

INTRODUCTION

- Of the 1.7 million annual traumatic brain injuries, 75% are concussions.^{1,2}
- 1 in every 220 pediatric patients seen in ED are diagnosed with concussion.³
- Concussion is defined as “a complex pathophysiological process affecting the brain, induced by biomechanical forces.... the acute clinical symptoms largely reflect a functional disturbance.”⁴
- Concussion symptoms are divided into 4 categories:

Physical	Cognitive	Emotional	Sleep
Headaches	Mentally foggy	Irritability	Drowsiness
Nausea	Problems concentrating	Sadness	Sleeping more
Fatigue	Problems remembering	More emotional	Sleeping less
Visual Problems	Feeling slowed down	Nervousness	Trouble falling asleep
Balance Problems			
Sensitivity to light			
Sensitivity to noise			
Numbness/Tingling			
Vomiting			
Dizziness			

Adapted from the CDC ACE Care Plan

- Children have a prolonged course of recovery after concussive injury.^{6,7}
 - Specific premorbid and post-injury factors that may impact recovery are unclear.
 - Possible factors include pre-injury history of ADHD, Learning Disabilities and anxiety.

PARTICIPANTS

- A clinical sample of all patients who presented to a multi-disciplinary Concussion Clinic with a history of recent concussion between 2010-2012.
 - Ages:
 - 6 – 8 years (n=12)
 - 9 - 12 years (n=39)
 - Seen by a Physician (Pediatric Rehabilitation Medicine or Child Neurology) and a Neuropsychologist.
 - Presented within 50 days of concussion.

METHODS

- Retrospective chart review of initial and follow-up concussion visits in a clinical sample.
 - Medical History:
 - Premorbid Diagnoses
 - Concussion History
 - School Data
 - Clinical Symptoms
 - Neuropsychological Testing from Initial Clinical Visit:
 - Initial and Delayed Verbal Memory:
 - Wide Range Assessment of Memory and Learning – 2nd Edition (WRAML-2): Verbal Learning Immediate and Delayed; Recognition
 - Response Time
 - Woodcock-Johnson Tests of Achievement – 3rd Edition (WJ-III Math Fluency)
 - Executive Functioning
 - Auditory Consonant Trigrams (ACT)
 - Delis-Kaplan Executive Functioning System (D-KEFS): Verbal Fluency, Letter Fluency and Category Fluency

- Statistical Analysis
 - SPSS 18: Mean and Standard Deviations; Pearson Correlations

RESULTS

Figure One
Cognitive Symptoms Reported

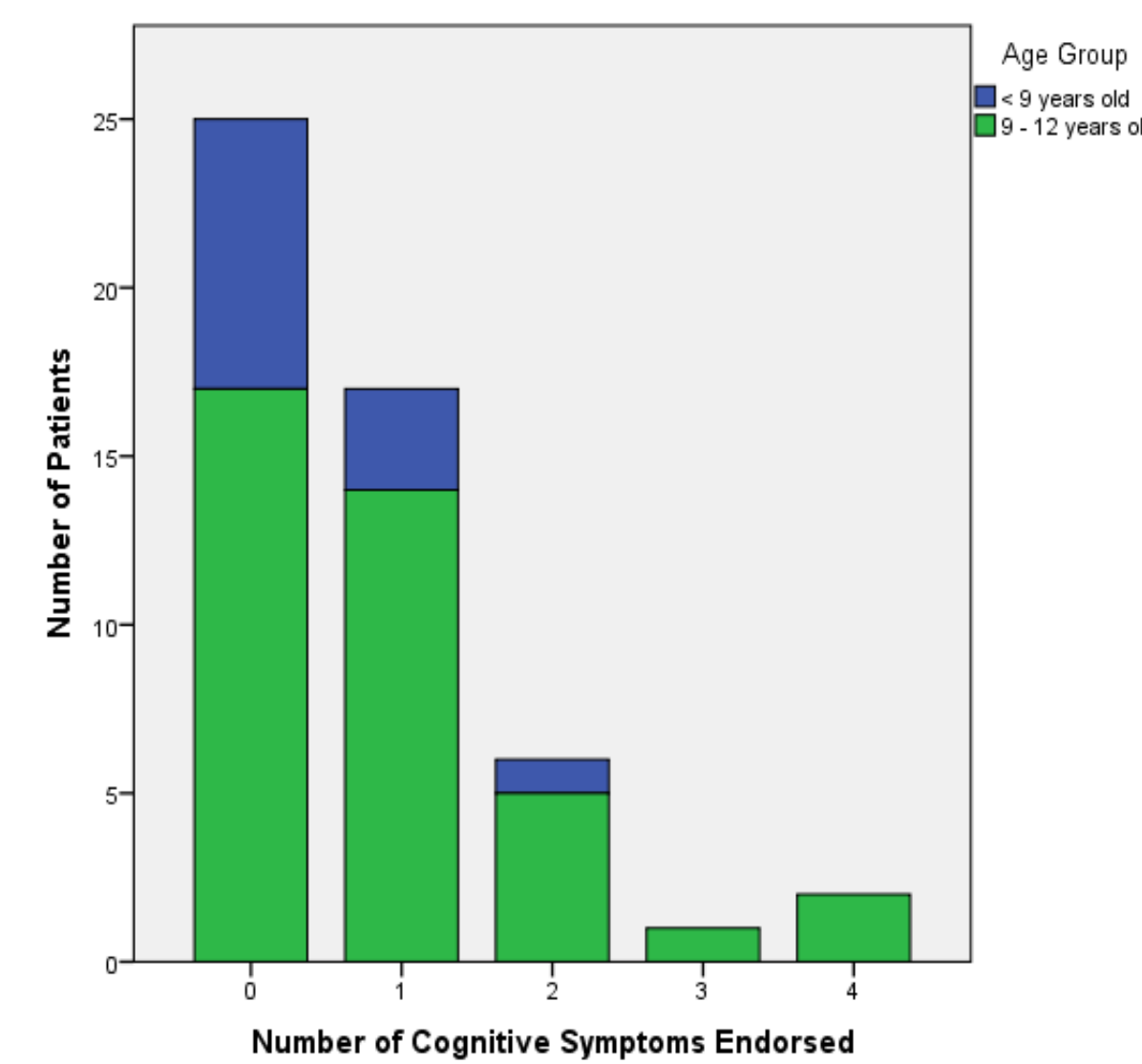
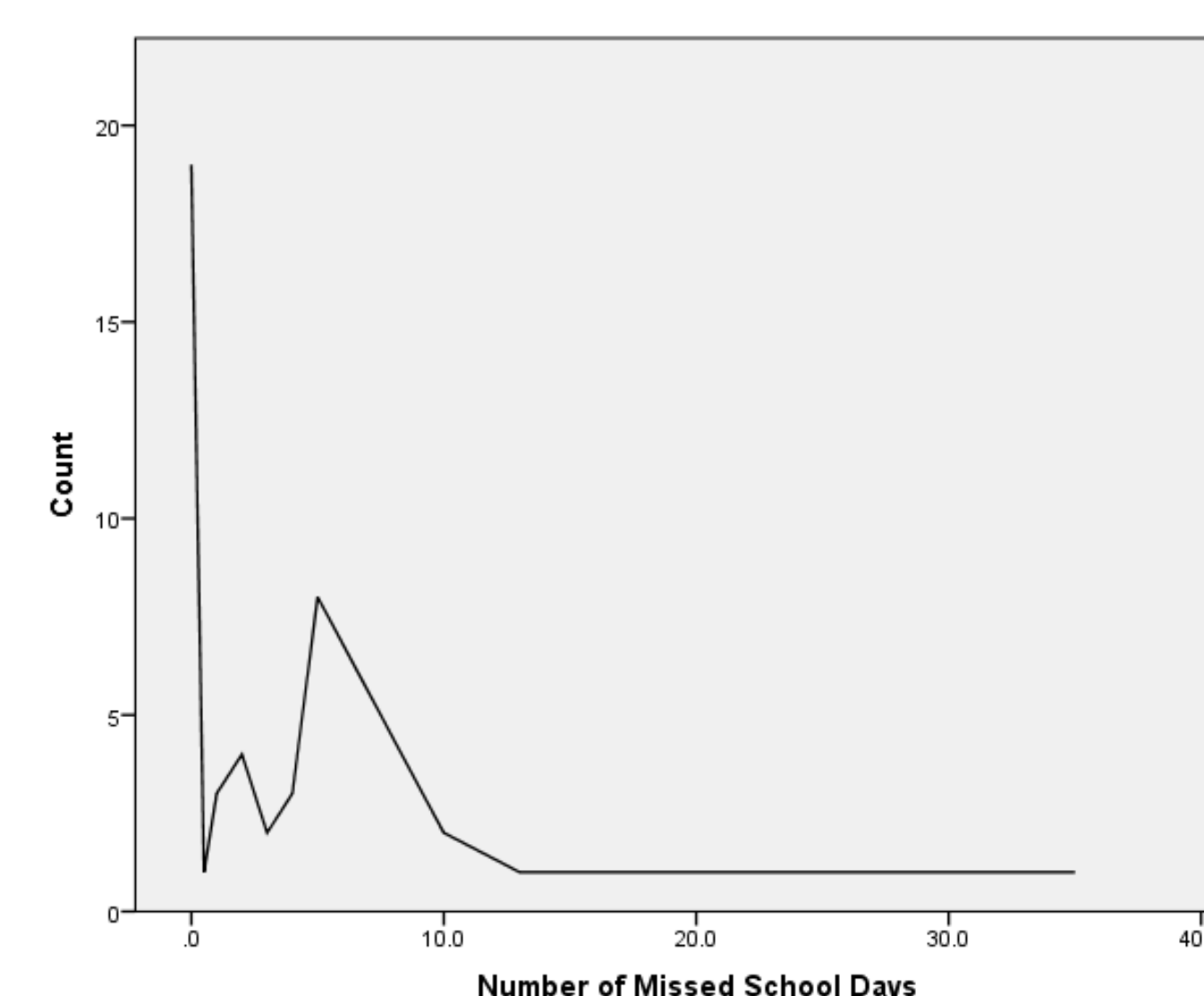


Figure Two
Number of Missed School Days



- At initial clinical evaluation:
 - 50% of patients endorsed at least one cognitive symptom (See Figure One).
 - 64% had missed at least one day of school (See Figure Two).
 - 34% had missed a week or more of school (See Figure Two).
- Mean scores for the overall sample fell within the average range for age on measures of initial and delayed verbal memory scores response speed, and executive functioning, although some individual patients displayed clinically significant deficits (See Table One).
- Pre-injury diagnosis of ADHD correlated with poorer performance on the WRAML-2 verbal learning recognition ($r=0.44$, $p=0.03$).
- Pre-injury history of Learning Disabilities correlated with poorer performance on the ACT Total ($r = 0.45$, $p=.007$) and D-KEFS letter fluency ($r = 0.40$, $p = 0.013$) and D-KEFS category fluency ($r = 0.37$, $p=.016$).
- Number of symptoms (cognitive or otherwise) and number of missed school days did not correlate with performance on neuropsychological testing.

Table One
Mean Performance on Neuropsychological Testing

	Descriptive Statistics		
	N	Mean	Standard Deviation
WRAML-2 Verbal Learning Immediate	46	9.5	2.5
WRAML-2 Verbal Learning Delayed	46	9.7	2.9
WRAML-2 Verbal Learning Recognition	44	9.8	3.6
WJ-III Math Fluency	37	102.6	18.2
ACT Total	34	98.8	13.8
DKEFS Letter Fluency	39	10.5	3.0
DKEFS Category Fluency	42	11.1	3.0

DISCUSSION

- The results of this clinical chart review provide a first look at the clinical presentation and neuropsychological performance of children less than 13 years old with concussion.
 - As a group, these patients presented as symptomatic and the majority missed at least one day of school, with a sizeable group missing at least a week of school.
 - While the group presented with largely average-range performance on selected neuropsychological measures, this is not surprising given that the acute neurocognitive effects of concussion are not expected to persist.
- It is unclear whether the average range performance displayed by the clinical sample as a whole represents a decrease from typical baseline functioning of this population given the high report of symptoms of cognitive dysfunction. Evaluation of their repeat testing after symptom resolution will be useful.
- A multi-disciplinary approach including neuropsychological and medical expertise is useful evaluate subjective symptoms, discern causes (cognitive and physical) and approaches to school difficulty following concussion and assist with school re-entry.
- These results also highlight the importance and need for prospective studies of pediatric populations with neurocognitive testing performed closer to the time of initial injury.
- Prospective studies examining performance of children on neurocognitive screening measures performed within 48-72 hours post-injury are essential, given this is the time thought to be most susceptible to neurometabolic disruption following mild TBI.
- The persistent symptoms of children who present to clinical specialist attention following concussion, may reflect the exacerbation of pre-injury risk factors, such as ADHD, learning disability, and anxiety/depression.

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