



Comparison of Post-Concussive Total Symptom Scores on ImPACT Testing by Demographic Data

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INTRODUCTION

Objective: To determine correlation between number of concussions and symptomatology and objective measures gathered from Immediate Post-Concussion Assessment and Cognitive Test (ImPACT) in the pediatric population.

METHODS

- Design: This is a retrospective cohort analysis of pediatric patients with identified history of concussion in January 2015 until August 1, 2016. Patient population was identified by presence of data in the ImPACT databases. Data review consisted of age, gender, education level, quality of student, performance on ImPACT testing, and total symptom score.
- Setting: Tertiary outpatient pediatric hospital
- Participants: Patient population includes ages 12 to 35 who presented to concussion clinic, were documented by rehabilitation providers of having a diagnosis of concussion, and received ImPACT testing.
- Level of evidence: Level III (Retrospective Comparative Study)

Sample questions from ImPact test

The ImPact test is administered at the start of a sports season to determine an athlete's baseline results, and again following a concussion to determine if his or her brain has recovered from the trauma. The memory and recognition tests, samples shown below, are conducted in conjunction with a general healthy history questionnaire and a survey of recent symptoms.

SYMBOL MATCHING
Evaluates visual processing speed, learning and memory

Click on the number that corresponds to the following symbols:

Symbols are shown with corresponding numbers. As a symbol is displayed below, the subject must click on the matching number above. After 27 matches, the subject must remember the correct symbol-number pairing.

DESIGN MEMORY
Evaluates attentional processes and visual recognition memory

Twelve designs are presented for 750 milliseconds, twice to facilitate learning. The subject is then shown a series of correct and incorrect designs and asked if each was displayed previously.

COLOR MATCH
Evaluates reaction time, impulse control/response inhibition

Some words are displayed in their matching color (e.g. RED appears in a red color) and some do not (e.g. BLUE appears in a green color). The subject is instructed to quickly click on the word box only if the word and color match.

RESULTS

After analyzing data from 356 patients, female gender was noted to be statistically significant ($p < 0.0001$) when comparing total symptom scores to male gender by Wilcoxon rank sums test. 186 females and 170 males and we found that the median symptom score of females and males were 23 (standard deviation ± 28.095) and 9 (standard deviation ± 23.460), respectively. No statistically significant differences were found regarding total symptom score with regard to age, presence of premorbid attention-deficit hyperactivity disorder, reported quality of student, or prior number of concussions.

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Exam Type	Baseline	Post-concussion	Post-concussion	Post-concussion	Post-concussion	Post-concussion						
Date Tested	09/21/2004	10/08/2004	10/12/2004	10/15/2004	10/19/2004	10/27/2004						
Last Concussion		10/07/2004	10/07/2004	10/07/2004	10/07/2004	10/07/2004						
Exam Language	English	English	English	English	English	English						
Test Version	2.2.729	2.2.729	2.2.729	2.2.729	2.2.729	2.2.729						
Composite Scores *												
Memory composite (verbal)	93	75%	66	1%	57	<1%	63	<1%	87	55%	88	55%
Memory composite (visual)†	70	23%	41	<1%	49	1%	47	<1%	55	3%	66	12%
Visual motor speed composite	45.88	85%	46.38	86%	40.13	65%	38.93	57%	45.85	85%	41.90	72%
Reaction time composite	0.54	46%	0.60	22%	0.66	6%	0.54	46%	0.62	15%	0.54	46%
Impulse control composite	8		14		10		16		10		11	
Total Symptom Score	0		14		3		1		0		0	

* Scores in bold type indicate scores that exceed the Reliable Change Index score (RCI) when compared to the baseline score. However, scores that do not exceed the RCI index may still be clinically significant. Percentile scores, if available, are listed in small type. Please consult your ImPACT User Manual for more details.

† Clinical composite score is available only for exams taken in ImPACT version 2.0 or later.

SUMMARY & CONCLUSION

Overall, our study found that female gender had higher total symptoms scores on ImPACT testing compared to males in the post-concussion population. Future studies may need more patients in sub-groups to determine if other contributors are equally significant. Concussions among the pediatric population is an important public health issue that should be addressed. In 2009, it was reported that 248,418 children were treated in U.S. Emergency Rooms for concussions, a number that has been on the rise [1]. While ImPACT testing has been used to identify neurocognitive impairments, the correlation with total symptom scores and psychosocial effects has not yet been explored. These symptoms include: headaches, dizziness, vertigo, mental dulling, confusion, impaired concentration, fatigue, irritability, and behavioral disturbances leading to a poorer quality of life [2]. We plan to use this study to gain a better understanding of how to aid children in returning to school by addressing their functional needs.

CREDITS/DISCLOSURE/REFERENCES

- 1 Centers for Disease Control and Prevention. Nonfatal Traumatic Brain Injuries Related to Sports and Recreation Activities Among Persons Aged ≤ 19 Years — United States, 2001–2009. MMWR 2011; 60(39):1337–1342. (http://www.cdc.gov/traumaticbraininjury/get_the_facts.html)
- 2 Bressan, Silvia et al. "Protocol for a Prospective, Longitudinal, Cohort Study of Postconcussive Symptoms in Children: The Take C.A.Re (Concussion Assessment and Recovery Research) Study." *BMJ Open* 6.1 (2016): e009427.PMC. Web. 2 Aug. 2016. (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4716210/>)
- 3 <http://www.josephmaroon.com/impact-concussion-testing/>
- 4 <http://akasport.org/blog/2016/7/25/concussions-and-sports-national-dizzy-balance-center>