

# Lack of Specificity of Post-Concussive Symptoms and Correlation with Depressive Symptoms in Concussed and Non-Concussed Pediatric Patients

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## INTRODUCTION

- While there is no universally accepted list, post-concussive symptoms generally consist of somatic, cognitive, and affective complaints.
- Post-concussive symptoms are non-specific and occur at comparable or higher rates in non-concussed medical and psychiatric adult samples.
- We previously demonstrated that post-concussive symptoms are as common in concussed children as non-concussed children with neurologic/neurodevelopmental disorders.
- Depressive symptoms are frequently exacerbated by or emerge after concussion and are likely correlated with increased post-concussive symptoms, although causality has not been established in either direction for these associations.
- It is unknown if this relationship is unique to concussion or generalizes to other disorders.
- The purpose of this study was to examine the relationship between depressive symptoms and post-concussive symptoms in a pediatric concussed sample and separately in a non-concussed sample with neurologic/neurodevelopmental disorders, then compare the magnitude of the relationship between groups.
- We hypothesized that depressive symptoms would positively correlate with post-concussive symptoms comparably in each group.

## PARTICIPANTS & METHODS

### Participants:

- We initially identified 567 patients ages 8-18 years referred for neuropsychological evaluation from 2012-2018 who completed post-concussive symptom measures.
- Of those, 362 patients ages 13-18 years (i.e., 259 concussed and 103 non-concussed with other neurologic/neurodevelopmental disorders) completed both post-concussive and depressive symptom questionnaires.
- Children with other neurologic/neurodevelopmental disorders had conditions or a history of conditions such as epilepsy, extremely low birth weight, encephalitis, chromosomal abnormalities, etc.
- Patients with mild complicated, moderate, or severe traumatic brain injuries (TBI) were excluded.

### Measures:

- Postconcussion Checklist (Gouvier, Cubic, Jones, Brantley, & Cutlip, 1992): 37-item questionnaire assessing total number of post-concussive symptoms.
- Postconcussion Syndrome Checklist (Gouvier, Cubic, Jones, Brantley, & Cutlip, 1992): 30-item questionnaire assessing duration, intensity, and frequency (collectively referred to here as severity) of specific post-concussive symptoms.
  - "PCS" will be used hereafter to refer to the two checklists and does not denote Post-Concussion Syndrome.
- Beck Depression Inventory, 2nd Edition (BDI-II): 21-question multiple-choice self-report inventory of depressive symptoms.

### Statistics:

- Analyses were conducted using SPSS & JASP.
- Independent-samples t-tests were used to compare groups on age, PCS (total symptoms and severity), and BDI-II total (effect sizes: Cohen's *d*), while a chi-square test was used to compare sex between groups (effect size: Cramer's *V*).
- Pearson correlations were conducted between BDI-II total and PCS scores (total and severity) for the separate groups.
- Fisher r-to-z transformations were used to compare the sizes of the correlations between groups. Two-tailed *p*-values are reported.

## RESULTS

### Participants:

- The groups did not significantly differ on age (*p* = 0.09) or sex (*p* = 0.58). See Table 1.

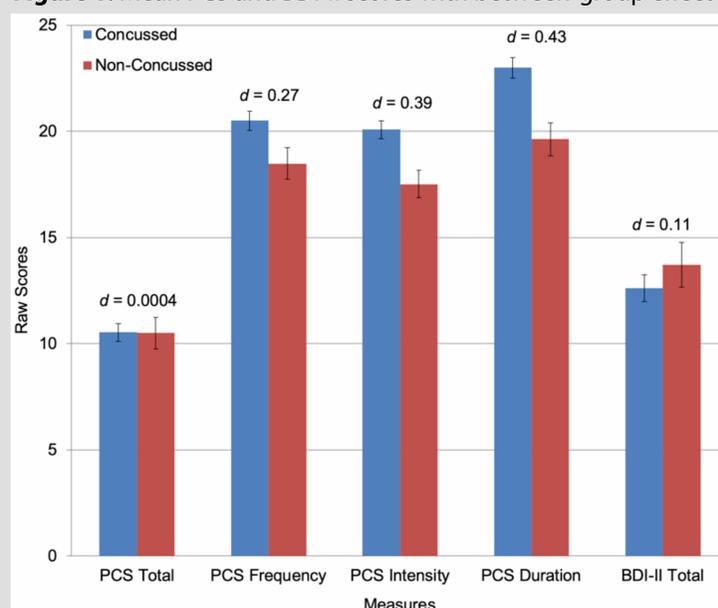
**Table 1.** Mean age and sex distribution

	Concussed (n = 259)	Non-Concussed (n = 103)	Effect Size
Age (years)	15.83 ± 1.46	15.51 ± 1.65	<i>d</i> = 0.21
Sex (% male)	55.21	51.96	<i>V</i> = 0.03

### Between-Group PCS & BDI-II Comparisons:

- The two groups did not differ on total PCS (*p* = 0.97) or BDI-II total (*p* = 0.35).
- The concussed group reported significantly greater frequency (*p* = 0.02), intensity (*p* = 0.001), and duration (*p* < 0.001) than the non-concussed group on the PCS. See Figure 1.

**Figure 1.** Mean PCS and BDI-II scores with between-group effect sizes.



### PCS & BDI-II Correlations and Comparisons:

- Pearson correlations between BDI-II total and PCS scores were generally large for both groups.
- Fisher r-to-z transformations showed that there were no significant differences between groups with regard to any correlation size. See Table 2.

**Table 2.** Correlations and r-to-z transformations.

	Concussed (n = 259)	Non-Concussed (n = 103)	z	p
	BDI-II Total	BDI-II Total		
PCS Total	r = 0.67	r = 0.63	0.59	0.55
PCS Frequency	0.64	0.62	0.28	0.78
PCS Intensity	0.64	0.62	0.28	0.78
PCS Duration	0.60	0.54	0.75	0.45

## CONCLUSIONS & IMPLICATIONS

- Findings support the lack of specificity of post-concussive symptoms.
- The relationship between post-concussive symptoms and depressive symptoms is equally strong in children with concussion and without concussion who have another neurologic/neurodevelopment disorder.
- Notably, children with concussion reported greater symptom severity (including duration) than non-concussed children with another neurologic/neurodevelopmental condition, despite many of the latter group's conditions being congenital or chronic.
- Present findings lend support to the notion that reliance on post-concussive symptoms to diagnose concussion provides no diagnostic specificity, presumes a causal relationship that may not exist, and often leads to delayed or missed treatment of mood symptoms.
- Athletic trainers, psychologists, and other providers should always assess depressive symptoms when post-concussive symptoms are assessed.
- The role of depressive symptoms in prolonged concussion recovery must be considered by all practitioners, particularly in the absence of quantifiable physical symptoms.

## LIMITATIONS & FUTURE DIRECTIONS

- The measures used to assess post-concussive symptoms in this study are somewhat dated.
- Correlations among other post-concussive symptom questionnaires, BDI-II, and other well-validated psychiatric measures should be studied in concussed and non-concussed samples.
- Complaints of prolonged post-concussive symptoms also may be heavily influenced by other psychiatric factors that remain to be explored (e.g., apathy, anxiety, family psychiatric history).
- Few studies have reported on pre-teens, and the relationship between post-concussive symptoms and depression should be investigated in younger concussed and non-concussed samples.

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