



# The Risks of Sport Specialization in the Youth Population: A Critically Appraised Topic

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## INTRODUCTION

In recent years, due to a push from parents, coaches and society to play and compete at a higher level, sport specialization in the youth population has become more prevalent. Numerous risks are associated with early specialization, the most common being an increased risk of injury. Some rules are being put in place to decrease injury risk among athletes in youth athletics; however, there are no rules in place to prevent or limit youth athletes from specializing in one sport. For the purposes of this Critically Appraised Topic (CAT), sport specialization is being defined as training in a single sport year-round, with injuries including both chronic and acute injuries seen or reported to a health care provider. Unfortunately, using these operational definitions, many studies have found a correlation between sport specialization and injury risk.<sup>1-6</sup>

## CLINICAL QUESTION

Does sport specialization, in the youth population, increase the risk of sustaining an injury?

## METHODS

### Search Strategy

Terms Used in the Search Strategy (PICO)

- Patient: youth athletes
- Intervention: sport specialization
- Comparison: none
- Outcome: injuries (risk OR acute OR overuse OR burnout)

### Sources of Evidence Searched

- PubMed
- ProQuest Central
- SPORTDiscus
- CINAHL
- Google Scholar
- Hand Search

### Inclusion and Exclusion Criteria

Studies that were included examined the effects of sport specialization on injury risk in the youth population, were a Level II evidence or higher, of the English language, and limited to athletes under 18 years of age who specialized in one sport. Articles excluded were those that focused on burnout or triathletes, articles written prior to 2006, studies on those aged 19 or older, studies on multi-sport athletes and those manuscripts that presented recommendations rather than study data collected.

## RESULTS

Studies selected were considered to be the best evidence, had a Level of Evidence of 3 and PEDro scores ranging from 2 to 4 (Table 1). Articles selected presented odds ratios (OR), hazard ratios (HR), or relative risk (RR), p-values, and 95% confidence intervals (CI) to evaluate risk of injury or injury incidence associated with sport specialization. All six articles suggested that sport specialization, in youth athletes, increases the risk of injury.<sup>1-6</sup> Increased risk of injury was associated with both acute and chronic injuries.<sup>1-6</sup> The Centre for Evidence Based Medicine recommends that Level 3 articles with consistent results be given a recommendation grade of B.



## DISCUSSION

Sport specialization increases the risk of injury in youth athletes.<sup>1-6</sup> We recommend that sport specialization should be reduced in youth athletics and suggest the following strategies:

- Alter/restrict the training volumes linked to single sports
- Have certified Athletic Trainers oversee activities
- Educate parents & coaches on the risks of sport specialization, while encouraging communication between all parties
- Encourage youth athletes to participate in multiple sports

Future research should continue to examine upper and lower extremity injury risk, long-term effects of sport specialization (i.e. injuries, health complications) and the roles of proper sport technique and specialization on injury risk.

	Bell et al. (2016) <sup>1</sup>	Hall et al. (2015) <sup>2</sup>	Jayanthi et al. (2011) <sup>3</sup>	Jayanthi et al. (2015) <sup>4</sup>	McGuine et al. (2017) <sup>5</sup>	Post et al. (2017) <sup>6</sup>
<b>PARTICIPANTS</b>	302 high school athletes (180 females, 122 males) aged 13-18 years	546 female basketball, soccer, and volleyball players	540 USA junior tennis players, aged 10-18 years from local Midwest tennis clubs	1190 (368 uninjured, 822 injured), aged 7-18 years from 2 hospital-based sport medicine clinics	1544 high school participants who were able to in team activities on the 1 <sup>st</sup> day of practice (grades 9-12; 50.5% female; mean age 16.1 ± 1.1 years)	2011 youth athletes around Wisconsin (989 female and 1022 male; 12-18 years of age)
<b>OUTCOME MEASURE(S)</b>	Prevalence and influences of specialization; reported history of lower extremity injuries (LEI) in highly specialized athletes	Relative risk factor; increased risk of anterior knee pain in female athletes	Injury development or medical withdrawal of tennis players from a tournament during the competition season (due to weekly practice volume, annual months competing, level of specialization)	Total injuries; acute injuries; overuse injuries; serious overuse injuries	Incidence of LEIs, group proportions, odds ratios, 95% CIs, and days lost due to injury; Multivariate Cox proportional hazard ratios with 95% CIs to investigate the association between the incidence of LEIs and sport specialization levels	Odds of reporting any previous injury associated with level of specialization
<b>MAIN RESULTS</b>	Highly specialized athletes are more likely to report a history of knee (OR, 2.32; 95% CI, 1.22-4.44; P = .009) and hip (OR, 2.74; 95% CI, 1.09-6.86; P = .026) injuries when participating in a single sport for more than 8 months per year	Specialization in a single sport increased the relative risk of patellofemoral pain 1.5 fold (CI, 1.0-2.2; P = .038), and 4 fold (CI, 1.5-10.1; P = .005) for developing apophyseal knee injuries or patellar tendinopathy than multi-sport athletes.	Athletes who specialized in tennis were more likely to report an injury in the last year (OR 1.55, p < .05), while those who had higher practice volumes were more likely to sustain an injury (OR 1.5, p < .04).	Sports-specialized training was an independent risk factor for injury (OR, 1.27, 95% CI, 1.07-1.52; P < .01). Youth athletes participating in more hours of sports per week had higher odds of experiencing overuse injury (OR, 1.87, 95% CI, 1.26-2.76, P < .01)	Athletes classified as high or moderate specialization had an 85% and 51% higher incidence of lower extremity injuries, respectively, compared to those with low specialization (HR, 1.85, 95% CI, 1.12-3.06, P = .02; HR, 1.51, 95% CI, 1.04-2.20, P = .03). 235 participants sustained a total of 276 LEIs that caused them to miss a median of 7 days	The odds of reporting a previous injury were significantly higher among highly specialized athletes compared to the low specialization category (OR, 1.59; 95% CI, 1.26-2.02, P < .001). Similar findings were noted for overuse injuries (OR, 1.45; 95% CI, 1.07-1.99, P = .011).
<b>LEVEL OF EVIDENCE</b>	3	3	3	3	2	3
<b>CONCLUSIONS</b>	Single sport athletes had an increased injury risk of LEI.	Early sport specialization was associated with increased risk of anterior knee pain disorders compared with multisport athletes.	Players who specialized in tennis were more likely to report a previous injury. Players who suffered an injury in the last year had a higher risk of future tournament withdrawal.	Sport specialization served as an independent risk factor of injury or serious overuse injury in youth athletes	Athletes who were classified as either moderately or highly specialized were more likely to sustain a LEI than those who were classified as low specialization.	High levels of specialization were associated with a history of injuries, independent of age, sex, and weekly organized volume.

## REFERENCES

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# THE EFFECTS OF ADHD AND LEARNING DISABILITIES ON SPORT-RELATED CONCUSSION NEUROCOGNITIVE BASELINE TESTING IN HIGH SCHOOL STUDENT-ATHLETES: A CRITICALLY APPRAISED TOPIC

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Sport-Related Concussion  
Research Lab

## INTRODUCTION

One out of every ten injuries sustained in high school athletic programs is a sport-related concussion (SRC).<sup>1</sup> A concussion is a complex pathophysiological process affecting the brain that is induced by traumatic biomechanical forces.<sup>2</sup>

- Computerized neurocognitive testing is one component of the multifaceted approach used to manage a SRC.
- The ImPACT is a common computerized neurocognitive test used to manage SRC that assesses verbal memory, visual memory, visual motor, and reaction time (Figure 1).

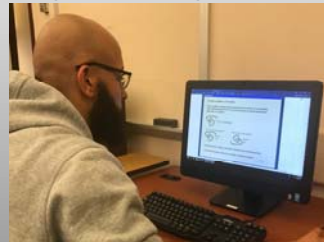
Developmental, behavioral, and learning disorders have emerged as disabling health conditions that affect one in six children in the United States.<sup>3</sup>

- A recent international consensus statement indicated that developmental conditions may influence the diagnosis, management, and return to play outcomes following SRC.<sup>2</sup>
- Computerized neurocognitive tests typically fail to accommodate to those with neurological impairments such as athletes with attention-deficit disorder (ADHD) and/or a learning disorder (LD).

## CLINICAL QUESTION

Do high school student-athletes with ADHD and/or a LD perform similarly or different compared to those without ADHD or a LD on baseline computerized neurocognitive tests?

Figure 1: Athlete taking the ImPACT



## METHODS

### Terms Used to Guide Search:

- Patient/Client group: High school athletes
- Intervention/Assessment: ADHD and/or LDs
- Comparison: No ADHD and/or LD
- Outcome: Neurocognitive Baseline Test Scores (ImPACT)

### Sources of Evidence Searched :

PubMed, Medline, SPORTDiscus

### Inclusion Criteria:

- High School Athletes
- History of ADHD, LD, or both
- Between the ages of 13-19
- Valid ImPACT baseline test
- Written in English

### Exclusion Criteria:

- Middle school, collegiate, and/or recreational athletes
- Invalid baseline scores (>30 on ImPACT)

## RESULTS

The literature search returned 10 possible studies related to the clinical question, but only 5 studies<sup>1,3,4,5,6</sup> were included as they meet the inclusion and exclusion criteria (Table 1).

- Three studies<sup>1,4,6</sup> compared subjects with ADHD to a control (i.e. no ADHD) group, while the remaining 2 studies<sup>3,5</sup> compared control, ADHD only, LD only, and combination ADHD/LD groups.
- High school student-athletes with ADHD and/or a LD performed significantly worse on 1 or more baseline ImPACT neurocognitive composite variables compared to high school student-athletes without ADHD and/or a LD.<sup>1,3,4,5,6</sup>
- High school student-athletes with ADHD and/or a LD endorsed significantly more symptoms at baseline compared to high school student-athletes without ADHD and/or a LD.<sup>1,3,4,5</sup>

## DISCUSSION

High school student-athletes that have ADHD and/or a LD are predisposed to lower baseline computerized neurocognitive scores compared to the those without ADHD or a LD. This predisposition brings forth numerous problems with using general population normative baseline scores for post-injury comparisons and return to play decision-making with these special populations.

### CLINICAL IMPLICATIONS

- It is imperative that pre-season neurocognitive concussion baseline tests be collected for student-athletes with ADHD and/or a LD in order to provide an accurate pre-injury cognitive ability measurement for these individuals.
- Without an personalized baseline score for this special population, recovery times may be increased as they would appear to be impaired for longer when compared post-injury to the general population normative values.
- This unintentional increase in time loss from sport could lead to adverse psychological effects, such as anxiety and depression, that accompany prolonged recovery times.

Future research should focus on tailoring return to play SRC management plans for athletes with ADHD and/or a LD.

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Table 1. Characteristics of Included Articles

	Brooks et al. <sup>1</sup>	Cook et al. <sup>4</sup>	Elbin et al. <sup>5</sup>	Salinas et al. <sup>6</sup>	Zuckerman et al. <sup>3</sup>
<b>STUDY DESIGN</b>	Cohort Study	Cross-sectional Study	Cross-sectional Study	Cohort Study	Case Control Study
<b>PARTICIPANTS</b>	698 high school student-athletes	36,549 high school student-athletes	2,377 high school varsity athletes	512 high school athletes	6636 high school athletes
<b>INTERVENTION(S)</b>	Boys with ADHD (n=249) Control Boys (n=249) Girls with ADHD (n=100) Control Girls (n=100)	ADHD medication (n= 764) ADHD no medication (n=1,530) Control (n=34,255)	ADHD only (n=882) LD only (n=396) Combined ADHD/LD (n=161) Control (n=938)	ADHD (n=256) Control (n=256)	ADHD only (n=262) LD only (n=90) Combined ADHD/LD (n=55) Control (n=407)
<b>OUTCOME MEASURE(S)</b>	ImPACT scores and symptoms reporting	ImPACT scores and symptoms reporting	ImPACT scores and symptom reporting	ImPACT scores	ImPACT scores and symptom reporting
<b>MAIN RESULTS</b>	Boys with ADHD had significantly worse performance than boys without ADHD on the reaction time composite ( $p=.005$ , Cohen's $d=0.27$ ).  Girls with ADHD when compared to controls showed decreased visual motor speed ( $p=.001$ , $d=.57$ ) at baseline.  Both boys ( $p<.001$ , $d=0.26$ ) and girls ( $p<.001$ , $d=0.44$ ) with ADHD reported significantly more symptoms at baseline compared to those without ADHD. • Boys: cognitive-sensory, sleep-arousal • Girls: cognitive-sensory, sleep-arousal, affective symptoms	ANOVAs and post-hoc results found: • Girls in the ADHD no medication group differed from controls on Reaction Time ( $d = .29$ ). • Girls in the ADHD no medication group performed worse compared to the ADHD medication group and controls ( $d$ ranging from .32 to .42) on the visual motor speed composite • The ADHD/Medication group did not differ meaningfully from Controls on any composite, for either sex ( $d$ ranging from 0 to .19).  The ADHD no medication group (girls: $d = .56$ ; boys: $d = .33$ ), ADHD medication group (girls: $d = .63$ ; boys: $d = .42$ ) both differed significantly and reported more severe symptoms compared to control subjects [girls: $F(3, 17,885) = 139.16$ , $p < .001$ ; boys: $F(3, 21,354) = 106.76$ , $p < .001$ ].	The results of a series of ANCOVAs (co-varied for age) with Bonferroni correction for multiple comparisons revealed significant differences between the four groups on verbal [ $F(3, 2,372) = 11.02$ , $p=.001$ , $\eta^2=0.014$ ] and visual [ $F(3, 2,372) = 11.59$ , $p=.001$ , $\eta^2=0.014$ ] memory, visual processing speed [ $F(3, 2,372) = 7.16$ , $p=.001$ , $\eta^2=0.08$ ], reaction time [ $F(3, 2,372) = 37.61$ , $p=.001$ , $\eta^2=0.05$ ], and total symptoms [ $F(3, 2,372) = 16.27$ , $p=.001$ , $\eta^2=0.02$ ].  Post hoc comparisons revealed that the control group demonstrated significantly higher performance on all ImPACT composite scores and reported fewer baseline symptoms than the LD, ADHD, and LD/ADHD groups.	Athletes with ADHD performed significantly worse when compared to controls on verbal memory [ $F(5, 506) = 9.1$ , $p=.003$ ], visual motor [ $F(5, 506) = 4.49$ , $p=.035$ ], and impulse control [ $F(5, 506) = 21.9$ , $p<.001$ ] ImPACT composite scores. No significant differences were found for visual memory [ $F(5, 506) = 3.54$ , $p=.061$ ] or reaction time [ $F(5, 506) = 3.65$ , $p=.057$ ].  It was also reported that high school athletes with ADHD were nearly twice as likely to have sustained a previous concussion (ADHD 14%; non-ADHD 7.8%) compared to those without ADHD.	Significant differences in mean baseline ImPACT composite scores between those with ADHD only and those with no history of LD or ADHD were found for all 6 composite scores ( $p<.001-.008$ ).  Significant differences in scores between those with LD only and those with no history of LD or ADHD were found for all composite scores except for impulse control ( $p=0.321$ ).  Significant differences were found for visual motor speed ( $p<.001$ ), reaction time ( $p=.002$ ), and total symptom scores ( $p<.001$ ) between those with combined ADHD/LD and those without ADHD and/or LD.
<b>LEVEL OF EVIDENCE</b>	3	2	2	3	4
<b>CONCLUSIONS</b>	Clinicians and amateur athletic programs need to be aware that having attention problems is associated with decreased scores on ImPACT domains and with more symptoms being endorsed at baseline.	Medication use had only a subtle effect on cognitive performance and no significant effect on concussion-like symptom reporting. Athletes reporting medication use for ADHD performed comparably to those with no ADHD.	Individualized computerized neurocognitive baseline data for high school student-athletes with LD, ADHD, or combined LD/ADHD should be used when evaluating SRCs as these groups have lower baseline scores than the general population.	ADHD status was related to a greater likelihood of having a concussion history and lower performance scores on baseline neurocognitive tests in comparison with peers without ADHD.	Having ADHD and/or LD is associated with significantly different baseline ImPACT scores on all neurocognitive parameters. Baseline normative ImPACT data for adolescents with ADHD and/or LD is needed.