficiency and Iron-Deficiency Anemia in Infants and Young Children (0 -3 Years of Age). *Pediatrics*.126;1040
187. Data on Iron Deficiency, Iron Deficiency Anemia and Anemia are from: Baker,R.D., Greer F.R and The AAP Committee on Nutrition. (2010). Diagnosis and Prevention of Iron Deficiency and Iron-Deficiency Anemia in Infants and Young Children (0 -3 Years of Age). *Pediatrics*.126;1040. This article used data from the 1999-2002 National Health and Nutrition Examination Survey.
188. Baker, R.D., Greer, F.R and The AAP Committee on Nutrition. (2010). Diagnosis and Prevention of Iron Deficiency and Iron-Deficiency Anemia in Infants and Young Children (0 -3 Years of Age). *Pediatrics*. 126;1040
189. Baker, R.D., Greer, F.R and The AAP Committee on Nutrition. (2010). Diagnosis and Prevention of Iron Deficiency and Iron-Deficiency Anemia in Infants and Young Children (0 -3 Years of Age). *Pediatrics*.126;1040
190. Baker,R.D., Greer F.R and The AAP Committee on Nutrition. (2010). *Diagnosis and Prevention of Iron Deficiency and Iron-Deficiency Anemia in Infants and Young Children (0 -3 Years of Age)*. *Pediatrics*. 126;1040
191. Halterman, J. S., Kaczorowski, J. M., Aligne, C. A., Auinger, P., & Szilagyi, P. G. (2001). Iron deficiency and cognitive achievement among school-aged children and adolescents in the United States. *Pediatrics*, 107(6), 1381-1386.
192. Buckley, N. (2016). Advancing Health through Food Security: A Multi-Sector Approach to Address the Disease Burden and Costs of U.S. Food Insecurity on our Health System. Retrieved from:<http://www.childrenshealthwatch.org/wp-content/uploads/Aspen-Report.pdf>
193. Council on Community Paediatrics, Committee on nutrition. (2015). Promoting Food Security for All Children. *Pediatrics* Oct 2015, peds.2015-3301; DOI: 10.1542/peds.2015-3301. Retrieved from:<http://pediatrics.aappublications.org/content/early/2015/10/20/peds.2015-3301>
194. Child Food Insecurity: The Economic Impact on our Nation. A report on research on the impact of food insecurity and hunger on child health, growth and development commissioned by Feeding America and The ConAgra Foods Foundation. John Cook, PhD, Project Director & Karen Jeng, AB, Research and Policy Fellow. 2009.
195. Perez-Escamilla R, Pinheiro de Toledo Vianna R (2012).) "Food Insecurity and the Behavioral and Intellectual Development of Children: A Review of the Evidence," *Journal of Applied Research on Children: Informing Policy for Children at Risk*: Vol. 3: Iss. 1, Article 9. Available at: <http://digitalcommons.library.tmc.edu/childrenatrisk/vol3/iss1/9>
196. McLaughlin KA, Green JG, Alegría M, Jane Costello E, Gruber MJ, Sampson NA, Kessler RC. Food insecurity and mental disorders in a national sample of U.S. adolescents. *J Am Acad Child Adolesc Psychiatry*. 2012 Dec;51(12):1293-303. doi: 10.1016/j.jaac.2012.09.009. Epub 2012 Nov 6.
197. Perez-Escamilla R, Pinheiro de Toledo Vianna R (2012).) "Food Insecurity and the Behavioral and Intellectual Development of Children: A Review of the Evidence," *Journal of Applied Research on Children: Informing Policy for Children at Risk*: Vol. 3: Iss. 1, Article 9. Available at: <http://digitalcommons.library.tmc.edu/childrenatrisk/vol3/iss1/9>

198. The ECLS-K is “a survey from the National center for Health Statistics, which followed a nationally representative sample of over 21,000 children focuses on children’s early school experiences beginning with kindergarten in 1998-1999, and following children through middle school. The ECLS-K data provide descriptive information on children’s status at entry to school, their transition into school, and their progression through 8th grade. The longitudinal nature of the ECLS-K data enables researchers to study how a wide range of family, school, community, and individual factors are associated with school performance.” From: Institute of Education Science, National Center for Health Statistics. Early Childhood Longitudinal Programs. Available at: <https://nces.ed.gov/ecls/kindergarten.asp>. Accessed on 06/06/2016.
199. Stormer, A and Harrison, G. (2013, November). Does Household Food Security Affect Cognitive and Social Development of Kindergarteners? Institute for Research on Poverty Discussion Paper no. 1267-03. Available at: <http://eric.ed.gov/?id=ED499717>. Accessed on 05/28/2016.
200. Kleinman, R.E., Murphy, J.M, Little, M, Pagano, M., Wehler, C.A., Regal, K and Jellinek, M.S. (1998, January). Hunger in children in the United States: potential behavioral and emotional correlates. *Pediatrics*.101(1):E3.
201. Weinreb, L., Wehler, C., Perloff, J., Scott, R., Hosmer, D., Sagor, L., Gundersen, C. (2002, October). Hunger: its impact on children’s health and mental health. *Pediatrics*. 110(4):e41.
202. McLaughlin KA, Green JG, Alegría M, Jane Costello E, Gruber MJ, Sampson NA, Kessler RC. Food insecurity and mental disorders in a national sample of U.S. adolescents. *J Am Acad Child Adolesc Psychiatry*. 2012 Dec;51(12):1293-303. doi: 10.1016/j.jaac.2012.09.009. Epub 2012 Nov 6.
203. Rose-Jacobs, R., Black, M.M., Casey, P.H., Cook, J.T., Cutts, D.B., Chilton, M., Heeren, T., Levenson, S.M., Meyers, A.F and Frank, D.A. (2008, January). Household food insecurity: associations with at-risk infant and toddler development. *Pediatrics*.121(1):65-72
204. Alaimo, K., Olson, C.M and Frongillo, E.A. Jr. (2001, July) Food insufficiency and American school-aged children’s cognitive, academic, and psychosocial development. *Pediatrics*. 108(1):44-53.
205. Ashiabi, G. (2005). Household food insecurity and children’s school engagement. *Journal of Children & Poverty*. Vol. 11 No 1,
206. Winicki, J and Jemison, K. (2003, November). Food insecurity and hunger in the kindergarten classroom: its effect on learning and growth. *Contemporary economic policy*. v. 21, no. 2: 145:157.
207. Kleinman, R.E., Murphy, J.M, Little, M., Pagano, M., Wehler, C.A., Regal, K and Jellinek, M.S. (1998, January). Hunger in children in the United States: potential behavioral and emotional correlates. *Pediatrics*. 101(1):E3.
208. Jyoti, D.F, Frongillo E.A and Jones S.J. (2005, December). Food insecurity affects school children’s academic performance, weight gain, and social skills. *J Nutr.*;135(12):2831-9. NOTE: In this study children were defined as food insecure if their parent or caregiver affirmed at least one question of the USDA food security questionnaire.
209. Weinreb, L, Wehler, C, Perloff, J, Scott, R, Hosmer, D, Sagor, L, Gundersen, C. (2002, October). Hunger: its impact on children’s health and mental health. *Pediatrics*.110(4):e41.
210. Stormer, A., Harrison G. (2003, November). Does Household Food Security Affect Cognitive and Social Development of Kindergarteners? Institute for Research on Poverty Discussion Paper no. 1267-03. Available at: <http://eric.ed.gov/?id=ED499717>. Accessed on 05/28/2016.

CERTAIN MENTAL HEALTH AND BEHAVIORAL PROBLEMS

211. Centers for Disease Control and Prevention. Mental health surveillance among children — United States 2005–2011. MMWR 2013;62(Suppl; May 16, 2013):1-35. Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/su6202a1.htm>. Accessed on May 12, 2016.
212. Centers for Disease Control and Prevention. Mental health surveillance among children — United States 2005–2011. MMWR 2013;62(Suppl; May 16, 2013):1-35. Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/su6202a1.htm>. Accessed on May 12, 2016. See TABLE 3. “Estimated prevalence and number of children with mental disorders, by surveillance system, age range, and year — National Health Interview Survey, National Survey of Children’s Health, National Survey on Drug Use and Health, and National Health and Nutrition Examination Survey, United States, 2007–2011.” Please note that for children aged 12 to 17 years alcohol abuse and illicit drug abuse are also among the most common mental health disorders. This report focuses on disorders in younger children.
213. Liu, J. (2004). Childhood Externalizing Behavior: Theory and Implications. *J Child Adolesc Psychiatr Nurs.* 17(3): 93–103.
214. Definitions of ADHD, ODD and Conduct Disorder taken from: Centers for Disease Control and Prevention. Mental health surveillance among children — United States 2005–2011. MMWR 2013;62. Suppl; May 16, 2013):1-35. Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/su6202a1.htm>. Accessed on May 12, 2016.
215. Liu, J. (2004). Childhood Externalizing Behavior: Theory and Implications. *J Child Adolesc Psychiatr Nurs.* 17(3): 93–103.
216. Substance Abuse and Mental Health Services Administration. Available at: <http://www.samhsa.gov/disorders/mental>. Accessed on 06/28/2016.
217. Centers for Disease Control and Prevention. Mental health surveillance among children — United States 2005–2011. MMWR 2013;62(Suppl; May 16, 2013):1-35. Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/su6202a1.htm>. Accessed on May 12, 2016.
218. The mental health problems examined in this section are behavioral disorders, depression, and anxiety. ADHD has a separate section (See Section 8.3) , since it is the most prevalent disorder among school-age children and it has a strong association with learning outcomes.
219. Mizock, L & Harkins, D. (2011). Diagnostic Bias and Conduct Disorder: Improving Culturally Sensitive Diagnosis, *Child & Youth Services*, 32:3, 243-253, DOI:10.1080/0145935X.2011.605315
220. Coker TR, Elliott MN, Toomey SL, et al. Racial and Ethnic Disparities in ADHD Diagnosis and Treatment. *Pediatrics.* 2016;138(3):e20160407
221. Paul L. Morgan, Jeremy Staff, Marianne M. Hillemeier, George Farkas, Steven Maczuga. Racial and Ethnic Disparities in ADHD Diagnosis From Kindergarten to Eighth Grade. *Pediatrics* Jun 2013, peds.2012-2390; DOI: 10.1542/peds.2012-2390.
222. Mizock, L & Harkins, D. (2011). Diagnostic Bias and Conduct Disorder: Improving Culturally Sensitive Diagnosis, *Child & Youth Services*, 32:3, 243-253, DOI:10.1080/0145935X.2011.605315
223. Coker TR, Elliott MN, Toomey SL, et al. Racial and Ethnic Disparities in ADHD Diagnosis and Treatment. *Pediatrics.* 2016;138(3):e20160407
224. Paul L. Morgan, Jeremy Staff, Marianne M. Hillemeier, George Farkas, Steven Maczuga. Racial and Ethnic Disparities in ADHD Diagnosis From Kindergarten to Eighth Grade. *Pediatrics* Jun 2013, peds.2012-2390; DOI: 10.1542/peds.2012-2390.

225. National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved from www.childhealthdata.org Accessed on November 7, 2016. Topic: Physical and Dental Health. Question: Prevalence of current behavioral or conduct problems such as oppositional defiant disorder or conduct disorder, age 2-17 years. NOTE: Prevalence of lifetime diagnosis of the mental health conditions in this section are based on parents responding "Yes" when asked whether they had ever been told by a doctor or other health-care provider that their child had the condition. Prevalence of current diagnosis is based on parents responding "Yes" when asked whether the child still had the condition.
226. National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved from www.childhealthdata.org Accessed on November 7, 2016. Topic: Physical and Dental Health. Question: Prevalence of current depression, age 2-17 years. NOTE: Prevalence of lifetime diagnosis of the mental health conditions in this section are based on parents responding "Yes" when asked whether they had ever been told by a doctor or other health-care provider that their child had the condition. Prevalence of current diagnosis is based on parents responding "Yes" when asked whether the child still had the condition.
227. National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved from www.childhealthdata.org Accessed on November 7, 2016. Topic: Physical and Dental Health. Question: Prevalence of current anxiety problems, age 2-17 years. NOTE: Prevalence of lifetime diagnosis of the mental health conditions in this section are based on parents responding "Yes" when asked whether they had ever been told by a doctor or other health-care provider that their child had the condition. Prevalence of current diagnosis is based on parents responding "Yes" when asked whether the child still had the condition.
228. Kataoka, S.H, Zhang, L, Wells, K.B. (2002, September). Unmet need for mental health care among U.S. children: variation by ethnicity and insurance status. *Am J Psychiatry*.159(9):1548-55.
229. Lê Cook B, Barry, C.L, Busch, S.H. (2013,February). Racial/Ethnic Disparity Trends in Children's Mental Health Care Access and Expenditures from 2002 to 2007. *Health Serv Res*.48(1):129-49.
230. National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved 05/31/16 from www.childhealthdata.org
231. American Academy of Pediatrics. Appendix S4: the case for routine mental health screening. *Pediatrics*. 2010;125(suppl 3):S133–S139. Retrieved from: http://pediatrics.aappublications.org/content/pediatrics/125/Supplement_3/S133.full.pdf
232. Carol Weitzman, Lynn Wegner, the SECTION ON DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS, COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH, COUNCIL ON EARLY CHILDHOOD, AND SOCIETY FOR DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS (2015).Promoting Optimal Development: Screening for Behavioral and Emotional Problems. *Pediatrics* Feb 2015, 135 (2) 384-395; DOI: 10.1542/peds.2014-3716. Retrieved from: <http://pediatrics.aappublications.org/content/135/2/384.full#ref-20>
233. Breslau, J., Miller, E., Breslau, N., Bohnert, K., Lucia, V., Schweitzer, J. (2009, June). The impact of early behavior disturbances on academic achievement in high school. *Pediatrics*.123(6):1472-6
234. McLeod, J.D., Kaiser, K. Childhood Emotional and Behavioral Problems and Educational Attainment. *American Sociological Review* Vol. 69, No. 5. 636-658.
235. Breslau, J., Lane, M., Sampson, N., Kessler, R.C. (2008, July). Mental disorders and subsequent educational attainment in a US national sample. *J Psychiatr Res*.42(9):708-16. doi: 10.1016/j.jpsychires. 2008.01.016. Epub 2008 Mar 10.

236. Breslau, J., Miller, E., Chung, W.J, Schweitzer, J.B. (2011, March). Childhood and adolescent onset psychiatric disorders, substance use, and failure to graduate high school on time. *J Psychiatr Res.* 45(3). 295-301.
237. Leach, L.S., Butterworth P. The effect of early onset common mental disorders on educational attainment in Australia. *Psychiatry Res.* 2012 Aug 30;199(1):51-7.
238. Esch P, Bocquet V, Pull C, Couffignal S, Lehnert T, Graas M, Fond-Harmant L, Anseau M. (2014, August). The downward spiral of mental disorders and educational attainment: a systematic review on early school leaving. *BMC Psychiatry.* 14:237
239. American Academy of Pediatrics, Subcommittee on Attention-Deficit/Hyperactivity Disorder, Steering Committee on Quality Improvement and Management. ADHD: Clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Pediatrics.* 2011;128:1007-1022.
240. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington, Va: American Psychiatric Publishing. 2013.
241. National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved 05/31/16 from www.childhealthdata.org. Link to specific query: <http://childhealthdata.org/browse/survey/results?q=2388&r=1>
242. Centers for Disease Control and Prevention. Mental health surveillance among children — United States 2005–2011. *MMWR* 2013;62(Suppl; May 16, 2013):1-35. Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/su6202a1.htm>. Accessed on May 12, 2016.
243. Coker TR, Elliott MN, Toomey SL, et al. Racial and Ethnic Disparities in ADHD Diagnosis and Treatment. *Pediatrics.* 2016;138(3):e20160407
244. Paul L. Morgan, Jeremy Staff, Marianne M. Hillemeier, George Farkas, Steven Maczuga. Racial and Ethnic Disparities in ADHD Diagnosis From Kindergarten to Eighth Grade. *Pediatrics* Jun 2013, peds.2012-2390; DOI: 10.1542/peds.2012-2390.
245. Mizock, L & Harkins, D. (2011). Diagnostic Bias and Conduct Disorder: Improving Culturally Sensitive Diagnosis, *Child & Youth Services*, 32:3, 243-253, DOI:10.1080/0145935X.2011.605315
246. National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved 05/31/16 from www.childhealthdata.org. Link to specific query: <http://childhealthdata.org/browse/survey/results?q=2388&r=1>.
247. National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved 05/31/16 from www.childhealthdata.org. Topic: Family Health and Activities. Question: Indicator 6.11: Adverse childhood experiences. Sub Group: Current ADD/ADHD (2-17 years). Link to specific query: <http://childhealthdata.org/browse/survey/results?q=2257&r=1&g=597>
248. Visser, S.N, Danielson, M.L, Bitsko, R.H, Holbrook, J.R, Kogan, M.D., Ghandour, R.M., Perou, R., Blumberg, S.J. (2014, January). Trends in the parent-report of health care provider-diagnosed and medicated attention-deficit/hyperactivity disorder: United States, 2003-2011. *J Am Acad Child Adolesc Psychiatry.*53(1):34-46.e2. doi: 10.1016
249. Coker TR, Elliott MN, Toomey SL, et al. Racial and Ethnic Disparities in ADHD Diagnosis and Treatment. *Pediatrics.* 2016;138(3):e20160407

250. Paul L. Morgan, Jeremy Staff, Marianne M. Hillemeier, George Farkas, Steven Maczuga. Racial and Ethnic Disparities in ADHD Diagnosis From Kindergarten to Eighth Grade. *Pediatrics* Jun 2013, peds.2012-2390; DOI: 10.1542/peds.2012-2390.
251. Barkley, R.A., Fischer, M., Smallish, L., Fletcher, K. (206, February). Young adult outcome of hyperactive children: adaptive functioning in major life activities. *J Am Acad Child Adolesc Psychiatry*. 45(2):192-202.
252. Frazier, T.W., Youngstrom, E.A., Glutting, J.J., Watkins, M.W. (2007). ADHD and achievement: meta-analysis of the child, adolescent, and adult literatures and a concomitant study with college students. *J Learn Disability*. 40(1):49-65.
253. Loe, I.M., Feldman, H.M. (2007). Academic and educational outcomes of children with ADHD. *Ambul Pediatr*. 7(1 Suppl):82-90.

EFFECTS OF LEAD EXPOSURE

254. CDC Agency for Toxic Substances & Disease Registry. "Lead Toxicity. What is Lead?" Retrieved from: <https://www.atsdr.cdc.gov/csem/csem.asp?csem=7&po=4>
255. World Health Organization 2010. PREVENTING DISEASE THROUGH HEALTHY ENVIRONMENTS. EXPOSURE TO LEAD: A MAJOR PUBLIC HEALTH CONCERN. Retrieved on 08/31/16 from <http://www.who.int/ipcs/features/lead.pdf>
256. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead. Atlanta, GA: US Department of Health and Human Services, CDC, Agency for Toxic Substances and Disease Registry; 2007. Available at <http://www.atsdr.cdc.gov/toxprofiles/tp13.pdf> NOTE: 1) See Page 2 for information on ban on lead in gasoline: "Tetraethyl lead and tetramethyl lead were once used in the United States as gasoline additives to increase octane rating. However, their use was phased out in the United States in the 1980s, and lead was banned for use in gasoline for motor vehicles beginning January 1, 1996." 2) See Pages 411 -412 for information on lead-soldered cans: "In 1993, the FDA has established an action level for lead in fruit beverages (80 µg/kg) packaged in lead-soldered cans (FDA 1998b); in 1995, the use of lead soldered cans was banned by the FDA." 3) For ban of lead for use in paints, see Page 19.
257. AMERICAN ACADEMY OF PEDIATRICS Committee on Environmental Health. Lead Exposure in Children: Prevention, Detection, and Management. *Pediatrics* 2005;116;1036. Available at: <http://pediatrics.aappublications.org/content/116/4/1036>. Note that this is a compilation of other articles, cited in the statement.
258. National Safety Council. Lead Poisoning Factsheet. Link: http://www.nsc.org/NSCDocuments_Advocacy/Fact%20Sheets/Lead-Poisoning-Fact-Sheet.pdf
259. AMERICAN ACADEMY OF PEDIATRICS Committee on Environmental Health. Lead Exposure in Children: Prevention, Detection, and Management. *Pediatrics* 2005;116;1036. Available at: <http://pediatrics.aappublications.org/content/116/4/1036>. Note that this is a compilation of other articles, cited in the statement.
260. AMERICAN ACADEMY OF PEDIATRICS Committee on Environmental Health. Lead Exposure in Children: Prevention, Detection, and Management. *Pediatrics* 2005;116;1036. Available at: <http://pediatrics.aappublications.org/content/116/4/1036>. Note that this is a compilation of other articles, cited in the statement.
261. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead. Atlanta, GA: US Department of Health and Human Services, CDC, Agency for Toxic Substances and Disease Registry; 2007. Available at <http://www.atsdr.cdc.gov/toxprofiles/tp13.pdf>
262. US Environmental Protection Agency. "Basic Information about Lead in Drinking Water." Link: <https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water>
263. CDC. Lead Overview. Link: http://www.atsdr.cdc.gov/sites/toxzine/lead_toxzine.html

264. CDC Factsheet “Blood Lead Levels in Children.” Retrieved on 05/26/16 from: http://www.cdc.gov/nceh/lead/acclpp/lead_levels_in_children_fact_sheet.pdf
265. AMERICAN ACADEMY OF PEDIATRICS Committee on Environmental Health. *Lead Exposure in Children: Prevention, Detection, and Management*. Pediatrics 2005;116;1036. Available at: <http://pediatrics.aappublications.org/content/116/4/1036.full.html>
266. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead. Atlanta, GA: US Department of Health and Human Services, CDC, Agency for Toxic Substances and Disease Registry; 2007. Available at <http://www.atsdr.cdc.gov/toxprofiles/tp13.pdf>
267. Educational Services for Children Affected by Lead Expert Panel. Educational interventions for children affected by lead. Atlanta: U.S. Department of Health and Human Services; 2015. Link: https://www.cdc.gov/nceh/lead/publications/educational_interventions_children_affected_by_lead.pdf
268. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead. Atlanta, GA: US Department of Health and Human Services, CDC, Agency for Toxic Substances and Disease Registry; 2007. Available at <http://www.atsdr.cdc.gov/toxprofiles/tp13.pdf> NOTE: See section “3.6.1 Biomarkers Used to Identify or Quantify Exposure to Lead” on Page 226.
269. CDC Advisory Committee on Childhood Lead Poisoning Prevention. Low level lead exposure harms children: a renewed call for primary prevention. Atlanta, GA: US Department of Health and Human Services, CDC; 2012. See Pages ix to x. Available at http://www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf
270. CDC. Morbidity and Mortality Weekly Report (MMWR). Blood Lead Levels in Children Aged 1–5 Years — United States, 1999–2010. April 5, 2013/62(13);245-248. Pages 245-248. Retrieved on 05/27/2016 from: <http://www.cdc.gov/mmwr/pdf/wk/mm6213.pdf> Note: i) Estimate of the 535,000 children with elevated Blood Lead Levels based on ≥ 5 $\mu\text{g}/\text{dL}$ threshold is based on the US Census Bureau 2010 count of the number of children aged 1 to 5 years. ii) For differences across race, ethnicity, Medicaid and income groups, the geometric mean for the blood lead levels was used. iii) As explained in Section 9.1 Definition, the reference value of 5 $\mu\text{g}/\text{dL}$ was based on 97.5th percentile (or top 2.5%) of the distribution of the combined 2007–2008 and 2009–2010 cycles of NHANES (National Health and Nutrition Examination Survey).
271. Michigan Department of Community Health. 2012 Annual data report on blood lead levels of children in Michigan. 2013. Page 13. Available at: http://www.michigan.gov/documents/mdch/2012AnnualDataReportOnBloodLeadLevels_419508_7.pdf See Table Childhood Lead Poisoning Data Facts All Counties in Michigan Calendar Year 2012 Children less than Six Years of Age on Page 13.
272. McLaine, P., Navas-Acien, A., Lee, R., Peter Simon, Diener-West, M and Agnew, J. Elevated Blood Lead Levels and Reading Readiness at the Start of Kindergarten. Pediatrics peds.2012-2277; published ahead of print May 13, 2013, doi:10.1542/peds.2012-2277
273. CDC Centers for Disease Control and Prevention (CDC) Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP). “Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention Report of the Advisory Committee on Childhood Lead Poisoning Prevention of the Centers for Disease Control and Prevention.” January 4, 2012. Retrieved on 05/27/16 from: http://www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf
274. U.S. Department of Housing and Urban Development. Office of Healthy Homes and Lead Hazard Control. American Healthy Homes Survey. Lead and Arsenic Findings. April 2011. See Page ES-2 of the Executive Summary. Retrieved on 05/27/16 from: http://portal.hud.gov/hudportal/documents/huddoc?id=AHHS_Report.pdf
275. Mona, H., LaChance, J. Sadler, R.C. and Schnepf, A.C. (2016, February). Elevated Blood Lead Levels in Children Associated With the Flint Drinking Water Crisis: A Spatial Analysis of Risk and Public Health Response. American Journal of Public Health. Vol. 106, No. 2, pp. 283-290. doi: 10.2105/AJPH.2015.303003

276. Educational Services for Children Affected by Lead Expert Panel. Educational interventions for children affected by lead. Atlanta: U.S. Department of Health and Human Services; 2015. Link: https://www.cdc.gov/nceh/lead/publications/educational_interventions_children_affected_by_lead.pdf
277. Two sources: 1) American Academy of Pediatrics Committee on Environmental Health. (2005). Lead Exposure in Children: Prevention, Detection, and Management. *Pediatrics* 2005;116;1036. Available at: <http://pediatrics.aappublications.org/content/116/4/1036.full.html> and 2) Bright Futures/American Academy of Pediatrics (January 2016). Recommendations for Preventive Pediatric Health Care (Periodicity Schedule). Link: https://www.aap.org/en-us/Documents/periodicity_schedule.pdf
278. CDC. Screening young children for lead poisoning: guidance for state and local public health officials. (1997). Atlanta, GA: US Department of Health and Human Services, CDC.
279. Early and Periodic Screening, Diagnostic, and Treatment. Retrieved on 05/27/2016 from: <https://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Benefits/Early-and-Periodic-Screening-Diagnostic-and-Treatment.html> Scroll down to "Lead Screening" section.
280. National Committee for Quality Assurance. "The state of health care quality, 2015." Washington, DC: National Committee for Quality Assurance; 2015. Available at: <http://www.ncqa.org/report-cards/health-plans/state-of-health-care-quality/2015-table-of-contents/lead-screening> Note that this measure assesses the percentage of children 2 years of age who had one or more blood tests for lead poisoning by their second birthday.
281. CDC Advisory Committee on Childhood Lead Poisoning Prevention. Low level lead exposure harms children: a renewed call for primary prevention. Atlanta, GA: US Department of Health and Human Services, CDC; 2012. Available at http://www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf
282. CDC. Preventing lead poisoning in young children. Atlanta, GA: US Department of Health and Human Services, CDC; 1991. Available at <http://www.cdc.gov/nceh/lead/publications/books/plpyc/contents.htm>.
283. Stuart Pocock, Marjorie Smith, Peter Baghurst. Environmental lead and children's intelligence, a systematic review of the epidemiological evidence. *BMJ*. 1994 Nov 5; 309(6963): 1189–1197.
284. Lanphear, B.P., Hornung, R et al. (2005, July). Low-level environmental lead exposure and children's intellectual function: an international pooled analysis. *Environ Health Perspect*. 113(7):894-9.
285. Richard canfield, Charles Henderson, Deborah Cory-Slechta, Christopher Cox, Todd Jusko, and Bruce Lamphear. Intellectual impairment in children with blood lead concentrations below 10 microg per deciliter. *N Engl J Med*. 2003 Apr 17;348(16):1517-26.
286. CDC Centers for Disease Control and Prevention (CDC) Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP). "Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention Report of the Advisory Committee on Childhood Lead Poisoning Prevention of the Centers for Disease Control and Prevention." January 4, 2012. Retrieved on 05/27/16 from: http://www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf
287. Lanphear BP, Dietrich K, Auinger P, Cox C. Cognitive deficits associated with blood lead concentrations <10 microg/dL in US children and adolescents. *Public Health Rep*. 2000 Nov-Dec;115(6):521-9.
288. Evans, A., Hryhorczuk, D., Lanphear, B.P., Rankin, K.M., Lewis, D.A., Forst, L and Rosenberg, D. (2015, April). The impact of low-level lead toxicity on school performance among children in the Chicago Public Schools: a population-based retrospective cohort study. *Environ Health*.14:21.
289. Miranda, M., Kim, D., Reiter, J. (2009, November). Overstreet Galeano MA, Maxson P. Environmental contributors to the achievement gap. *Neurotoxicology*. (6):1019-24. doi: 10.1016/j.neuro.2009.07.012. Epub 2009 Jul 28.

290. randa, M., Kim, D., Osgood, C and Douglas, H. (2011). The Impact of Early Childhood Lead Exposure on Educational Test Performance among Connecticut Schoolchildren, Phase 1 Report. Children's Environmental Health Initiative.
291. McLaine, P., Navas-Acien, A., Lee, R etal. (June 2013). Elevated Blood Lead Levels and Reading Readiness at the Start of Kindergarten. PEDIATRICS Volume 131, Number 6.
292. Miranda, M.L, Maxson, P., Kim D. (2010). Early childhood lead exposure and exceptionality designations for students. [Int J Child Health Hum Dev](#). 3(1):77-84.
293. U.S. Department of Health and Human Services (2015). Educational Services for Children Affected by Lead Expert Panel. Educational interventions for children affected by lead. Atlanta. See Page 7. Link: https://www.cdc.gov/nceh/lead/publications/educational_interventions_children_affected_by_lead.pdf This report in turn cites the following studies: 1) Campbell TF, Needleman HL, Riess JA, Tobin MJ. 2000. Bone lead levels and language processing performance. *Dev Neuropsychol* 18:171–86. 2) Yuan W, Holland SK, Cecil KM, Dietrich KN, Wessel SD, Altaye M, Hornung RW, et al. 2006. The impact of early childhood lead exposure on brain organization: A functional magnetic resonance imaging study of language function. *Pediatrics* 118:971–7. 3) Dietrich KN, Succop PA, Berger OG, Keith RW. 1992. Lead exposure and the central auditory processing abilities and cognitive development of urban children: The Cincinnati Lead Study cohort at age 5 years. *Neurotoxicol Teratol* 15:51–6. 4) Osman K, Pawlas K, Schutz A, Gazdzik M, Sokal JA, Vahter M. 1999. Lead exposure and hearing effects in children in Katowice, Poland. *Environ Res* 80:1–8. 5) Schwartz J, Otto D. 1987. Blood lead, hearing thresholds, and neurobehavioral development in children and youth. *Arch Environ Health* 42:153–60. 6) Schwartz J, Otto D. 1991. Lead and minor hearing impairment. *Arch Environ Health* 46:300–5.
294. Braun, J.M, Kahn, R.S, Froehlich, T., Auinger, P., Lanphear, B.P. (2006, December). Exposures to environmental toxicants and attention deficit hyperactivity disorder in U.S. children. *Environ Health Perspect*. 114(12):1904-9.
295. Wasserman, G.A., Staghezza-Jaramillo, B., Shrout, P., Popovac,D., and Graziano,J. (1998, March). The effect of lead exposure on behavior problems in preschool children. *Am J Public Health*. 88(3): 481–486.
296. U.S. Department of Health and Human Services (2015). Educational Services for Children Affected by Lead Expert Panel. Educational interventions for children affected by lead. Atlanta. See Page 7. Link: https://www.cdc.gov/nceh/lead/publications/educational_interventions_children_affected_by_lead.pdf This report in turn cites the following studies: 1) Braun JM, Froehlich TE, Daniels JL, Dietrich KN, Hornung R, Auinger P, Lanphear BP. 2008. Association of environmental toxicants and conduct disorder in U.S. children: NHANES 2001-2004. *Environ Health Perspect* 116:956–62. 2) Dietrich KN, Ris MD, Succop PA, Berger OG, Bornschein RL. 2001. Early exposure to lead and juvenile delinquency. *Neurotoxicol Teratol* 23:511–8. 3) Fergusson DM, Boden JM, Horwood LJ. 2008. Dentine lead levels in childhood and criminal behaviour in late adolescence and early adulthood. *J Epidemiol Community Health* 62:1045–50. 4) Needleman HL, Riess JA, Tobin MJ, Biesecker GE, Greenhouse JB. 1996. Bone lead levels and delinquent behavior. *JAMA* 275:363–9. 5) Needleman HL, McFarland C, Ness RB, Fienberg SE, Tobin MJ. 2002. Bone lead levels in adjudicated delinquents. A case-control study. *Neurotoxicol Teratol* 24:711–7. 6) Wright JP, Dietrich KN, Ris MD, Hornung RW, Wessel SD, Lanphear BP, et al. 2008. Association of prenatal and childhood blood lead concentrations with criminal arrests in early adulthood. *PLoS Med* 5:e101.
297. U.S. Department of Health and Human Services (2015). Educational Services for Children Affected by Lead Expert Panel. Educational interventions for children affected by lead. Atlanta. See Page 9. Link: https://www.cdc.gov/nceh/lead/publications/educational_interventions_children_affected_by_lead.pdf

DISCUSSION AND RECOMMENDATIONS

298. See: 1) Bright Futures/American Academy of Pediatrics (January 2016). Recommendations for Preventive Pediatric Health Care (Periodicity Schedule). Link: https://www.aap.org/en-us/Documents/periodicity_schedule.pdf; 2) American Academy of Pediatrics COMMITTEE ON PRACTICE AND AMBULATORY MEDICINE, SECTION ON OPHTHALMOLOGY, AMERICAN ASSOCIATION OF CERTIFIED ORTHOPTISTS, AMERICAN ASSOCIATION FOR PEDIATRIC OPHTHALMOLOGY AND STRABISMUS, AMERICAN ACADEMY OF OPHTHALMOLOGY (December 2015). Policy Statement "Visual System Assessment in Infants, Children, and Young Adults by Pediatricians." Link: <http://pediatrics.aappublications.org/content/early/2015/12/07/peds.2015-3596#T1>
299. Two sources: 1) American Academy of Pediatrics Committee on Environmental Health. (2005). Lead Exposure in Children: Prevention, Detection, and Management. Pediatrics 2005;116;1036. Available at: <http://pediatrics.aappublications.org/content/116/4/1036.full.html> and 2) Bright Futures/American Academy of Pediatrics (January 2016). Recommendations for Preventive Pediatric Health Care (Periodicity Schedule). Link: https://www.aap.org/en-us/Documents/periodicity_schedule.pdf
300. American Academy of Pediatrics COUNCIL ON COMMUNITY PEDIATRICS, COMMITTEE ON NUTRITION (October 2015). Policy Statement "Promoting Food Security for All Children." Link: <http://pediatrics.aappublications.org/content/early/2015/10/20/peds.2015-3301>
301. American Academy of Pediatrics COUNCIL ON COMMUNITY PEDIATRICS (April 2016). Policy Statement "Poverty and Child Health in the United States." Link: <http://pediatrics.aappublications.org/content/137/4/e20160339>
302. This estimate is based on the proportion of the US population who are under 18 years of age (23%) multiplied by the number of people living in Health Professional Shortage Areas for primary medical care (62,396,277 people). Sources: 1) US Census. Persons under 18 years, percent, July 1, 2015, 22.9%. Link: <https://www.census.gov/quickfacts/table/PST045215/00> and 2) Bureau of Health Workforce Health Resources and Services Administration (HRSA) U.S. Department of Health & Human Services (As of September 11, 2016) "Designated HPSA Statistics" report. See "Shortage Areas, Health Professional Shortage Area (HPSA)-Basic Primary Medical Care" at: <http://datawarehouse.hrsa.gov/tools/hdwreports/Reports.aspx>
303. Definition of Medical Home taken from American Academy of Pediatrics. Link: <https://www.aap.org/en-us/professional-resources/practice-transformation/medicalhome/Pages/home.aspx>
304. Unpublished, internal, preliminary review done by Children's Health on the landscape of schools' requirements to identify and address HBLs. Review of state requirements for: comprehensive health examination requirements for school entry (beyond immunizations); vision screenings/exams; hearing screenings/exams; and dental screenings/exams. January 2016.