Sickle Cell Disease and the Brain: *Supporting Students*

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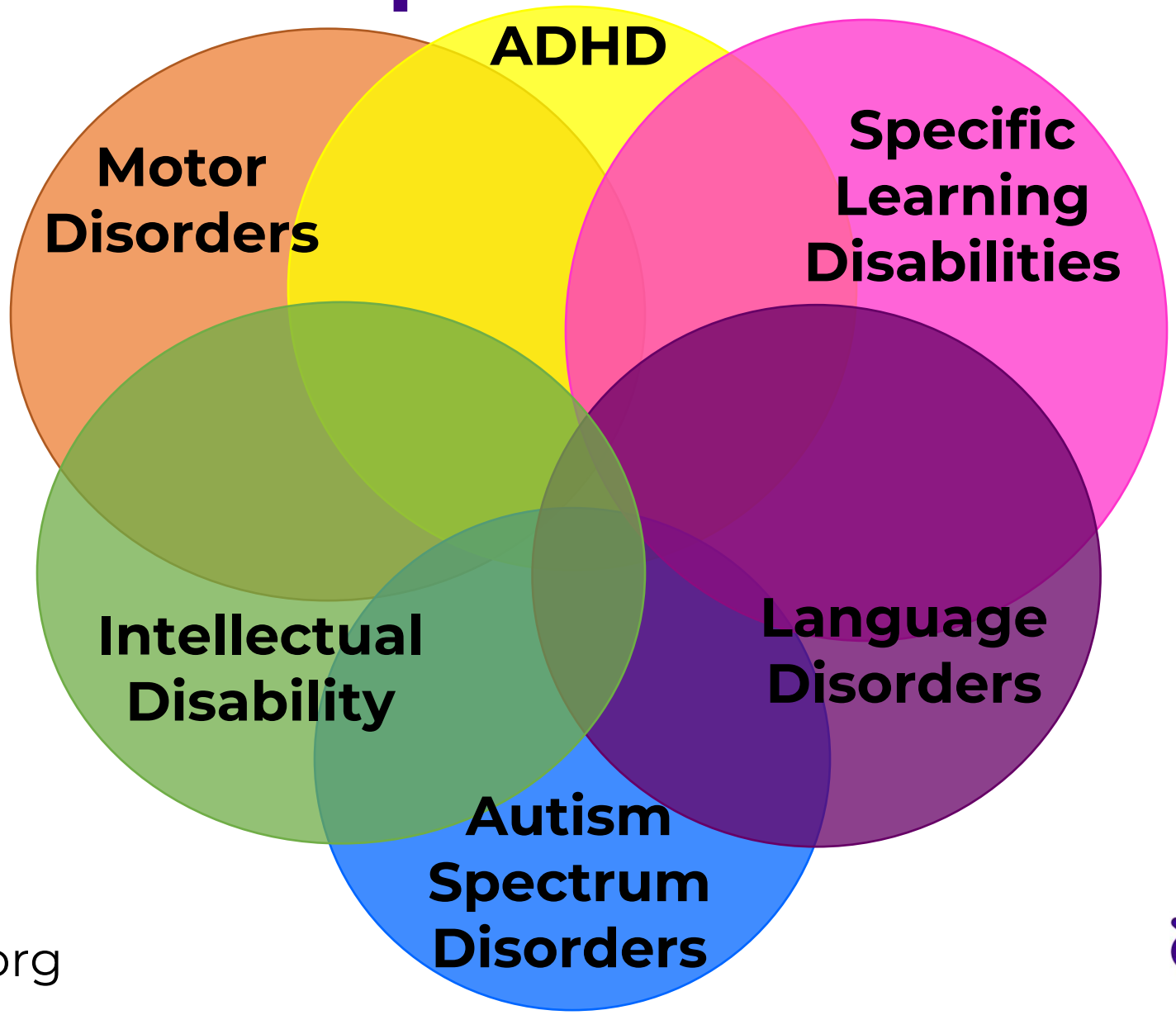
Neurodevelopmental Disabilities



Pediatrics

Child/Adult Neurology

Developmental Pediatrics

Birth

Childhood

Adulthood

www.nddtraining.org

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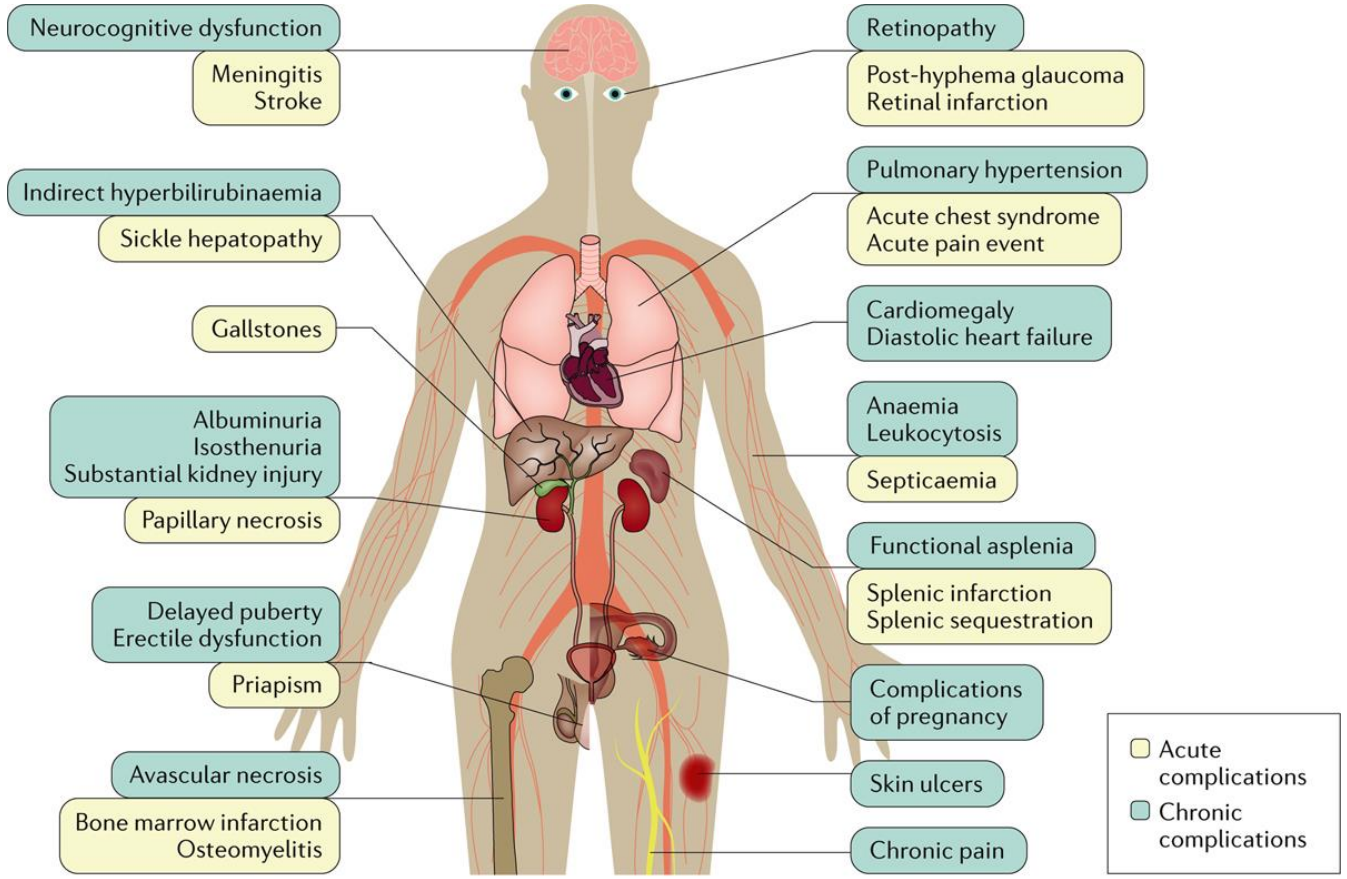
Complications



Kato, G. J. et al. (2018) *Nat. Rev. Dis. Primers*

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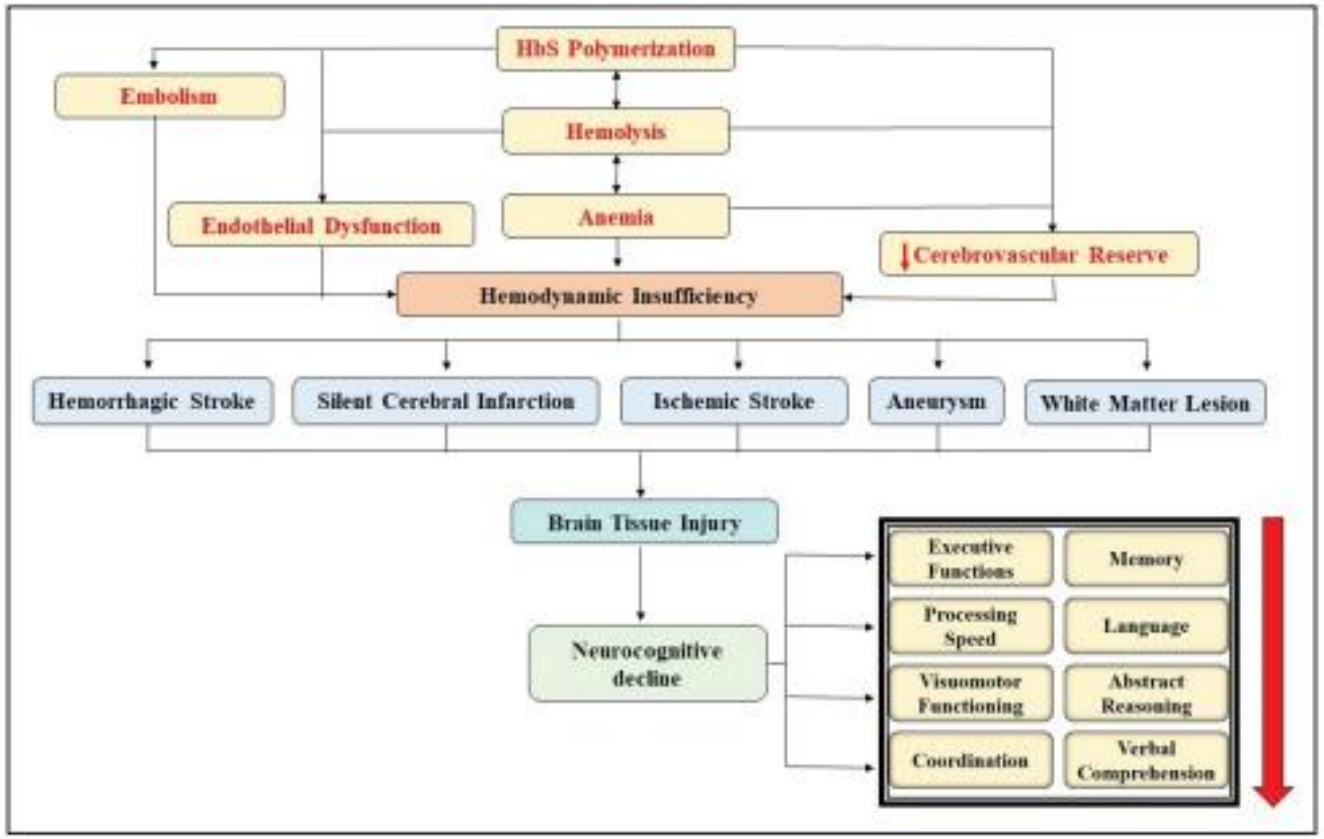
SCD and the Brain



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Sahu T, et. al. Ann Neurosci. 2022 29(4):255.

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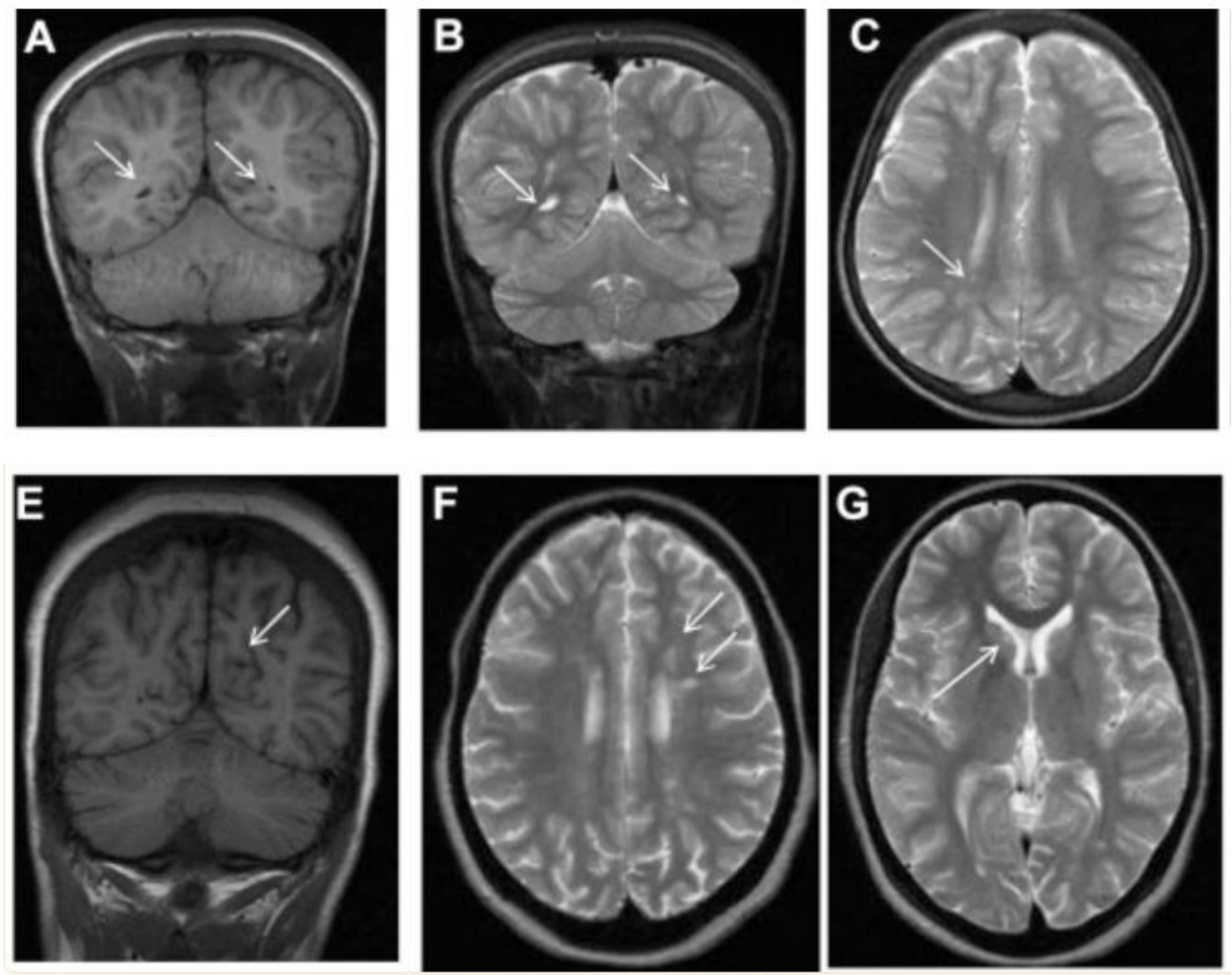

DeBaun et. al. Blood. 2012 119(20):4587-96.

SCI definition

- An area of abnormal T2 hyperintensity
- No history/physical findings of a focal neurological deficit in a corresponding localizing vascular distribution
- The lesion must be ≥ 3 mm in diameter & visible in at least two planes of T2 images

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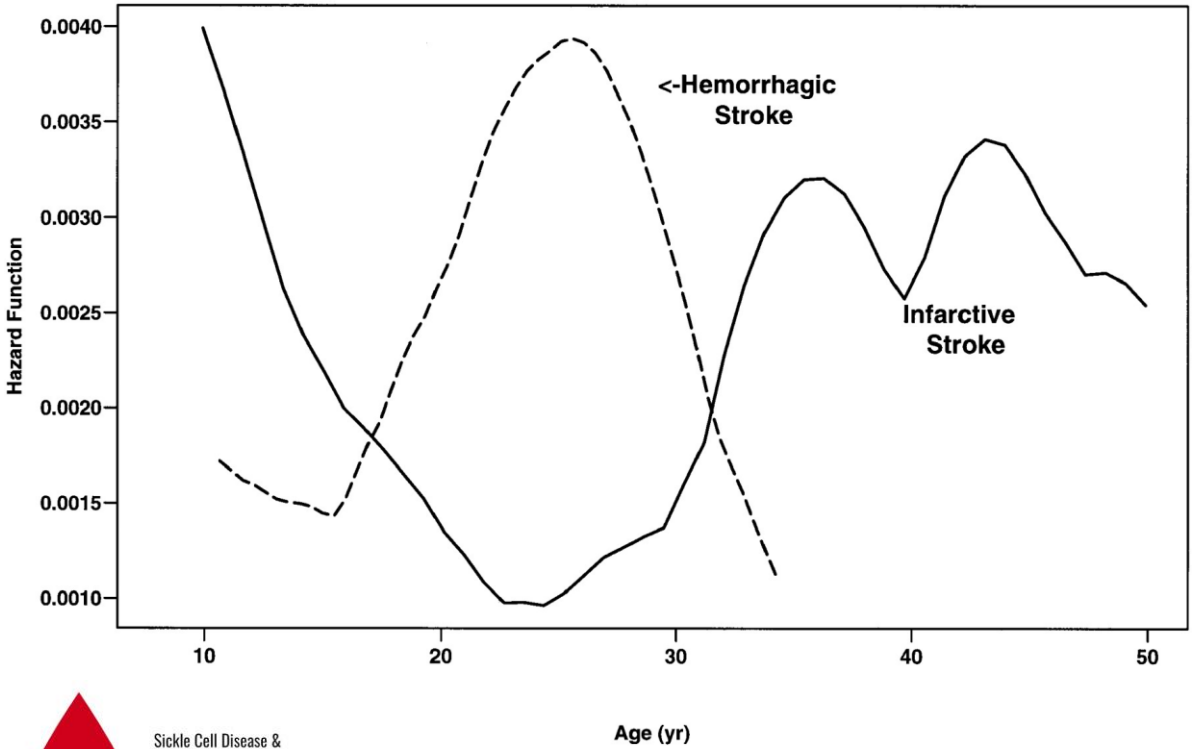
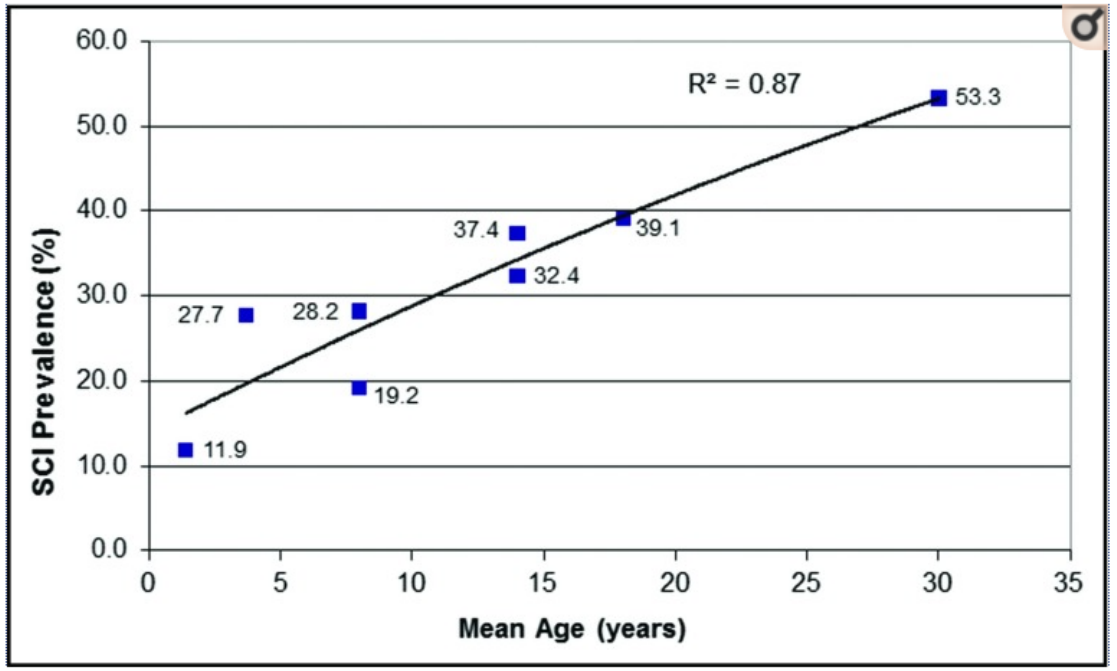
Stroke Rates in Patients with SCD

Stroke Hazard Rates in SS Patients



SCI Rates in SS & S-β^0 Patients



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Ohene-Frempong K et al. Blood 1998;91;
Kassim, AA et. A. *Blood*. 2016; 127(16): 2038.

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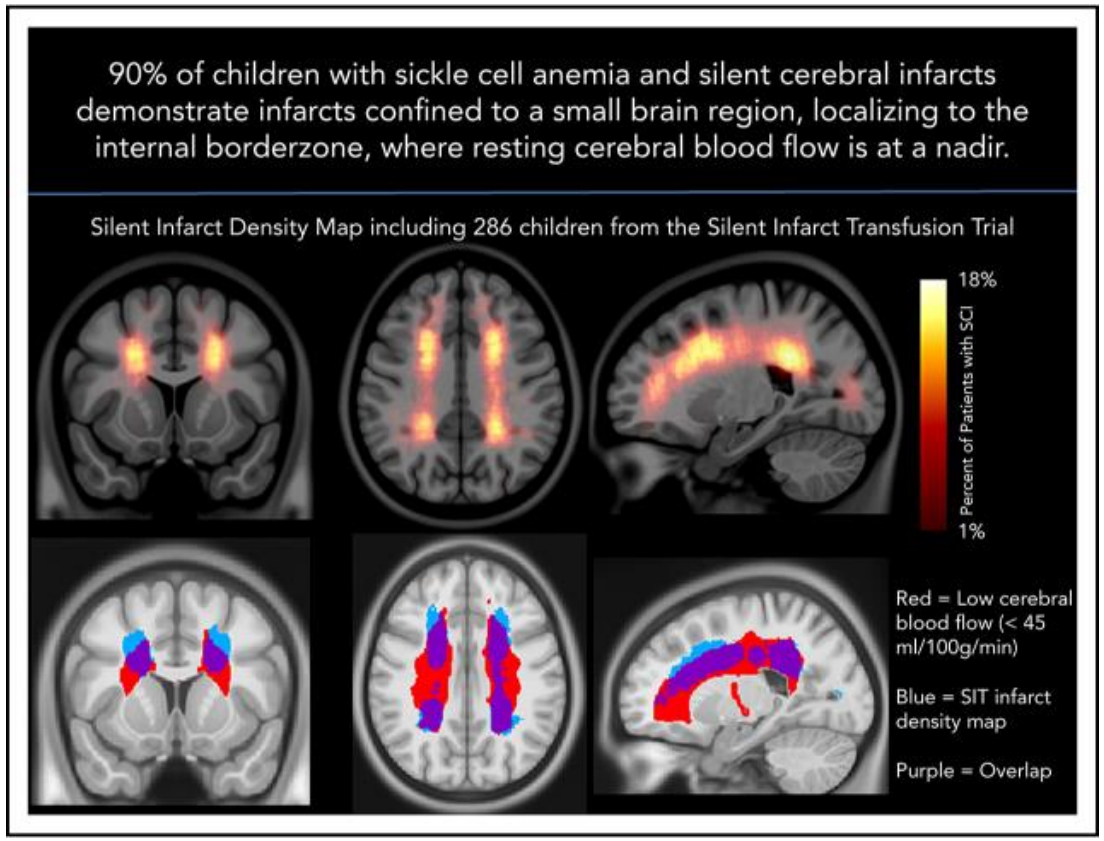
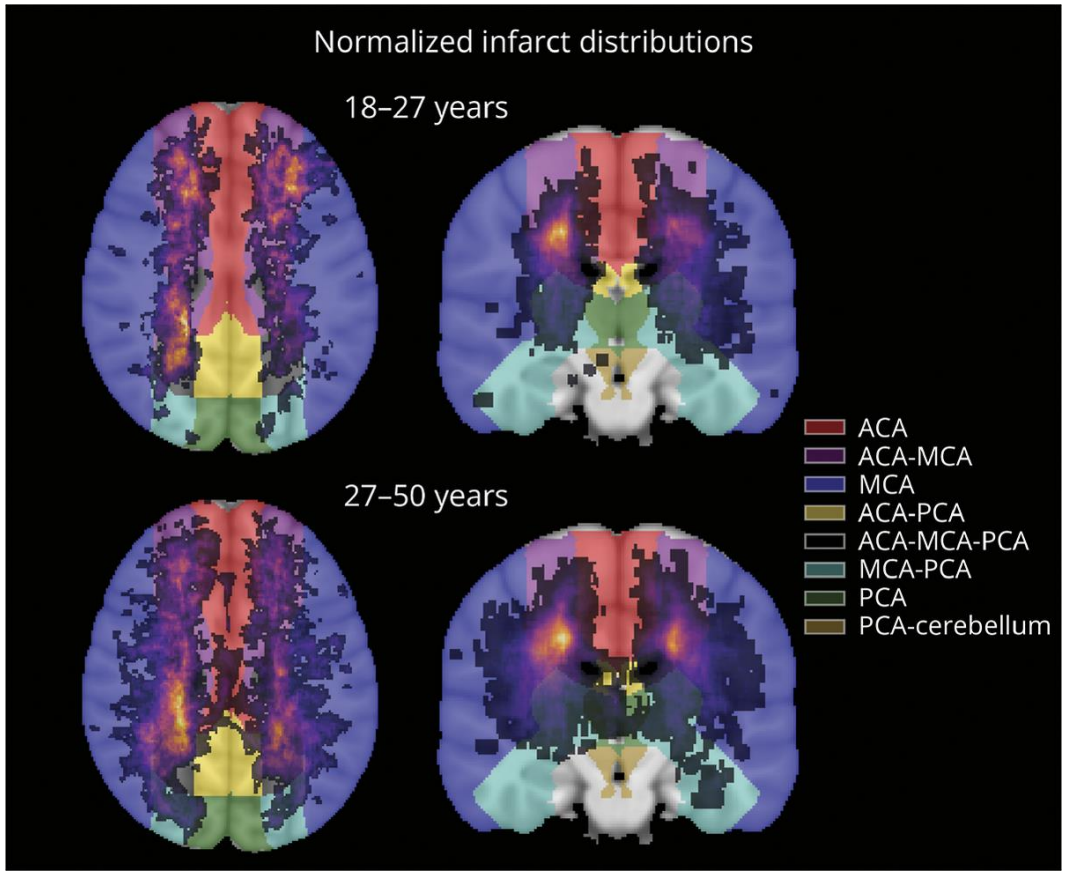
Stroke Locations in SCD





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Ford AL, et al. *Blood*. 2018;132(16);
Jones, R. et. al. *Neurology. 2024 102* (10).

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Cognition in SCD

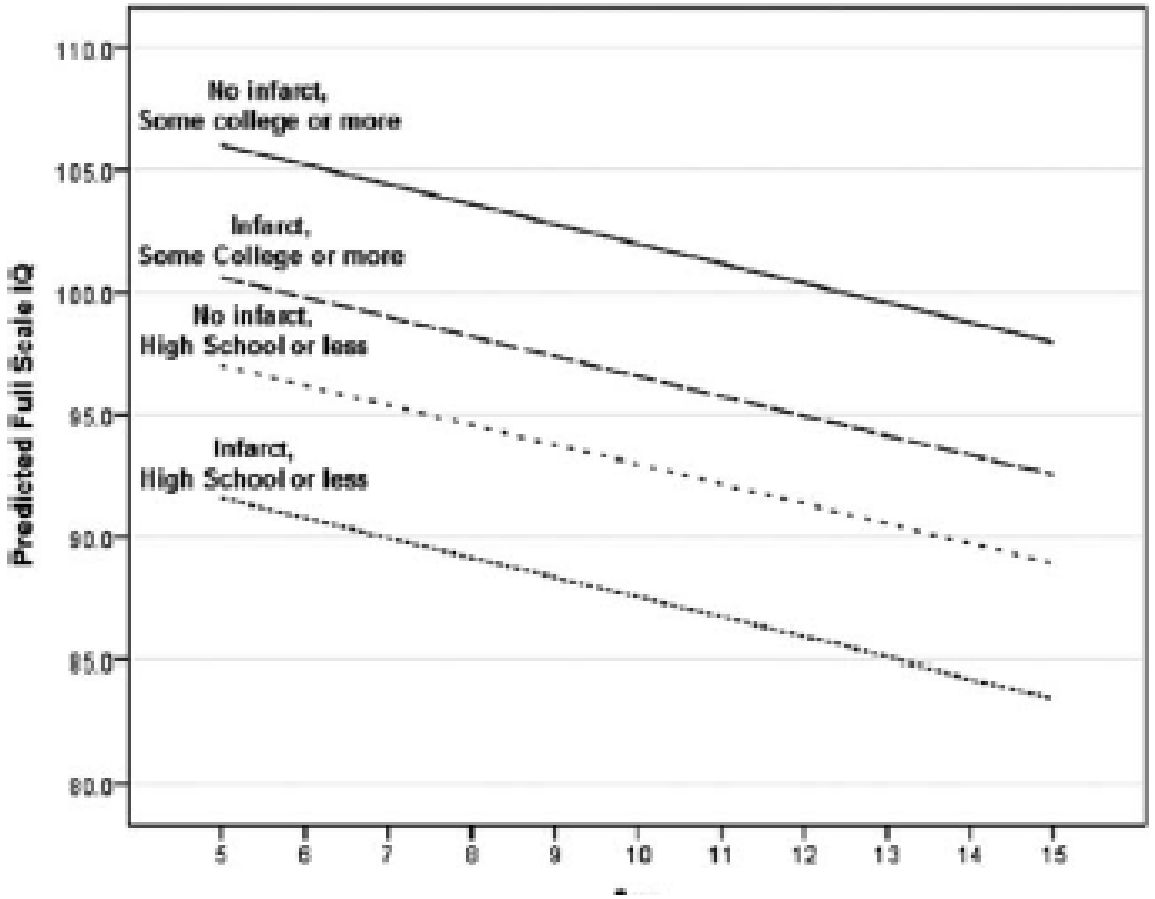

Table 3. Proportion of Patients With Sickle Cell Anemia (n = 146) and Healthy Controls (n = 47) in Wechsler Adult Intelligence Scale III Categories[a]

Category	No. (%) ≤69	70-84	85-99	≥100	*P* Value[b]
Expected %[c]	2	14	34	50	
Performance IQ Index					
Patients	4 (3)	44 (30)	67 (46)	31 (21)	.03
Controls	2 (4)	5 (11)	24 (51)	16 (34)	
Verbal IQ Index					
Patients	5 (3)	40 (27)	55 (38)	46 (32)	.16
Controls	1 (2)	7 (15)	22 (47)	17 (36)	
Full-scale IQ Index					
Patients	6 (4)	43 (29)	59 (40)	38 (26)	.06
Controls	1 (2)	9 (19)	19 (40)	18 (38)	
Perceptual Organization Index					
Patients	8 (5)	34 (23)	69 (47)	35 (24)	.03
Controls	1 (2)	5 (11)	25 (53)	16 (34)	
Working Memory Index					
Patients	5 (3)	47 (32)	61 (42)	33 (23)	.01
Controls	0	7 (15)	25 (53)	15 (32)	
Verbal Comprehension Index					
Patients	6 (4)	32 (22)	51 (35)	57 (39)	.48
Controls	1 (2)	9 (19)	17 (36)	20 (43)	
Processing Speed Index					
Patients	8 (5)	53 (36)	63 (43)	22 (15)	<.001
Controls	0	5 (11)	22 (47)	20 (43)	

King, AA et. al. Am J of Hematology 2014; 89. Vichinsky, E. P. et al. JAMA 2010; 303.

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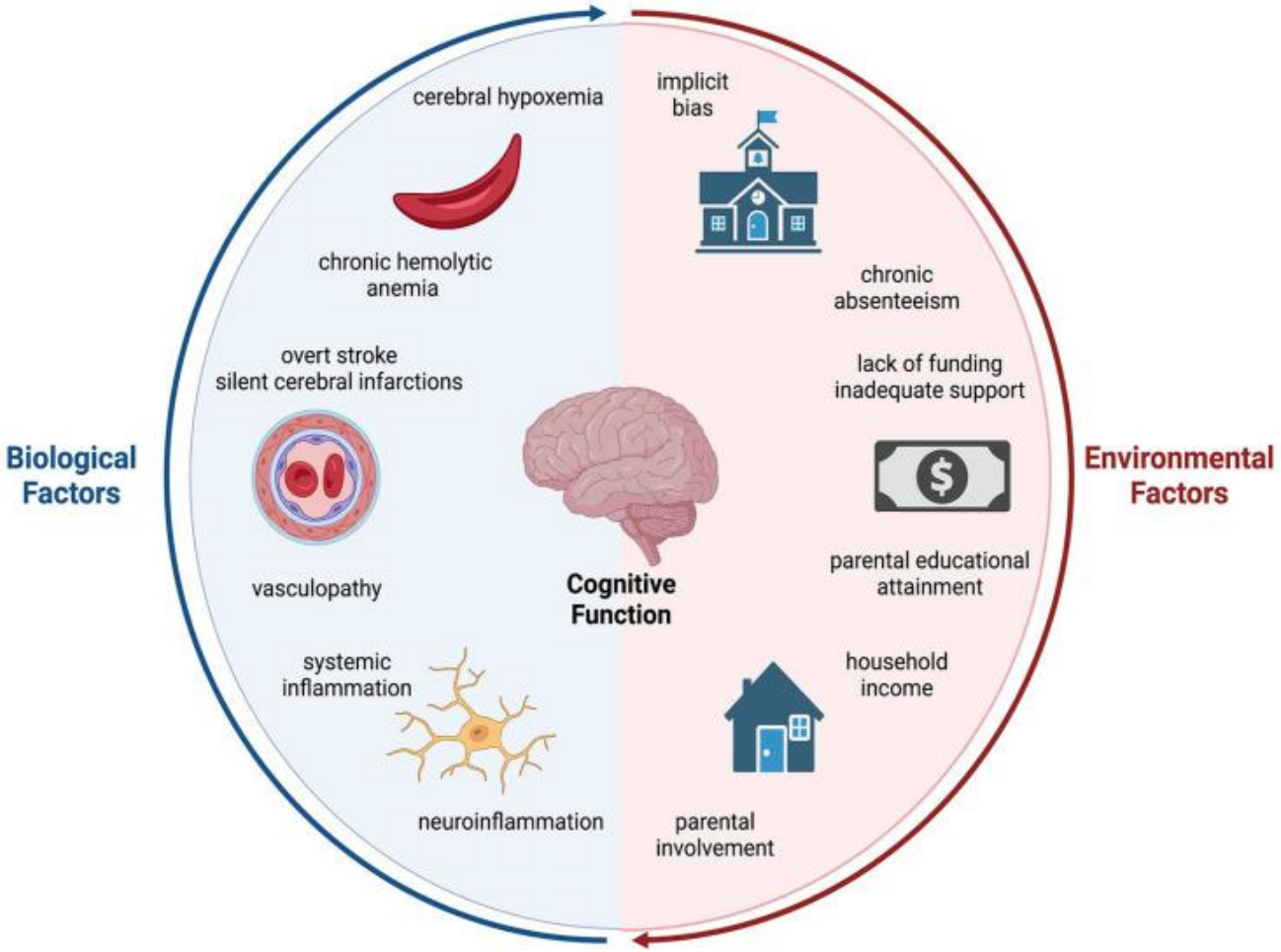
Multiple Factors



Karkoska KA, et. al. Exp Biol Med (Maywood). 2023; 248(15).

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Case Example

Joe was first seen at 8 years old for a research study → clinic visit

He has S-β^+ type sickle cell disease

- Acute chest syndrome (age 7)
- Pain crises (back)
- Headaches

H/o asthma, allergies

Appropriate development

Poor sleep, excessive electronics use

Neurological exam

- Low axial tone
- Coordination difficulties

Concerns about attention, learning, mood
Behavioral Therapy services
Normal research MRI

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Case Example (Continued)

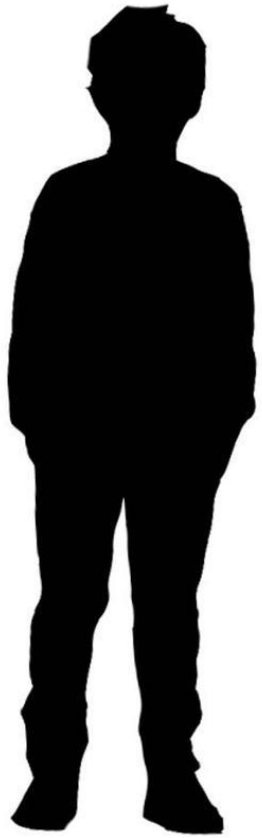
Joe followed up at 9 years old

He has S-β^+ type sickle cell disease

- Pain crises (groin, shoulder)
- Headaches improved with glasses

Neurological exam:

- Foot in-toeing - orthotics



Joe followed up at 12 years old

- Acute chest syndrome (11 years)
- Avascular necrosis of hip
- Pica
- Headaches

Concerns for ADHD, anxiety, and autism, normal repeat MRI

Sleep log, Neuropsych evaluation
Orthopedics care
Continue therapy services

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Role of Neuropsychology

- Provide information about the neurocognitive profile of SCD to families, patients, care providers, and educators.
- Assess neurocognitive functioning across the lifespan to identify potential risks and provide recommendations for current risks. Evaluations typically include assessment of intellectual functioning, attention, executive functioning, motor skills, academic skills, language, and learning/memory.
- Integrate information from multiple sources.
- Provide insight on the interactions between disease factors (e.g., imaging, pain, seizure), cognition, education, socialization, and emotional functioning.

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Neuropsychological Profile in SCD

- Preschoolers are at higher risk for developmental delays
- School age children are at risk for delays in sustained attention, working memory, EF, processing speed
- Cognitive impact is associated with neurological compromise
  - Overt vs. Silent Stroke
  - Larger lesion → greater impact
  - Comorbid conditions
- Difficulties often become more noticeable as academic demands increase
- Many have special education needs

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Drazen et. al., 2016, Shatz, et. al. 2017, Smith & Shatz, 2016

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Cognitive Risk in SCD

Language Delays → Difficulty Communicating / Behavior Problems → Difficulty Following Instructions / Reading/Writing Delays

Executive Delays → Tantruming Disorganization → Difficulties w/ Attention, Efficiency, Task Completion, Organization, Planning and Social Problem Solving

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Case Example (Joe)

- S-β^+ type sickle cell disease
- Full term pregnancy with maternal hypertension, low birth weight, perinatal hyperglycemia
- Developmental milestones on time
- Complications: acute chest syndrome, pain crises, headaches, fatigue, dizziness.
- Eval through study at 8 yr
- MRI was normal
- Parent concerns re: behavior, transitioning between households

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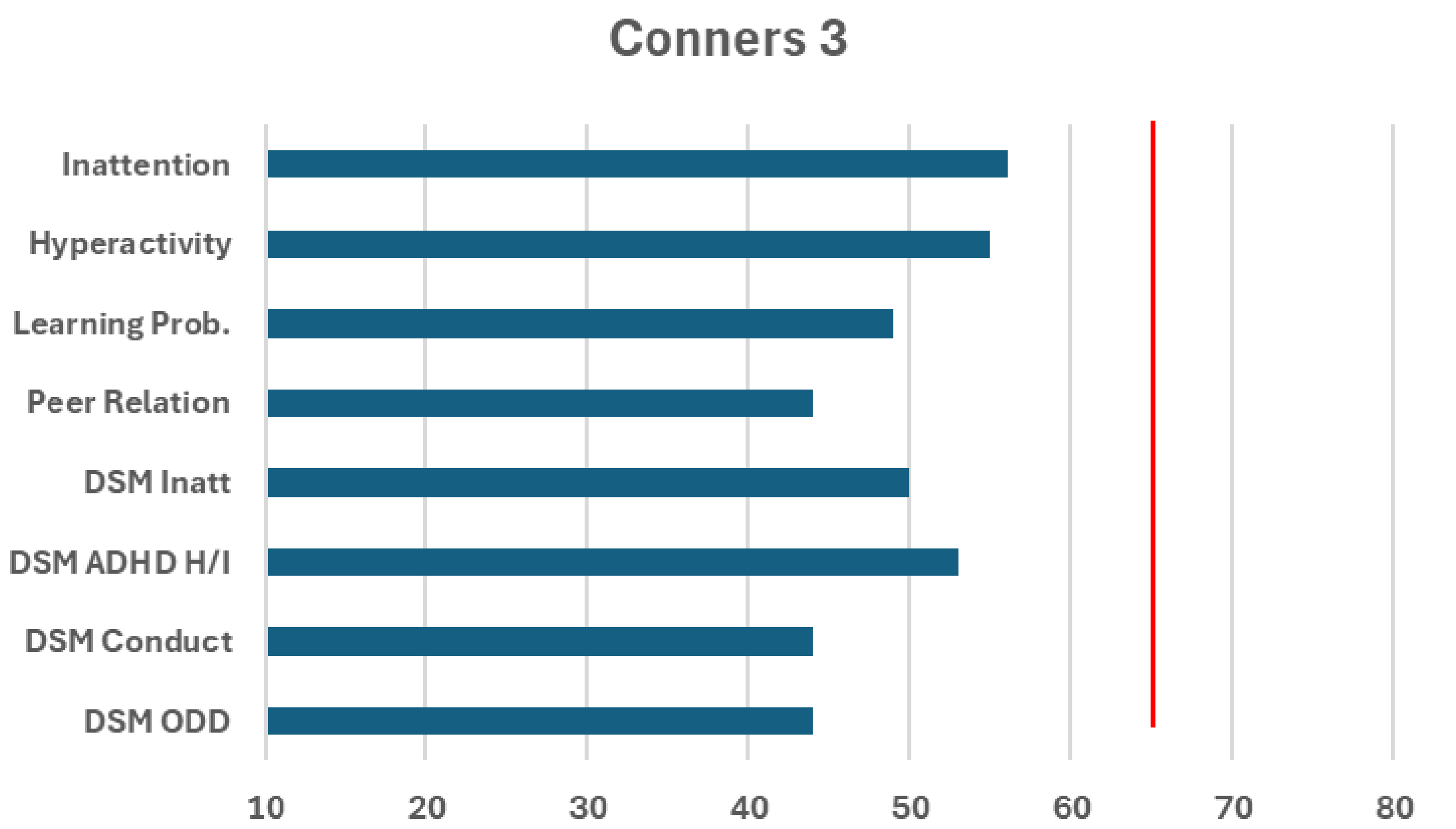
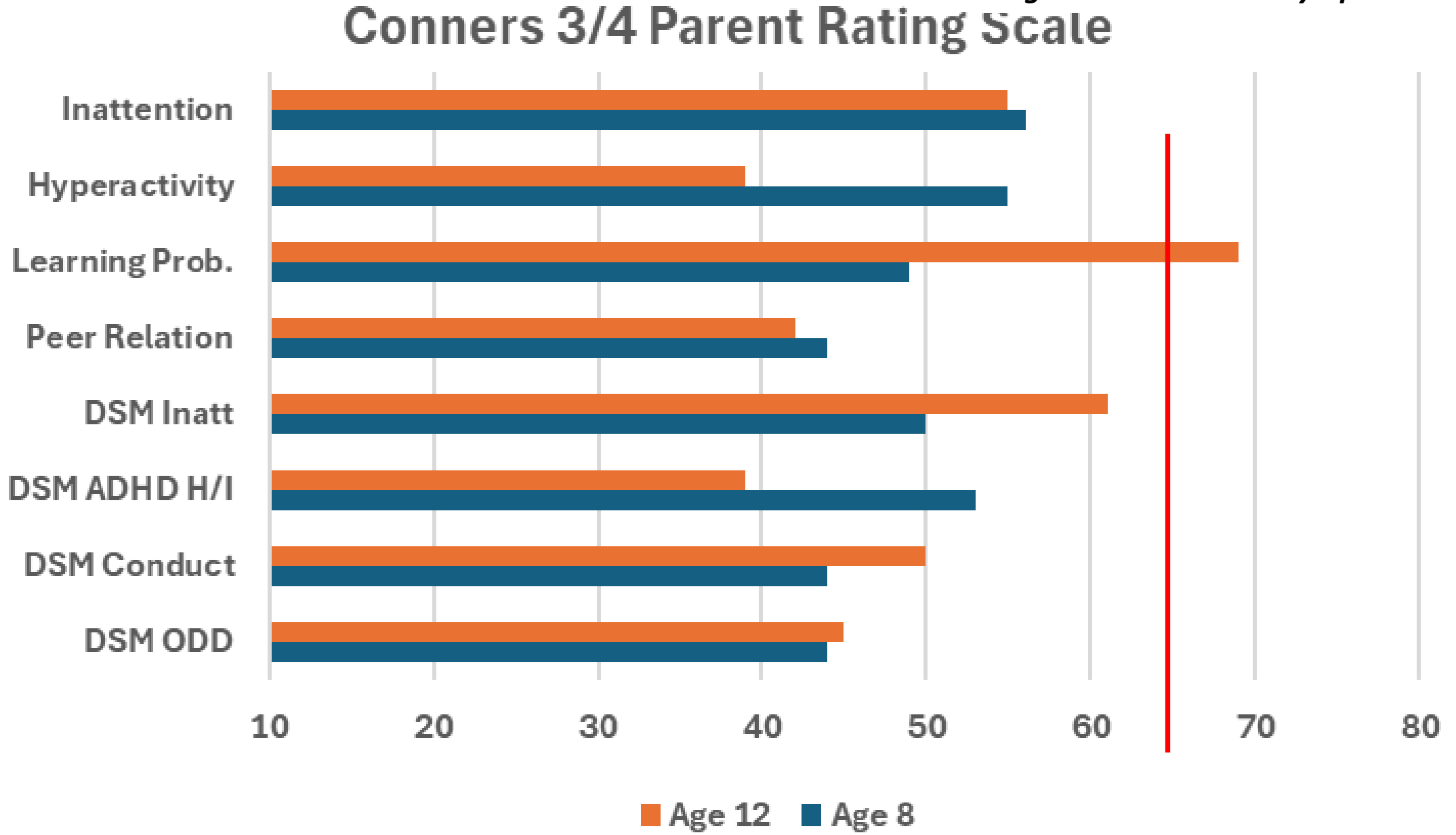
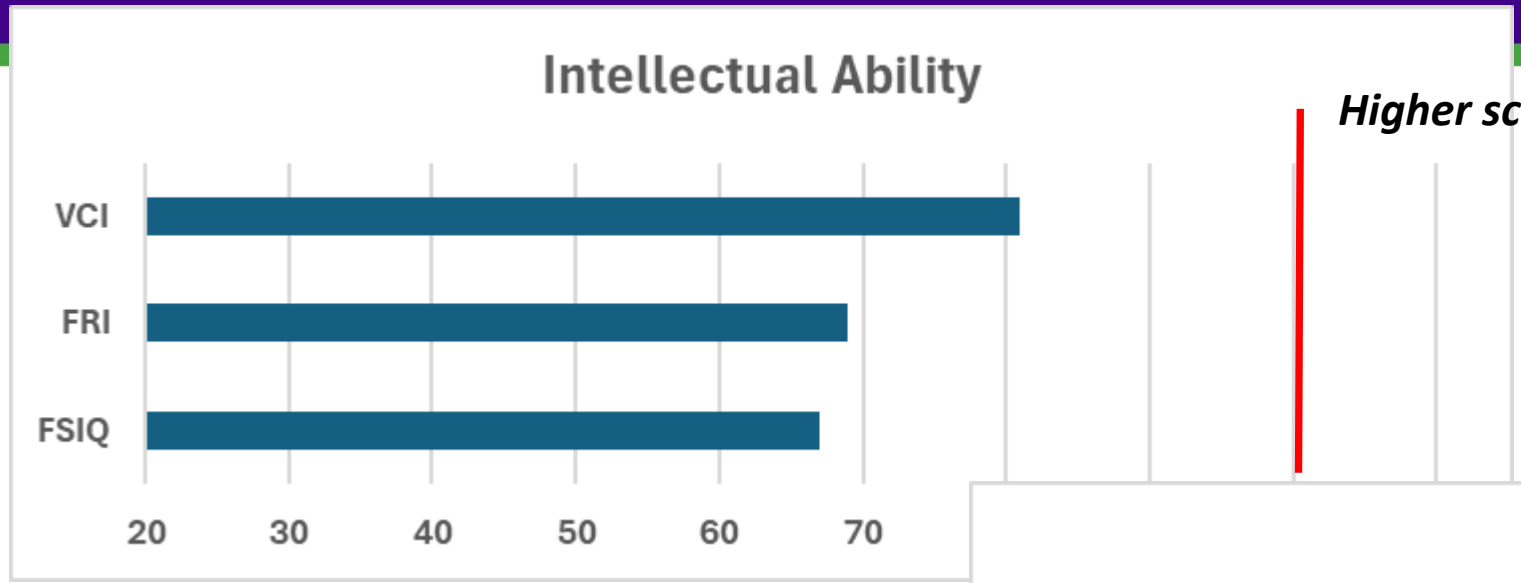
Higher scores = more symptoms



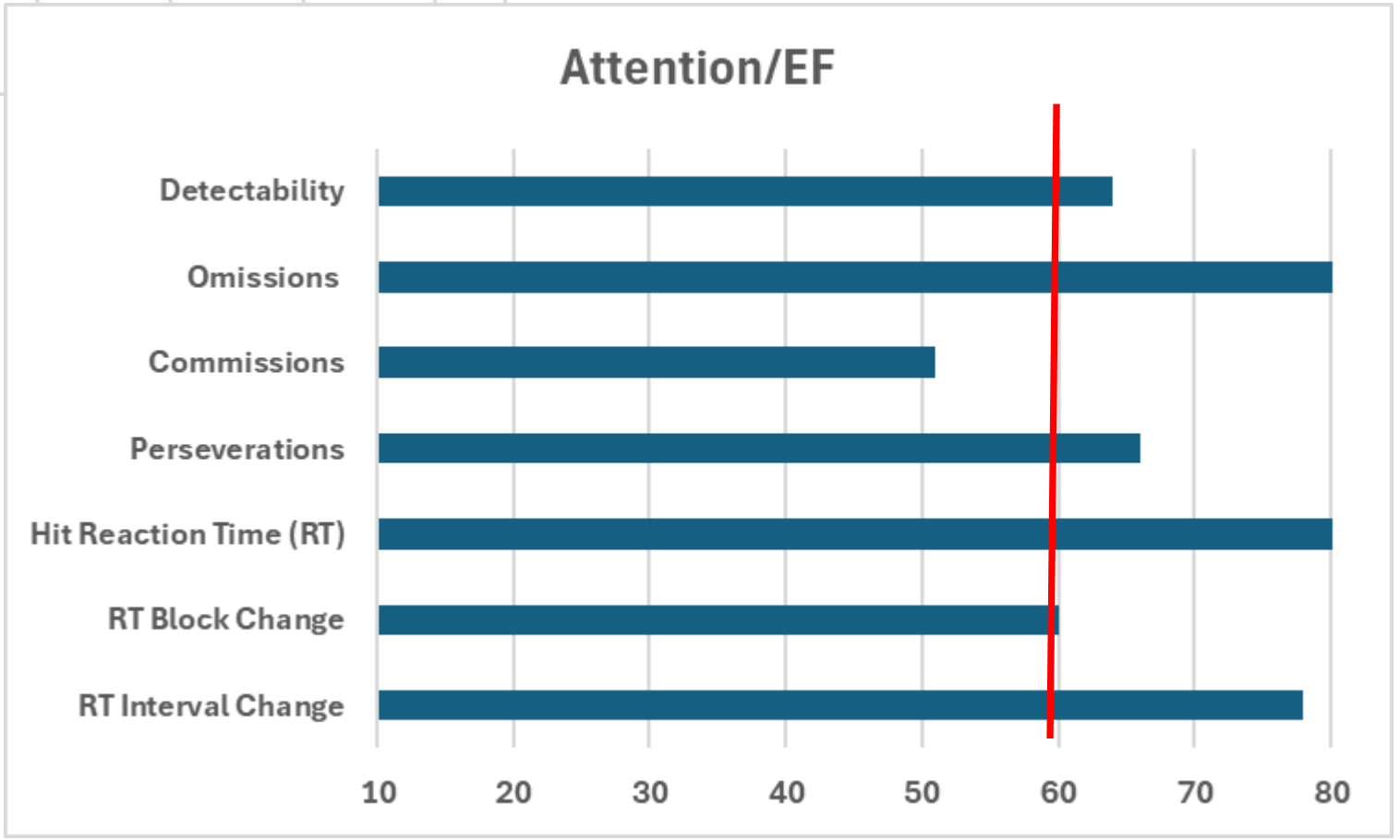
Higher scores = more symptoms





Higher scores = better performance

Higher scores = more symptoms



- Testing revealed delays in attention, working memory, nonverbal reasoning, and academic skills

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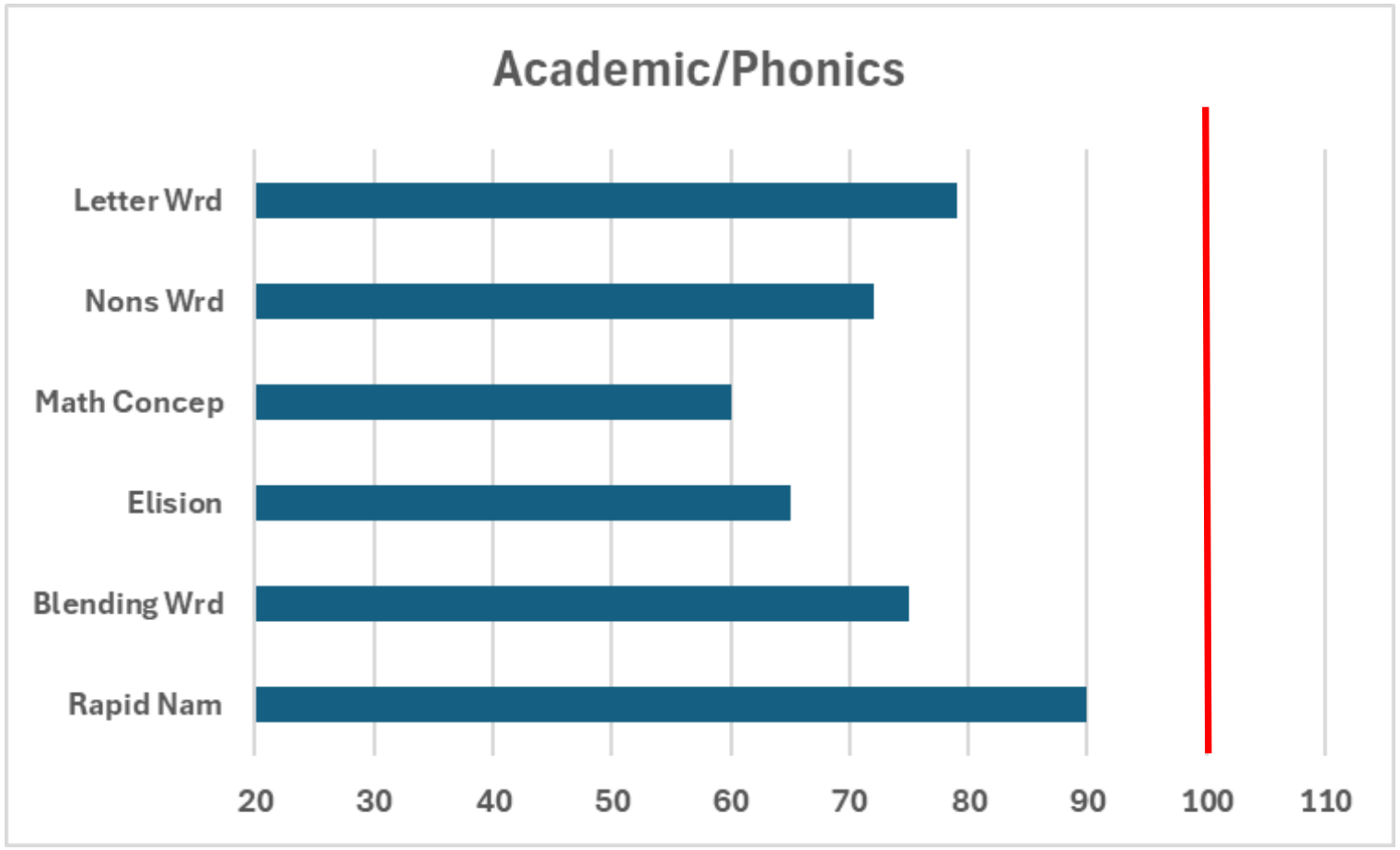

Higher scores = better performance

- Follow up testing confirmed deficits in sustained attention and documented additional academic concerns.
- Joe was highly distractible during testing & often needed repetition.
- Spoke mostly in short phrases.
- Joe moved nearly constantly.
- Affect was generally positive, but he became tearful during reading tasks.

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- Age 8 (3rd grade)
- Multiple school formats
- Dx of ADHD deferred
- Dx of Specific Learning Disorder in Reading
- Dx Adjustment Disorder

- Recommendations:
  - Psychotherapy for anxiety/mood
  - Psychoed. Re: anxiety in children
  - Classroom accommodations
  - Education re: SCD
  - Reading intervention
  - Resources to practice reading and math at home.
  - Re-eval in SCD clinic

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- Age 12
- Just completed 6th grade, with 504 in place.
- After-school math tutoring program
- Passed all county benchmarks and did well in 5th grade, **but** executive difficulties were interfering with task completion (all Es at one point in school year).
- Missed appr. 10 days due to illness.
- Dx: avascular necrosis of hip, elevated thyroid levels
- Updated MRI this year also normal
- Loss in family, ongoing challenges switching between homes.

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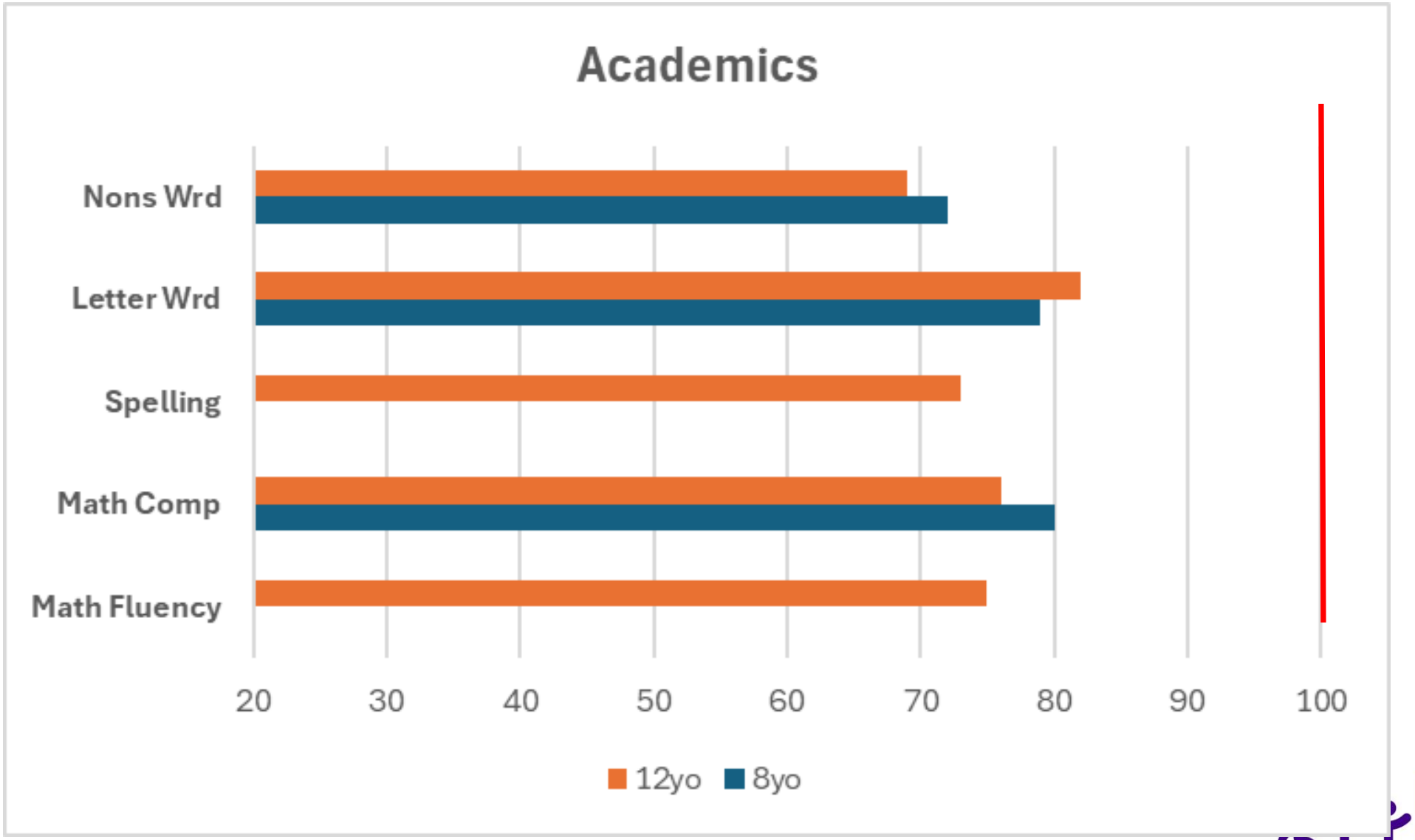
Higher scores = better performance



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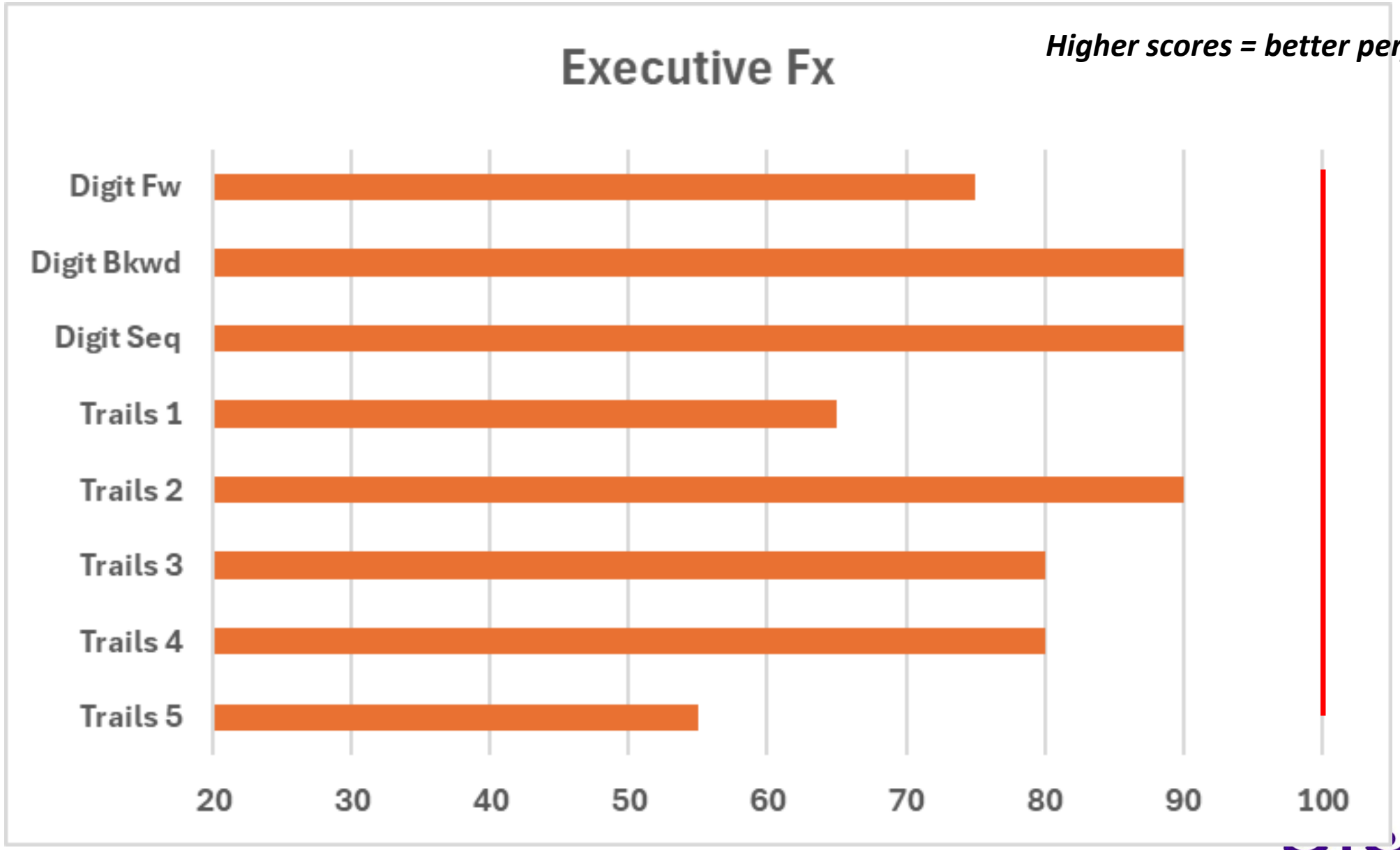
Higher scores = better performance



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- Ongoing delays in attention, academics, emotional fx
- Dx: Specific Learning Disorder in Reading & Math, Adjustment Disorder
- Referred for Speech/Language Eval
  - Dx Mixed Receptive Expressive Language D/O
  - Delays in comprehension, sentence formation, reading comp., pragmatics
- Continue therapy, monitor mood
- School Recommendations:
  - 504 not sufficient, need IEP
  - Reading and math interv.
  - Classroom Accommodations
  - Modified Work
  - Home and Hospital
  - Education Liaison

Adult Outcomes

- In adulthood, executive deficits are associated with increased risk for lower educational attainment, social difficulties, unemployment, financial instability, and legal/safety risks.

- Jonassaint, et. al., (2016) performed a retrospective study at 2 mid-Atlantic medical centers with 258 adults with SCD
- Patients without high school diploma or GED
  - 3x as many hospital visits
  - Higher rates of depression
  - More likely to be in poverty
  - Much less likely to be employed
  - Post-sec education: 55% employed
  - No diploma: 19% employed

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Lifelong Implications

- Fixed Factors
  - SES
  - Maternal Education
  - Past Brain Injury
- Modifiable Factors
  - Attention Symptoms
  - Access to Interventions
  - Access to Medical Care

- Neuropsychological evaluations can:
  - Identify/diagnose specific areas of delay, deficit, or change
  - Provide recommendations for intervention
  - Monitor response to interventions

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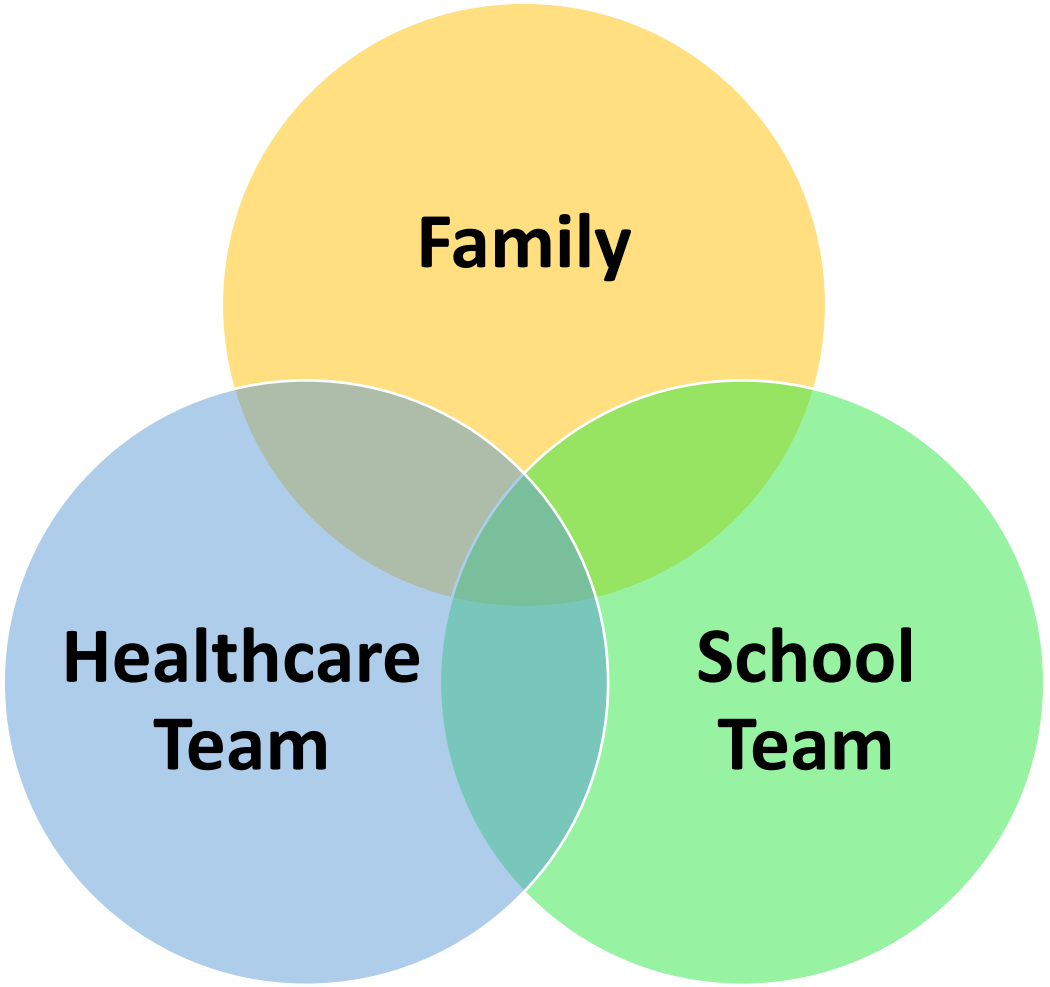
Education

Education is a social determinant of health - therefore critical in health maintenance for children and adolescents with sickle cell disease.

Supporting educators in developing knowledge and skills means supporting patients.

Facilitating Communication



The reciprocal relationship between health care service delivery and school systems calls for widespread and routine collaboration between medical and educational systems."

(Shaw & Brown, 2011)

Tips for Supporting Healthcare – School Team Communication

- Encourage “early and often!”
- Make sure all teams have **copies of signed releases** that comply with both HIPAA and FERPA.
- Support agreement on a **best method** of communication for all teams.
- Support agreement on types of information critical to share with other teams.
- Each team needs a contact point-person.

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Agree on Types of Information to Share

Healthcare Team →

- New side effects of a treatment change
- Cognitive/physical status
- Requests for data
- Concerns that might be able to be addressed at school

← **School Team**

- Changes in behavior
- Changes in cognition
- Skill loss
- Requests for specialized instruction/accommodation/modification recommendations
- Concerns about vision/hearing changes

Formalized School Supports

Section 504 Plan

- Rehabilitation Act
- School-based accommodations
- Dx. of SCD entitles students to a 504 plan.

Individualized Education Program

- Individuals with Disabilities Education Act (IDEA)
- Specialized Instruction & Related Services
- Dx. of SCD with cognitive impacts that require specialized instruction entitles students to an IEP.

IDEA OHI Eligibility is Confusing

- The Other Health Impairment (OHI) Eligibility Criteria are confusing.
- Language used is **neither** education nor healthcare related.
- Translation of terms is necessary for ALL parties.
- Ensuring that school-based healthcare professionals understand the terms is very helpful to the IEP team!

IEP Eligibility Questions

- Is there a chronic/acute health condition?
- Does the health conditions result in limited strength, vitality, or alertness?
- Does the health condition have an educational impact?
- Is there a need for specialized instruction?

Limited strength, vitality, or alertness…

Overview of terms used in IDEA - Other Health Impairment
Limited strength
Difficulty completing routine physical tasks within the school setting (including navigating hallways and stairs without falls, maintaining a seated posture, completing written work within the same efficiency as non-disabled peers, etc.) as well as stamina to persist across a school day.
Limited Vitality
Fatiguing physically or mentally more easily than non-disabled peers.
Limited Alertness
Trouble attending to relevant stimuli, sustaining attention, or attending to the same amount of information as non-disabled peers.

Linking IHPs to 504s & IEPs

- It is important for teachers and other school staff to consider how a student's individualized healthcare plan fits within other formalized supports they receive.

- **Include IHP accommodations within the 504/IEP when possible.**
- **Ensure 504/IEP accommodations match the healthcare needs of the student.**
- **Propose communication strategy between the 504/IEP team and school healthcare providers.**

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Behavioral Psychology

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Role of Behavioral Psychology

- Provide education, assessment, and intervention to support individuals with SCD
- Target specific health behaviors and interventions addressing coping and adjustment with having with a chronic medical condition

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Role of Behavioral Psychology

Address the interplay between medical, psychological, and social factors impacting coping and adjustment

- Coping with a chronic medical condition
- Anxiety & depression
- Peer/family relations
- School functioning

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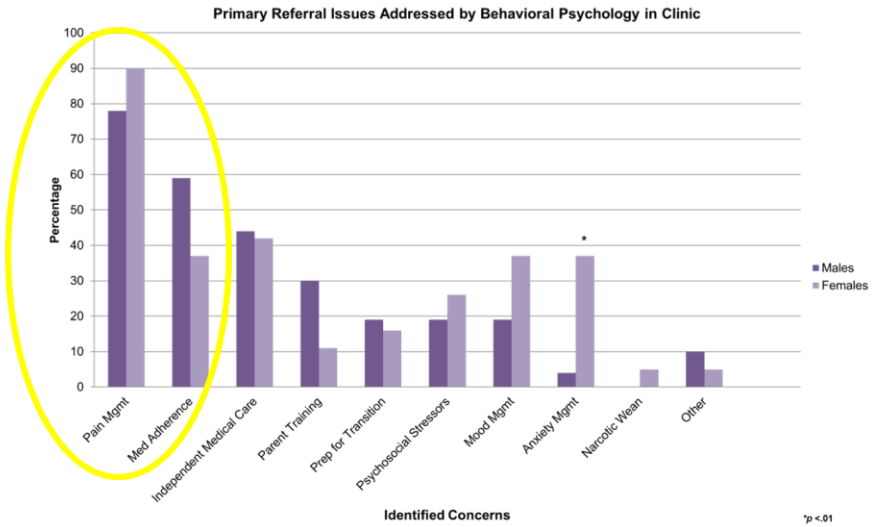
Primary Areas of Intervention

- Adherence with medical recommendations
- Behavioral pain management
- Coping with medical procedures
- Coping and adjustment with having a chronic medical condition



Bierenbaum, M.et al (November 2011) Sickle cell transition clinic: The role of behavioral psychology in shaping age-appropriate disease management. Poster presented at the Convention for the Association for Behavioral and Cognitive Therapies, Toronto.

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Adherence

"The extent to which a person's behavior (in terms of taking medications, following diets, or executing lifestyle changes) coincides with medical or health advice" (Haynes, 1979).

"Despite evidence to the contrary, there continues to be a tendency to focus on patient-related factors as the causes of problems with adherence, to the relative neglect of provider and health system-related determinants. These latter factors, which make up the health care environment in which patients receive care, have a major effect on adherence."

World Health Organization (2003). Adherence to Long Term Therapies, Evidence for Action

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Adherence

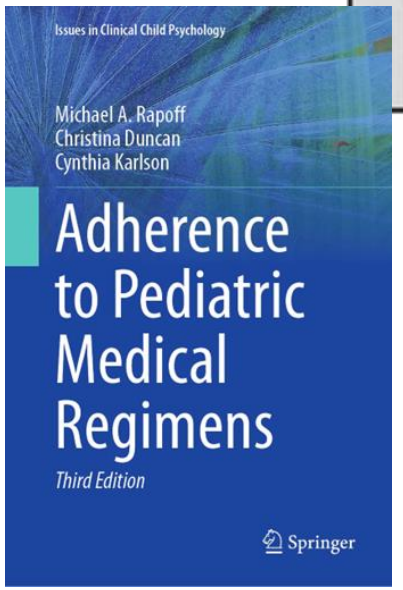
- Antecedent Disease Management Strategies
- Medication & medical regimen

To avoid problems, remember

FARMS

F	Fever Fluids Food	Tell a grownup if you feel warm. See a doctor if your temp is over 101. Drink plenty of fluids each day. (Water is best.) Eat a healthy, balanced diet.
A	Air	Be careful in situations where you might not get enough oxygen (like in airplanes).
R	Rest	Get plenty of sleep each night. Take a break whenever you feel tired. Don't overdo it.
M	Medications Medical Care	Always take your medicine and vitamins as directed. Get proper medical care .
S	Situations	Be aware of certain situations: -Don't get too hot or too cold . -Stay away from cigarettes, alcohol and illegal drugs. -Avoid getting too tired or upset. -If you go outside to play wear the proper clothes for the season and take plenty of water and rest breaks. -Pace yourself at work and play.

www.SickleCellKids.org



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Adherence & School

- Support student with antecedent disease management strategies
  - Free access to fluids
  - Free access to the bathroom (**“my teacher makes us fill out a log to poop”**)
  - Rest breaks
- Support student’s privacy about visits to the nurse’s office/discretion about receiving medical intervention at school (consider flash pass)
- Side effects from medical intervention may impact student’s behavioral presentation
- Anxiety/distress related to medical care may impact coping at school
- Adherence will likely by impacted by neurodevelopmental presentation, and student’s ability to self-advocate

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Adherence & School

- Adherence to medical recommendations can lead to school absences, which can negatively impact coping and adjustment (related to academic concerns and social concerns)
  - Chronic transfusions, blood work, pain crises requiring ED visits and/or hospitalization
  - Scheduled visits to hematology, neurology, ophthalmology, other specialists

“Getting transfusions is scary enough, and then on top of that I miss a whole day of school and get further behind!”

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Pain

- Students with SCD may experience acute pain or chronic pain
- Pain is subjective and can challenging for others to discern
- Students with neurocognitive challenges may have a harder time reporting/recognizing pain

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Pain

- Signs child may be in pain
- Physical indicators of pain
- Communication with student and caregivers
- Pain can look like behavioral distress/irritability
- Bidirectional relationship between pain and anxiety
- Early intervention may potentially prevent more serious complications, hospitalization etc.

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Pain

- Pain coping and behavioral pain management strategies
- Distraction
- Relaxation
- Breaks
- Mindfulness
- Movement

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Pain and School

- Pain can look like disengagement or behavioral dysregulation
- Pain can impact focus and attention
- Pain coping strategies can be mistaken for off task behavior (**“I’m not allowed to doodle”**)
- Pharmacological treatments for pain can impact alertness
- Pain can be exacerbated by anxiety/stress
- Importance of pain management plan as part of student’s school plan across staff and school settings

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Social Considerations

- Student may downplay pain/symptoms of SCD due to

embarrassment, fear of going to the hospital, not wanting to miss out, not wanting to burden caregivers

- Anxiety about taking a break, missing extracurricular activities, being different from peers
- Bullying related to difference
- Student may not ask for accommodations for these reasons

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Signs a child may need additional support

- Even with supports student is having behavioral or academic challenges that are impairing school functioning
- Who to refer to:
  - Caregiver
  - Child’s medical team
  - Health psychologist

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Key Take Aways

- Behavioral challenges may mask academic/learning challenges
- Behavior changes may indicate a need to modify academic supports, consider additional supports
- More frequent monitoring of appropriateness/effectiveness of accommodations
- Changes in medical status may warrant an updated school plan
- Communication between student, family, school, medical providers is critical

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Current SCD CNS Guidelines

- **HbSS & HbSβ⁰ thalassemia patients should receive:**
- 1 pediatric brain MRI without sedation & 1 adult brain MRI
  - *High prevalence of SCI*
  - *Associations with cognitive impairment, poor school performance, and future cerebral infarcts*

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DeBaun MR & Jordan LC, et. al. *Blood Adv*. 2020;4(8):1554-1588.

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Current SCD CNS Guidelines

- **Children & Adults with SCD should receive:**
  - Developmental/Cognitive surveillance
  - Validated Developmental/Cognitive screening
  - Neurodevelopmental evaluation & treatment
- *High prevalence of developmental delay & cognitive impairment*

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DeBaun MR & Jordan LC, et. al. *Blood Adv*. 2020;4(8):1554-1588.

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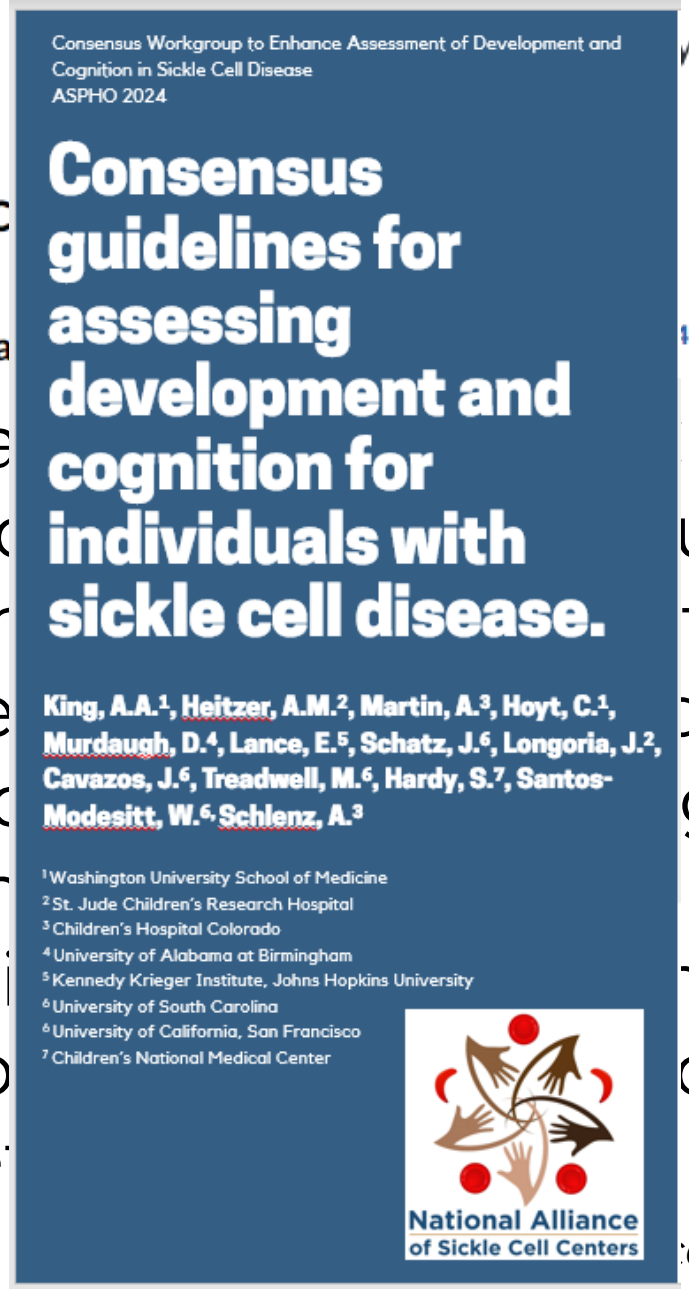
COMMENTARY

Neurocognitive screening in sic

Eboni I. Lance[1,2] | Alicia D. Cannon[3] | Ja

"Given tha D are already known to be at inc urocognitive impairmer t baseline testing and periodic re d be the standard of care, as is c gh-risk pediatric populatior and low birth-weight infants, chi nital heart disease, pediatric o children with epilepsy, e

Lance, er. 2022



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