

Sport Specialization and Risk of Overuse Injuries: A Systematic Review With Meta-analysis

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abstract

CONTEXT: Sport specialization is theorized to increase the risk of sustaining overuse musculoskeletal injuries.

OBJECTIVE: To complete a systematic review and meta-analysis of the literature to determine if sport specialization is associated with overuse musculoskeletal injuries.

DATA SOURCES: An electronic search was conducted using the search terms “specialization,” “year-round,” “overuse,” “repetitive stress,” “injury,” “young,” “pediatric,” and “sports.”

STUDY SELECTION: Studies were included if their population was ≤ 18 years of age, if they compared athletes with high or single-sport specialization with athletes with low or multisport specialization, and focused on overuse injuries.

DATA EXTRACTION: Of the 12 articles that were identified for full-text review, 5 studies met all the inclusion criteria. Four studies provided adequate data for the meta-analysis. Quality scores on the modified Downs and Black scale ranged from 69% to 81%.

RESULTS: Athletes with high specialization were at an increased risk of sustaining an overuse injury compared with athletes with low (pooled relative risk [RR] ratio: 1.81; 95% confidence interval [CI]: 1.26–2.60) and moderate (pooled RR: 1.18; 95% CI: 1.05–1.33) specialization. Athletes with moderate specialization were at a higher risk of injury compared with athletes with low specialization (RR: 1.39 [95% CI: 1.04–1.87]).

LIMITATIONS: Four of the 5 studies included in this systematic review were included in the meta-analysis because of the lack of access to the original data set for 1 article.

CONCLUSIONS: Sport specialization is associated with an increased risk of overuse musculoskeletal injuries (Strength of Recommendation Taxonomy grade: B).



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Participation in youth sports offers a number of benefits to children and adolescents, including improving fitness, academic performance, and self-esteem.^{1,2} However, recent evolution of youth sports has shifted focus from these positive attributes to concerns regarding scholarships and playing time,³ resulting in young athletes focusing on a single sport at a high volume or specializing in 1 sport. Sport specialization is commonly defined as “participation in a single sport at the exclusion of other sports.”⁴ Sport specialization is often associated with training at high volumes both in terms of hours per week and months per year and can result in a variety of negative consequences, such as burnout and overtraining.^{1,5} This topic is so concerning that several medical and sport organizations have released statements warning against the increasing trend toward sport specialization among youth.⁵⁻⁹

These statements address concerns regarding the psychological impact of sport specialization and possible physical consequences, including the potential risk of overuse musculoskeletal injuries.⁵⁻⁹ These injuries are problematic because physical activity or sport-related injuries account for up to 20% of injury episodes for persons between 5 and 24 years of age.¹⁰ Additionally, in recent data, the annual direct and indirect cost of adolescent athletic injuries is estimated to be at \$6.7 billion (US Consumer Product Safety Commission; Directorate of Economic Analysis, personal communication, 2006). However, this number may underestimate the total impact of overuse injuries, which often go unreported.¹¹ Finally, and perhaps most importantly, sustaining an injury has been linked with dropout from sport with slightly <10% of youth athletes who cease participation in sports doing so as a result of injury or fear of reinjury.^{12,13} Among elite youth athletes, the rate of dropping out

TABLE 1 Search Terms and Number of Articles Generated

Search Terms (Including MeSH Terms)	Reference Database	No. Identified Studies
1. (Specialization or specialization or single-sport or y-round)	EBSCO-CINAHL	7267
	Medline (Ovid)	41 719
	PubMed	41 739
	EBSCO-SPORTDiscus	2749
2. (Specialization or specialization or single-sport or y-round) AND (overuse OR injury OR chronic OR gradual onset OR repetitive stress)	Cochrane	81
	EBSCO-CINAHL	477
	Medline (Ovid)	1401
	PubMed	1879
3. (Overuse OR injury OR chronic OR gradual onset OR repetitive stress) AND (young OR youth OR pediatric OR high school OR child* OR adolescent)	EBSCO-SPORTDiscus	195
	Cochrane	55
	EBSCO-CINAHL	412
	Medline (Ovid)	380
4. (young OR youth OR pediatric OR high school OR child* OR adolescent) AND (athlete OR athletes OR sports)	PubMed	533
	EBSCO-SPORTDiscus	106
	Cochrane	53
	EBSCO-CINAHL	87
	Medline (Ovid)	73
	PubMed	108
	EBSCO- SPORTDiscus	98
	Cochrane	12

because of injury is close to 20% and represents the second most common reason to cease sport participation.¹²

Despite a number of recent publications in which the impact of specialization on overuse injury was investigated, the position and consensus statements that have been released to date have relied on expert opinion and not empirical evidence.⁵⁻⁹ Therefore, we believe that a more focused review of the literature is warranted. Our purpose in this study was to systematically review the literature to determine if sport specialization is associated with an increased risk of musculoskeletal overuse injuries. The following specific clinical question of interest framed our analysis: “Are highly specialized youth athletes at a greater risk of overuse injury compared to low specialization youth athletes?”

METHODS

This systematic review was completed in accordance with the guidelines from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses. The systematic review was registered in

PROSPERO (<https://www.crd.york.ac.uk/prospero/>) before beginning the search (registration number: CRD42017078750).

Data Sources and Searches

An electronic search was conducted in 5 databases, including the Cochrane Database of Systematic Reviews, EBSCO-hosted Cumulative Index to Nursing and Allied Health Literature (CINAHL), EBSCO-hosted SPORTDiscus, Educational Resources Information Center (ERIC), EBSCO-hosted Medline, and PubMed Central. The search terms included (specialization or specialization or single-sport or year-round) AND (overuse OR injury OR chronic OR gradual onset OR repetitive stress) AND (young OR youth OR pediatric OR high school OR child* OR adolescent) AND (athlete OR athletes OR sports). The authors also conducted a hand search from reference lists in other relevant articles. Results from the search strategy for each database are presented in Table 1.

Study Selection

All search results were transcribed into an Excel file, and the database

was sorted to find duplicates, which were removed. An initial screen of the titles and abstracts was performed by 4 of the authors (D.R.B., E.G.P., K.B., T.V.M.) independently and recorded in an Excel file. A meeting was held to discuss any studies for which consensus on inclusion was not obtained. During that meeting, a final list of studies to undergo full-text review was determined. Each of the authors independently completed a full-text review of the remaining manuscripts. A second meeting was held to discuss any studies that did not have consensus regarding inclusion. The final list of included studies was then moved to the data extraction phase.

Studies were included if they were peer-reviewed, published in English, published in the year 2000 or later, were original research, and included patients or participants ≤ 18 years of age. Excluded studies consisted of narrative (clinical) reviews, editorials, critically appraised topics, commentaries, abstracts, animal research, or original research that did not address the primary clinical question of interest.

Data Extraction and Quality Assessment

The authors, journal, year of publication, sample demographics, level of evidence, study period, type of sports examined, outcome measures (specialization and overuse injury rates), type of injuries examined, and main results (odds ratios or relative risk [RR] ratios with 95% confidence intervals [CIs] and *P* values) were extracted as appropriate from each study on a standard data collection form. Because many of the studies included primary and secondary outcomes, extraction of the outcomes and presentation of the results were limited to only those outcomes that fit the clinical question of interest (overuse injuries). Studies were assigned a level of evidence as

outlined by the 2011 Oxford Centre for Evidence-Based Medicine scale. The risk of bias was assessed by using the adapted Downs and Black scale, which is a 16-item version of the original Downs and Black Quality Index.^{14,15} The recommendations of Munn et al¹⁶ were used to evaluate the quality of the included studies. Studies that met fewer than 60% of the adapted Downs and Black criteria were considered to be of low methodologic quality, studies that met 60% to 74.9% of the criteria were considered to be of moderate methodologic quality, and studies that met $>75\%$ of the criteria were considered to be of high methodologic quality (Table 2).¹⁶ The Strength of Recommendation Taxonomy criteria were used to determine an overall recommendation on the basis of the findings of the included studies.¹⁷

Data Synthesis and Analysis

A narrative, qualitative synthesis of results was performed to evaluate and summarize the patients, methods, results, and conclusions of the included studies. A summary table was developed to present the results of these 5 included studies (Table 2).

Four of the 5 studies provided sufficient data for use in a meta-analysis. For 3 studies, logged RRs and SEs were calculated from data that were provided in the manuscripts. For 1 study, the authors provided raw data to allow for calculation of RRs and SEs. Three analyses were conducted: between low and moderate specialization, low and high specialization, and moderate and high specialization. The heterogeneity of the studies was assessed by using the I^2 index. MIX 2.0 Professional²³ was used to combine effect sizes across studies. A DerSimonian-Laird random-effects-model approach was selected for the analysis.

RESULTS

Results of Search

The results of the search are presented in Fig 1. The extensive literature search resulted in 381 potential studies. After the removal of 184 duplicates that were found across databases or with different search terms, 197 studies remained and were screened to meet the inclusion and exclusion criteria. After screening the titles and abstracts, 185 studies were removed (62 narrative reviews, 7 commentaries, 3 editorials, 2 case studies, 1 news article, 1 non-peer-reviewed article, 5 non-English articles, 5 consensus or position statements, 17 articles that were published before the year 2000, and 82 articles that were not relevant to the clinical question; Supplemental Table 3), leaving 12 articles for a full text evaluation. The application of the inclusion and exclusion criteria during the full-text review resulted in the exclusion of 7 studies. Two studies were removed because they were not explicitly focused on overuse injury,^{24,25} 1 was removed because the comparison was between athletes with high specialization in team sports and athletes with high specialization in individual sports,²⁶ 1 was removed because the authors did not directly compare specialized and nonspecialized groups and the measurement of specialization was not clearly defined,²⁷ and 3 studies were removed because the athletes fell outside of the established age range,^{28–30} leaving 5 studies from which data were abstracted and synthesized in the results.

Qualitative Review of the Articles

A summary of the final studies is found in Table 2. Of the studies that were identified, 1 study was a prospective investigation and 4 studies were retrospective investigations. The injury outcomes of interest included patellofemoral pain,¹⁹ overuse knee injuries,¹⁸ overuse lower extremity injuries,²¹

TABLE 2 Summary of High Specialization and Overuse Injury Rates Across Studies

Study	N	LOE	Adjusted Downs and Black Score, %	Study Period, mo	Type of Sport(s)	Age, Mean (SD)	Sex, n (%)	High Specialization, %	Injured for High Specialization, %	Type of Injury	OR (95% CI)	P
Bell et al ¹⁸	302	3	69	NR	Soccer, basketball, tennis, and women's volleyball	15.5 (1.2)	Female: n = 180 (59.6); male: n = 122 (40.4)	36.4	10.9	Overuse, knee injury	2.93 (1.16–7.36)	.018
Hall et al ¹⁹	546	NR	78	NR	Women's volleyball, soccer, and basketball	14.0 (NR)	Female: n = 546 (100)	34.6	28	Patellofemoral pain	1.5 (1.0–2.2)	.038
Jayanthi et al ²⁰	1214	3	75	36	NR	13.7 (2.3)	Female: n = 587 (49.3); male: n = 603 (50.7)	28.1	11.0	Serious overuse injury	1.36 (1.08–1.72)	<.001
McGuine et al ²¹	1544	2	81	12	Baseball, softball, basketball, football, soccer, tennis, track and cross country, volleyball, wrestling, and other	16.1 (1.1)	Female: n = 780 (50.5); male: n = 764 (49.5)	13.3	4.6	Lower extremity overuse injuries	4.74 (2.04–11.05)	<.001
Post et al ²²	2011	3	75	NR	Soccer, basketball, swimming and diving, ice hockey, volleyball, track and cross country, lacrosse, baseball, football, softball, cheer and dance, gymnastics, tennis, and wrestling	13.7 (1.6)	Female: n = 989 (49.1); male: n = 1022 (50.9)	37.5	19.2	Overuse injury	1.45 (1.07–1.99)	.011

LOE, level of evidence; NR, not reported; OR, odds ratio.

and overuse injuries of any type.^{20,22} Sport specialization status was classified on the basis of self-report of the number of sports played (single versus multisport)¹⁹ or a sport specialization scale. Four studies included a variety of sports (soccer, basketball, and volleyball), whereas 1 study²⁰ did not include the sports of the athletes in the study. Four of the studies were focused on both sexes, whereas 1 study¹⁹ only included girls.

Overall, in all 5 studies, a significant association between high levels of sport specialization and overuse injury was observed. In a retrospective study of high school athletes, Hall et al¹⁹ observed that athletes of a single sport were more likely to have a diagnosis of patellofemoral pain compared with athletes of multiple sports. When applying the 3-point specialization scale to high school athletes, Bell et al¹⁸ found that athletes with high specialization were more likely to have a previous history of overuse knee injury when examined in a cross-sectional manner. In 2 similarly designed studies of large samples of youth athletes, both Jayanthi et al²⁰ and Post et al²² observed associations between high levels of specialization and overuse injury. In the only prospective study, McGuine et al²¹ established high levels of specialization to be a prospective risk factor for overuse lower extremity injury but not for acute injuries.

Pooled Estimates

Participants who were categorized as highly specialized were at a significantly greater risk of overuse injury compared with participants who were categorized as moderately specialized (RR: 1.18 [95% CI: 1.05–1.33]; $I^2 = 0\%$; analysis sample size = 3005) and participants with low specialization (RR: 1.81 [95%

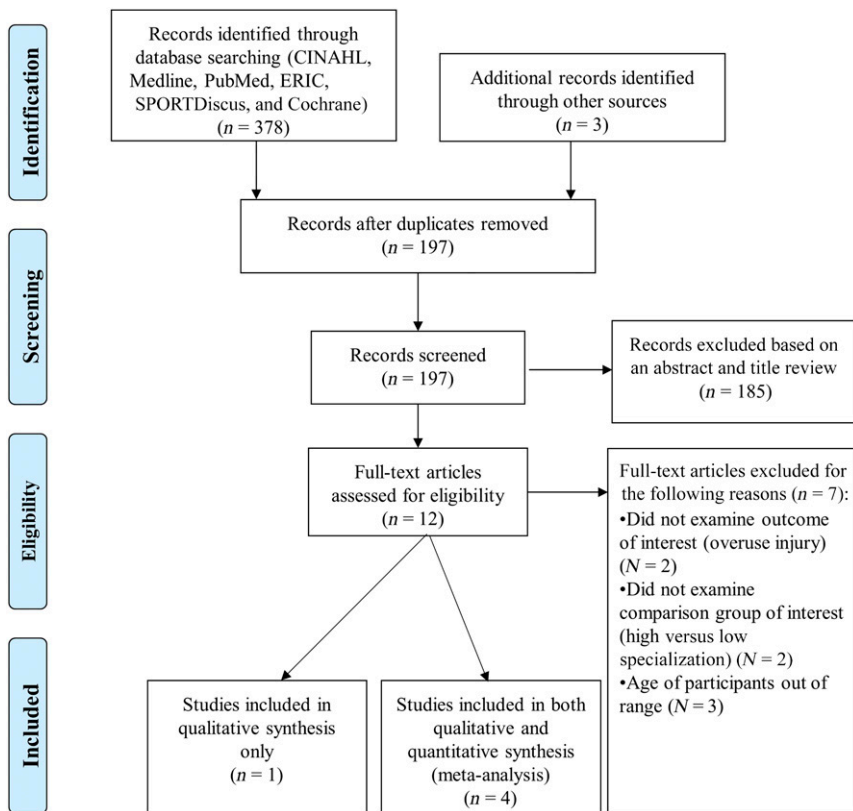


FIGURE 1 Flowchart of the articles that were reviewed for inclusion.

CI: 1.26%–2.60%]; $I^2 = 77.15\%$; analysis sample size = 3342). Those with moderate specialization were at a significantly higher risk of overuse injury compared with those with low specialization (RR: 1.39 [95% CI: 1.04–1.87]; $I^2 = 64.32$; analysis sample size = 3601). Forest plots for each analysis are provided in Figs 2–4.

Level of Evidence and Strength of Recommendation

The current review included 3 studies that were of level III evidence, 1 study that was of level II evidence, and 1 study that was of level IV evidence. By using the adjusted Downs and Black metric, 4 studies were considered to be of high methodologic quality, whereas 1 study was considered to be of moderate methodologic quality. On the basis of the level of evidence of the included studies, the Strength of Recommendation Taxonomy

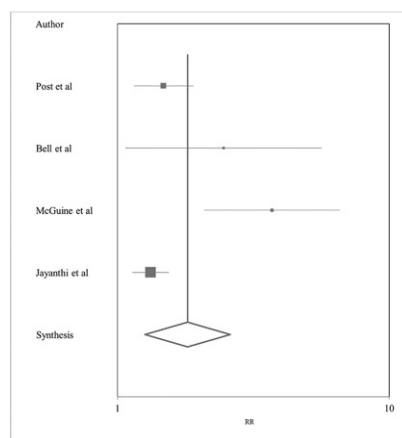


FIGURE 2 Pooled RR of high specialization versus low specialization.

criteria level of recommendation was B. Although there were consistent findings that sport specialization increased the risk of overuse injury across studies, there were not enough studies of level II evidence or stronger included in our review to allow us to provide a recommendation of A.¹⁷

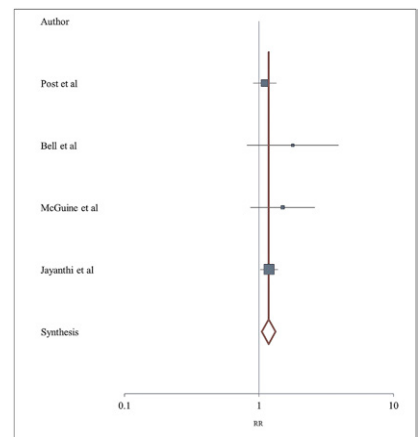


FIGURE 3 Pooled RR of high specialization versus moderate specialization.

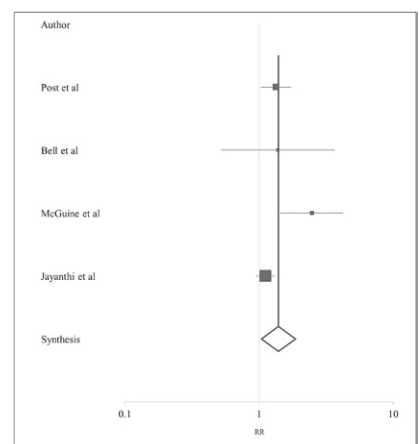


FIGURE 4 Pooled RR of moderate specialization versus low specialization.

DISCUSSION

The results of this systematic review reveal that although there is consistent evidence suggesting that high level of sport specialization is associated with a greater risk of developing an overuse injury, the quality of included studies is limited. This evidence is based on the 5 studies that were identified in the review. These studies yielded consistent results and were supported by the meta-analysis of 4 studies in which pooled estimates were calculated. Athletes with high specialization were nearly twice as likely to sustain an overuse injury compared with athletes with low

specialization (81% more likely) and even moderate specialization (18% more likely). Even moderate specialization appears to be associated with a greater risk of injury than low specialization (39% more likely). These results revealed a stepwise increase in risk with increasing levels of specialization.

Clinically, the results of this review are important because they provide evidence to support the notion that sport specialization increases injury risk. There is a large number of clinical reports and position statements that warn against this practice despite the limited evidence in this area.^{1,5-7,9} In fact none of the position and/or summary statements that are listed promote or endorse sport specialization. Our review supports the recommendation that athletes should delay specialization until late adolescence.⁶ Specialization has been proposed as a mechanism for attaining elite sport performance because of increased time spent in intensive training for that sport.³¹ However, comparisons of elite and nonelite athletes and studies of professional or collegiate athletes across a variety of sports indicate that elite athletes typically specialize later in adolescence and participate in more sports during high school than nonelite athletes.³²⁻³⁵ Medical providers and researchers believe that diversified training during early adolescence results in a more well-rounded athlete.^{1,5,7,36} Finally, 4 of the studies that are included in this review use a recently developed scale to classify athletes along a spectrum of specialization.^{4,20} This scale has high clinical utility given the simplicity of application. Physicians and other health care providers should consider using this specialization scale to classify their patients and help counsel youth athletes and their parents regarding the possible risks of specialization.

The findings of our systematic review and meta-analysis are in general

agreement with a previous review on this topic area by Fabricant et al.³⁷ The authors of that review also concluded that there was level B evidence to support the association between sport specialization and increased injury risk. The key difference between that review and the current review is that Fabricant et al³⁷ chose to include articles that were focused on all musculoskeletal injuries. The authors were unable to focus on overuse injuries explicitly because of limitations in the literature. For example, they included an article in which rates of withdrawal from a tennis tournament due to injury were compared between athletes who played only tennis and athletes who reported playing multiple sports.²⁵ Although this is a logical and interesting approach, it was unclear from our review of the article how the injuries were classified. Therefore, we were unable to determine the number of injuries that were explicitly associated with chronic or overuse mechanisms and thus were unable to include this study in the current analysis. Thus, we were able to focus our review on studies with more consistent methodology. This reveals the growth in this area of literature and the recent improvement in methodology; however, there is still a need for more prospective studies on this topic.

One study was included in our systematic review (but not in the meta-analysis) and is worth discussing because of methodologic differences.¹⁹ This was a retrospective study in which specialization was defined by using a single- versus a multisport framework. The authors observed that female soccer, basketball, and volleyball players who participated in a single sport had a higher risk of developing overuse anterior knee pain disorders, such as patellofemoral pain. However, additional reading of the methods reveals that athletes who played

a single sport for a single season could have been classified as highly specialized. Participating in a single sport without the year-round component does not necessarily match the working definition of sport specialization. It is unclear how many cases this may have affected and how it might have influenced their results; however, it also reveals the difficulty of consistently applying sport specialization definitions.

Post et al²⁴ examined the association between specialization and injury and found that athletes with specialization were more likely to report a history of any type of injury in the previous year. Unfortunately, the authors did not explicitly focus on overuse injury, and we were unable to include this article in the review. However, the primary findings of this study are in line with the conclusions of our systematic review and meta-analysis: specialization increases the risk of musculoskeletal injury.

There are several limitations to this systematic review and meta-analysis that should be considered. Of the final studies that were included in this review, 3 were conducted by a study team that included 2 of the authors of this review and meta-analysis.^{18,21,22} We attempted to control for potential bias on the part of these authors by adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, registering the study in PROSPERO with a clearly defined clinical question of interest before performing the literature search, and requiring a consensus from 4 of the authors (D.R.B., E.G.P., K.B., and T.V.M.) for all study inclusion decisions. Additionally, the final number of included studies in the review was small ($n = 5$), revealing the limited research in which the relationship between specialization and overuse injury is examined. Additional research is needed to continue to refine our understanding of the connection between sport specialization and

overuse injury, including interactions with other factors such as playing style, nutrition and recovery, and athleticism. Only 4 of the final 5 studies that were included in this systematic review were included in the meta-analysis because of the lack of access to the original data set for 1 article. Finally, there is ongoing debate regarding the best way to define and classify sport specialization, and limitations exist in both the 3-point scale and single- and multisport methods of classification.³⁸ However, we felt justified using

these classification methods as the basis for our clinical question of interest because these are by far the most commonly used methods for classifying sport specialization.

CONCLUSIONS

Sport specialization is associated with an increased risk of overuse musculoskeletal injuries. This conclusion is based on a qualitative review of the findings of the 5 articles that were included in this review and is confirmed by a meta-analysis of

4 of these studies. There appears to be a stepwise increase in the risk of overuse injury with increasing levels of specialization.

ABBREVIATIONS

CI: confidence interval
CINAHL: Cumulative Index to Nursing and Allied Health Literature
ERIC: Education Resources Information Center
RR: relative risk

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Supplemental Information

SUPPLEMENTAL TABLE 3 Summary of the 195 Articles Identified During the Systematic Review and Reason for Inclusion and Exclusion.

Database	Year	Journal	Lead Author Last Name	Title (Abbreviated)	Inclusion or Exclusion Reason
CINAHL	2014	<i>J Can Chiropr Assoc</i>	Ferguson	A case of early sport specialization in an adolescent athlete	Case study
PubMed	2018	<i>Int J Sports Phys Ther</i>	DePhillipo	Patellofemoral chondral defect in a preadolescent skier: a case report in early sport specialization	Case study
PubMed	2017	<i>Br J Sports Med</i>	DiFiori	Debunking early single sport specialization and reshaping the youth sport experience: an NBA perspective	Commentary
SPORTDiscus	2012	<i>Lacrosse Magazine</i>	Lochary	Not sold on the upsell	Commentary
SPORTDiscus	2013	<i>Athletic Business</i>	Andrews	Sports doc to the stars targets youth injuries straight talk about children and sport: advice for parents, coaches, and teachers	Commentary
SPORTDiscus	2010	<i>Assoc Can Splash</i> (10998306) Sep/Oct 2015, Vol. 23	LeBlanc	—	Commentary
SPORTDiscus	2015	Issue 5, p41 1/3p	Splash	The price is right?	Commentary
Medline	2016	<i>J Sports Sci</i>	Read	Specialization	Commentary
SPORTDiscus	2012	<i>Running Times</i>	McMillan	There is no track season	Commentary
Medline	2016	<i>Orthop J Sports Med</i>	LaPrade	AOSSM early sport specialization consensus statement	Consensus or position statement
PubMed	2000	<i>Pediatrics</i>	Anderson	Intensive training and sports specialization in young athletes. American Academy of Pediatrics. Committee on Sports Medicine and Fitness.	Consensus or position statement
Medline	2011	<i>J Athl Train</i>	Valovich	National Athletic Trainer's Association position statement: prevention of pediatric overuse injuries	Consensus or position statement
CINAHL	2014	<i>Clin J Sport Med</i>	DiFiori	Overuse injuries and burnout in youth sports: a position statement from the American Medical Society for Sports Medicine	Consensus or position statement
Medline	2016	<i>Counc Sports Med Fitness</i>	Brenner	Sports specialization and intensive training in young athletes	Consensus or position statement
CINAHL	2005	<i>Interdiscip J Rehabil</i>	Swanson	A new youth epidemic? Sport specialization can lead to overuse injuries in young athletes	Editorial
SPORTDiscus	2010	<i>Curr Sports Med Rep</i>	Roberts	EDITORIAL: youth sports: who's pushing the cart	Editorial
Medline	2017	<i>Am J Sports Med</i>	Reider	Too much? Too soon?	Editorial
Medline	2017	<i>Sports Health</i>	Post	Association of competition volume, club sports, and sport specialization with sex and lower extremity injury history in high school athletes	Full-text review; excluded because overuse injury was not examined
Hand search	2011	<i>J Med Sci Tennis</i>	Jayanthi	Training and specialization risks in junior elite tennis players	Full-text review; excluded because overuse injury was not examined
Medline	2017	<i>Phys Sportsmed</i>	Pasulka	Specialization patterns across various youth sports and relationship to injury risk	Full-text review; excluded because specialized and non-specialized groups were not directly compared
Medline	2017	<i>Orthop J Sports Med</i>	O'Kane	Risk factors for lower extremity overuse injuries in female youth soccer players	Full-text review; - excluded because specialized and non-specialized groups were not directly compared

TABLE 3 Continued

Database	Year	Journal	Lead Author Last Name	Title (Abbreviated)	Inclusion or Exclusion Reason
Medline	2017	<i>Orthop J Sports Med</i>	Buckley	Early single-sport specialization: a survey of 3090 high school, collegiate, and professional athletes	Full-text review; excluded because participants were outside of age range
Medline	2017	<i>Orthop J Sports Med</i>	Wilhelm	Early sport specialization: effectiveness and risk of injury in professional baseball players	Full-text review; excluded because participants were outside of age range
SPORTDiscus	2018	<i>Am J Sports Med</i>	Rugg	The effects of playing multiple high school sports on National Basketball Association players' propensity for injury and athletic performance prevalence of sport specialization in high school athletes: a 1-y	Full-text review; excluded because participants were outside of age range
PubMed	2016	<i>Am J Sports Med</i>	Bell	Observational study	Full-text review; included
SPORTDiscus	2015	<i>J Sport Rehabil</i>	Hall	Sport specialization's association with an increased risk of developing anterior knee pain in adolescent female athletes	Full-text review; included
Medline	2015	<i>Am J Sports Med</i>	Jayanthi	Sports-specialized intensive training and the risk of injury in young athletes: a clinical case control study	—
SPORTDiscus	2017	<i>Am J Sports Med</i>	Post	The association of sport specialization and training volume with injury history in youth athletes.	Full-text review; included
CINAHL	2017	<i>Am J Sports Med</i>	McGuine	A prospective study on the effect of sport specialization on lower extremity injury rates in high school athletes	Full-text review; included
PubMed	2000	<i>US News World Rep</i>	Lord	Too much, too soon? Doctors group warns against early specialization.	News article
CINAHL	2014	<i>Orthopedics Today</i>	—	Pediatric overuse injuries increase due to year round, 1one sport training	Non-peer reviewed
PubMed	2016	<i>Rev Med Suisse</i>	Tercier	Adolescent and physical activity: addi(c)tive excesses [in French]	Not in English
PubMed	2009	<i>Sportverletz Sportschaden</i>	Summerer	Basic principles of diver medical certification [in German]	Not in English
PubMed	2007	<i>HNO</i>	Tetzlaff	Diving for children: the 3rd Heidelberg Symposium on diving medicine [in German]	Not in English
Medline	2016	<i>Revue Medicale Suisse (French)</i>	Tercier	Adolescent and physical activity: addictive excesses	Not in English
SPORTDiscus	2017	<i>Schweizerische Zeitschrift für Sportmedizin & Sporttraumatologie</i>	Hildebrandt	Management con verletzungen bei nachwuchysathleten am beispiel des alpinen skirennsports	Not in English
SPORTDiscus	2004	<i>Am J Sports Med</i>	Petty	Ulnar collateral ligament reconstruction in high school baseball players: clinical results and injury risk factors	Not relevant to clinical question
Medline	2018	<i>Orthop J Sports Med</i>	Pennock	Shoulder MRI abnormalities in asymptomatic little league baseball players	Not relevant to clinical question
Hand search	2017	<i>Sports Health</i>	Padaki	Factors that drive youth specialization	Not relevant to clinical question
SPORTDiscus	2016	<i>Med Sci Tennis</i>	Schneider	Health and fitness status of parent-child dyads: tennis-only athletes versus multisport athletes in competitive adolescent population	Not relevant to clinical question
SPORTDiscus	2017	<i>Sports Health</i>	Post	High school sport specialization patterns of current division I athletes	Not relevant to clinical question
PubMed	2018	<i>J Strength Cond Res</i>	Post	Knowledge, attitudes, and beliefs of youth sports coaches regarding sport volume recommendations and sport specialization	Not relevant to clinical question
CINAHL	2015	<i>J Athl Train</i>	Beese	Landing error scoring system differences between single-sport and multi-sport female high school-aged athletes	Not relevant to clinical question
Hand search	2017	<i>Orthop J Sports Med</i>	Padaki	Quantifying parental influence on youth athlete specialization	Not relevant to clinical question

TABLE 3 Continued

Database	Year	Journal	Lead Author Last Name	Title (Abbreviated)	Inclusion or Exclusion Reason
PubMed	2018	<i>Sports Health</i>	DiStefano	Sport sampling is associated with improved landing technique in youth athletes	Not relevant to clinical question
PubMed	2018	<i>Orthop J Sports Med</i>	Bell	Sport specialization characteristics between rural and suburban high school athletes	Not relevant to clinical question
CINAHL	2011	<i>Appl Physiol Nutr Metab</i>	Skurvydas	The effect of sports specialization on musculus quadriceps function after exercise-induced muscle damage	Not relevant to clinical question
SPORTDiscus	2017	<i>Sports Health</i>	Miller	The effects of specialization and sex on anterior Y-balance performance in high school athletes	Not relevant to clinical question
SPORTDiscus	2013	<i>J Sport Behav</i>	Russell	The relationship between youth sport specialization and involvement in sport and physical activity in young adulthood	Not relevant to clinical question
SPORTDiscus	2009	<i>Missouri J Health, Phys Educ, Recreation, Dance</i>	White	Does specializing in team sports during childhood translate into a college athletic career?	Not relevant to clinical question
CINAHL	2012	<i>Int J Sports Phys Ther</i>	Gorman	Differences in dynamic balance scores in 1 sport versus multiple sport high school athletes	Not relevant to clinical question
SPORTDiscus	2014	<i>J Strength Cond Res</i>	Lloyd	Chronological age vs. biological maturation: implications for exercise programming in youth	Not relevant to clinical question
SPORTDiscus	2013	<i>Clin J Sport Med</i>	Beck	Can therapeutic ultrasound accurately detect bone stress injuries in athletes?	Not relevant to clinical question
CINAHL	2001	<i>Clin Sports Med</i>	Geissler	Carpal fractures in athletes	Not relevant to clinical question
PubMed	2012	<i>Pediatrics</i>	LaBella	Cheerleading injuries: epidemiology and recommendations for prevention	Not relevant to clinical question
PubMed	2015	<i>Orthop J Sports Med</i>	Zaremski	Does geographic location matter on the prevalence of ulnar collateral ligament reconstruction in collegiate baseball pitchers?	Not relevant to clinical question
Medline	2017	<i>J Pediatr Orthop</i>	Axibal	Epidemiology of anterior tibial spine fractures in young patients: a retrospective cohort study of 122 cases	Not relevant to clinical question
Medline	2017	<i>Transl Pediatr</i>	Patel	Epidemiology of sports-related musculoskeletal injuries in young athletes in United States	Not relevant to clinical question
Medline	2011	<i>Curr Med Res Opin</i>	Muller-Schwefe	European survey of chronic pain patients: results for Germany	Not relevant to clinical question
SPORTDiscus	2016	<i>Int J Sports Sci Coach</i>	Voigt	Expert youth coaches' diversification strategies in talent development: a qualitative typology	Not relevant to clinical question
Medline	2017	<i>Phys Sportsmed</i>	Read	Competitive bass anglers: a new concern in sports medicine	Not relevant to clinical question
SPORTDiscus	2010	<i>sportEX dynamics</i>	Carolan	Falling short: is there a problem with grass roots athletics that widens the gap between the gifted and the great?	Not relevant to clinical question
CINAHL	2016	<i>Am J Sports Med</i>	Ramey	Femoral neck stress fracture	Not relevant to clinical question
PubMed	2018	<i>J Sport Rehabil</i>	Powell	Functional performance measures used for return-to-sport criteria in youth following lower extremity injury	Not relevant to clinical question
SPORTDiscus	2017	KAHPERD J	Picucci	High school cross-country coaches' perception of junior high school athletes competing at the varsity level	Not relevant to clinical question
PubMed	2011	<i>Clin Sports Med</i>	Jacoby	Hip problems and arthroscopy: adolescent hip as it relates to sports	Not relevant to clinical question
CINAHL	2005	<i>Strength Cond J</i>	Brumitt	In-season functional shoulder training for high school baseball pitchers	Not relevant to clinical question
CINAHL	2010	<i>Perform Train J</i>	Hedrick	In-season training for the high school athlete	Not relevant to clinical question
SPORTDiscus	2017	<i>Strength Cond J</i>	Barreiro	Incorporating unstructured free play into organized sports	Not relevant to clinical question
Cochrane Database	2015	<i>Cochrane Database Syst Rev</i>	Kearney	Injection therapies for Achilles tendinopathy	Not relevant to clinical question

TABLE 3 Continued

Database	Year	Journal	Lead Author Last Name	Title (Abbreviated)	Inclusion or Exclusion Reason
CINAHL	2016	<i>J Athl Train</i>	Kuzuhara	Injuries in Japanese mini-basketball players during practices and games	Not relevant to clinical question
Cochrane Database	2010	<i>Cochrane Database Syst Rev</i>	Goldman	Interventions for preventing hamstring injuries	Not relevant to clinical question
Cochrane Database	2011	<i>Cochrane Database Syst Rev</i>	Yeung	Interventions for preventing lower limb soft-tissue running injuries	Not relevant to clinical question
Cochrane Database	2011	<i>Cochrane Database Syst Rev</i>	Walline	Interventions to slow progression of myopia in children	Not relevant to clinical question
Medline	2014	<i>Orthop J Sports Med</i>	Erickson	Is Tommy John surgery performed more frequently in major league baseball pitchers from warm weather areas	Not relevant to clinical question
SPORTDiscus	2016	<i>J Phys Educ Sport</i>	Pereira	Journeys of Portuguese athletes to sporting success: the peaks and troughs	Not relevant to clinical question
SPORTDiscus	2017	<i>IDEA Fitness Journal</i>	LeBella	Kids' injury risk is higher in particular sports	Not relevant to clinical question
Medline	2015	<i>Phys Sportsmed</i>	Ludwig	Management of anterior cruciate ligament tears in skeletally immature athletes	Not relevant to clinical question
Medline	2016	<i>PLoS One</i>	Hug	Motor adaptations to pain during a bilateral plantarflexion task: does the cost of using the non-painful limb matter	Not relevant to clinical question
Cochrane Database	2016	<i>Cochrane Database Syst Rev</i>	Saragiotto	Motor control exercise for chronic non-specific low-back pain	Not relevant to clinical question
Cochrane Database	2017	<i>Cochrane Database Syst Rev</i>	Aalbers	Music therapy for depression	Not relevant to clinical question
CINAHL	2013	<i>Appl Neuropsychol</i>	Tsushima	Neurocognitive functioning and symptom reporting of high school athletes following a single concussion	Not relevant to clinical question
PubMed	2018	<i>Pediatr Exerc Sci</i>	Behm	Neuromuscular physiology, exercise, and training during youth-the year that was 2017	Not relevant to clinical question
SPORTDiscus	2017	<i>J Athl Train</i>	Bell	New investigator award	Not relevant to clinical question
SPORTDiscus	2011	<i>Phys Educ Sport Manag</i>	Magdalena	Nutrition in sports performance	Not relevant to clinical question
SPORTDiscus	2016	<i>Med Sci Sports Exerc</i>	Tisano	Overuse injuries of the pediatric and adolescent throwing athlete	Not relevant to clinical question
Cochrane Database	2016	<i>Cochrane Database Syst Rev</i>	Husk	Participation in environmental enhancement and conservation activities for health and well-being in adults: a review of quantitative and qualitative	Not relevant to clinical question
CINAHL	2016	<i>Orthop Clin North Am</i>	Ellington	Pediatric elbow and wrist pathology related to sports participation	Not relevant to clinical question
CINAHL	2010	<i>Clin Sports Med</i>	Seto	Pediatric running injuries	Not relevant to clinical question
CINAHL	2003	<i>Spinal Cord</i>	Augutis	Pediatric spinal cord injury in Sweden: incidence, etiology and outcome	Not relevant to clinical question
Cochrane Database	2017	<i>Cochrane Database Syst Rev</i>	Radtko	Physical exercise training for cystic fibrosis	Not relevant to clinical question
CINAHL	2016	<i>Am J Sports Med</i>	Lerebours	Prevalence of cam-type morphology in elite ice hockey players	Not relevant to clinical question
SPORTDiscus	2017	<i>Asian J Sports Med</i>	Grover	Prevalence of shoulder pain in competitive archery	Not relevant to clinical question
SPORTDiscus	2017	<i>Sports Health</i>	Zwolski	Resistance training in youth: laying the foundation for injury prevention and physical literacy	Not relevant to clinical question
PubMed	2001	<i>Spine (Phila Pa 1976)</i>	Morganti	Return to play after cervical spine injury	Not relevant to clinical question

TABLE 3 Continued

Database	Year	Journal	Lead Author Last Name	Title (Abbreviated)	Inclusion or Exclusion Reason
Medline	2011	<i>Am J Sports Med</i>	Ardern	Return to the preinjury level of competitive sport after anterior cruciate ligament reconstruction surgery: two-thirds of patients have not returned	Not relevant to clinical question
Cochrane Database	2017	<i>Cochrane Database Syst Rev</i>	Head	Saline irrigation for allergic rhinitis	Not relevant to clinical question
Medline	2016	<i>Sports Med Arthrosc Rev</i>	Smucny	Shoulder and elbow injuries in the adolescent athlete	Not relevant to clinical question
PubMed	2018	<i>Orthop J Sports Med</i>	Pennock	Shoulder MRI abnormalities in asymptomatic little league baseball players	Not relevant to clinical question
CINAHL	2016	<i>Gait Posture</i>	Barbado	Sports-related testing protocols are required to reveal trunk stability adaptations in high-level athletes	Not relevant to clinical question
Cochrane Database	2017	<i>Cochrane Database Syst Rev</i>	Wolfenden	Strategies for enhancing implementation of school-based policies or practices targeting risk factors for chronic disease	Not relevant to clinical question
SPORTDiscus	2006	<i>Research Yearbook</i>	Platanov	The basis of modern training process periodization in high-performance athletes for year preparation	Not relevant to clinical question
Medline	2005	<i>Scott Med J</i>	Carmont	The impact of an extreme sports event on a district general hospital	Not relevant to clinical question
CINAHL	2017	<i>J Am Assoc Nurse Pract</i>	Graves	The impact of patient characteristics on nurse practitioners' assessment and management of adolescent concussion	Not relevant to clinical question
SPORTDiscus	2012	<i>ACSM's Health Fit J</i>	Young	The importance of putting the fun back into youth sports	Not relevant to clinical question
CINAHL	2017	<i>J Athl Train</i>	—	The new investigator award presented in honor of Freddie H. Fu, MD: David R. Bell, PhD, ATC University of Wisconsin-Madison	Not relevant to clinical question
PubMed	2017	<i>Curr Sports Med Rep</i>	Solomon	The pediatric endurance athlete	Not relevant to clinical question
CINAHL	2009	<i>Strength Cond J</i>	Ochi	The progressive physical development of a high-performance tennis player	Not relevant to clinical question
PubMed	2001	<i>Clin Sports Med</i>	Cahill	The three critical components in the conservative treatment of juvenile osteochondritis dissecans (JOCD). Physician, parent, and child	Not relevant to clinical question
Cochrane Database	2007	<i>Cochrane Database Syst Rev</i>	Sayyad	Topical nasal steroids for intermittent and persistent allergic rhinitis in children	Not relevant to clinical question
PubMed	2017	<i>Physiol Rep</i>	Weber	Trunk muscle activation during movement with a new exercise device for lumbo-pelvic reconditioning	Not relevant to clinical question
PubMed	2007	<i>BMC Musculoskeletal Disord</i>	Skedros	Variations in corticosteroid/anesthetic injections for painful shoulder conditions: comparisons among orthopedic surgeons, rheumatologists	Not relevant to clinical question
Cochrane Database	2006	<i>Cochrane Database Syst Rev</i>	Bellamy	Viscosupplementation for the treatment of osteoarthritis of the knee	Not relevant to clinical question
SPORTDiscus	2009	<i>GAHPERD Journal</i>	N/A	What does it take to reach the summit?	Not relevant to clinical question
SPORTDiscus	1986	<i>Sports Coach</i>	Carmichael	What every adult should know about children and sport	Not relevant to clinical question
SPORTDiscus	2010	<i>Sports Med</i>	Elliot	Young women's anterior cruciate ligament injuries	Not relevant to clinical question
CINAHL	2010	<i>Sports Med</i>	Elliot	Young women's anterior cruciate ligament injuries; an expanded model and prevention paradigm	Not relevant to clinical question
Medline	2017	<i>Orthop J Sports Med</i>	Fraser	Bony morphology of femoroacetabular impingement in young female dancers and single-sport athletes	Not relevant to clinical question
PubMed	1984	<i>Pediatrics</i>	[No authors listed]	Participation in boxing among children and young adults	Published before 2000
PubMed	1999	<i>J Biomed Mater Res</i>	Wei	Knee joint	Published before 2000
SPORTDiscus	1989	<i>Revue de l'AEFA</i>	Clement	D'une specialisation precoce	Published before 2000

TABLE 3 Continued

Database	Year	Journal	Lead Author Last Name	Title (Abbreviated)	Inclusion or Exclusion Reason
SPORTDiscus	1989	<i>Medecine Du Sport</i>	Vidalin	Terrain	Published before 2000
SPORTDiscus	1990	Thompson	Willman	School athletic fitness program	Published before 2000
Medline	1994	<i>Br J Sports Med</i>	So	Comparative study of elite versus untrained subjects	Published before 2000
SPORTDiscus	1996	<i>J Strength Cond Res</i>	Lehnhard	Monitoring injuries on a college soccer team: the effect of strength training	Published before 2000
Medline	1998	<i>Adolesc Med</i>	Kelly	Shoulder and elbow injuries and painful syndromes	Published before 2000
SPORTDiscus	1981	<i>Am J Sports Med</i>	Jackson	Stress reactions involving the pars interarticularis in youth athletes	Published before 2000
SPORTDiscus	1997	<i>Sports Med</i>	Morris	Walking to health	Published before 2000
SPORTDiscus	1988	<i>Phys Sportsmed</i>	Hellstedt	Kids, parents, and sports: some questions and answers	Published before 2000
CINAHL	1998	<i>J Musculoskelet Med</i>	Peterson	Sports injuries: how they differ (and don't differ) in the aging athlete: conditioning and warm-up are keys to injury avoidance	Published before 2000
ERIC	1999	<i>Educ Leadersh</i>	Rasmussen	The changing sports scene	Published before 2000
SPORTDiscus	1990	<i>Med Sci Sports Exer</i>	—	Body fat distribution in females: metabolic consequences and implications for wt loss	Published before 2000
SPORTDiscus	1987	<i>Sci Sports</i>	Hughson	Children in competitive sports. A multi-disciplinary approach	Published before 2000
PubMed	1999	<i>Am J Sports Med</i>	Kizer	Literature review	Published before 2000
SPORTDiscus	1983	Australian Track and Field Coaches Association	Arens	Train or play for the young runner: a study of specialization versus general development for our young	Published before 2000
SPORTDiscus	2014	<i>J Orthop Sports Phys Ther</i>	Nyland	Coming to terms with early sports specialization and athletic injuries	Review article
CINAHL	2015	<i>J Hand Ther</i>	Leahy	Common medial elbow injuries in the adolescent athlete	Review article
SPORTDiscus	Na	Na	Small	Conclusion (?)	Review article
CINAHL	2015	<i>Orthop Clin North Am</i>	Smucny	Athlete	Review article
SPORTDiscus	2015	<i>Kinesiol Rev</i>	Goodway	Sampling from a physical growth and motor development perspective	Review article
CINAHL	2010	<i>Curr Sports Med Rep</i>	Malina	Early sport specialization: roots, effectiveness, risks	Review article
Medline	2017	<i>J Sports Med Physl Fitness</i>	Walters	Effects of resistance training, overtraining, and early specialization on youth athletes	Review article
PubMed	2011	<i>J Fam Pract</i>	Southard	Elbow injuries: getting kids back in the game	Review article
PubMed	2018	<i>Pediatr Exerc Sci</i>	Williams	Elite youth sports- the year that was 2017	Review article
SPORTDiscus	2008	<i>Parks and Recreation</i>	Bach	Research update: combating the overuse epidemic	Review article
SPORTDiscus	2005	Unpublished	Baker	Sowing the seeds of adult expertise: optimal environments for acquiring sports skill during early phases of development	Review article
SPORTDiscus	2015	<i>Sports Health</i>	Myer	Sport specialization, part I: does early sports specialization increase negative outcomes and reduce the opportunity for success in young	Review article
Medline	2017	<i>Radiologic Soc North America</i>	Nguyen	Sports and the growing musculoskeletal system: sports imaging series	Review article
SPORTDiscus	2013	<i>Sports Health</i>	Jayanthi	Sports specialization in youth athletes: evidence-based recommendations	Review article
SPORTDiscus	2016	<i>Sports Health</i>	Myer	Sports specialization, part II: alternative solutions to early sport specialization in youth athletes	Review article
Medline	2015	<i>Orthop Traumatol</i>	Launay	Sports-related overuse injuries in children	Review article
CINAHL	2016	<i>Pediatr Exer Sci</i>	McKay	The adolescent athlete: a developmental approach to injury risk	Review article
SPORTDiscus	2014	<i>IDEA Fitness Journal</i>	Halvorson	The danger of sports specialization	Review article
SPORTDiscus	2014	<i>Athletic Business</i>	Van Milligen	The death of the multisport athlete	Review article
SPORTDiscus	2010	<i>J Pract Clin</i>	Callender	The early specialization of youth in sports	Review article
CINAHL	2006	<i>Time</i>	Gorman	Active kids at increased risk of crippling injury	Review article
CINAHL	2011	<i>Sports Med Arthosc Rev</i>	Mariscalco	Upper extremity injuries in the adolescent athlete	Review article
SPORTDiscus	2016	<i>Am J Sports Med</i>	Feeley	When is it too early for single sport specialization?	Review article
CINAHL	2016	<i>Orthop Clin North Am</i>	Fabricant	Anterior cruciate ligament injuries in children and adolescents	Review article

TABLE 3 Continued

Database	Year	Journal	Lead Author Last Name	Title (Abbreviated)	Inclusion or Exclusion Reason
Medline	2013	<i>J Orthop Sports Phys Ther</i>	Frank	Anterior cruciate ligament injuries in the skeletally immature athlete: diagnosis and management	Review article
CINAHL	2011	<i>Sports Med Arthosc Rev</i>	Schub	Anterior cruciate ligament injuries in the young athlete: evaluation and treatment	Review article
CINAHL	2013	<i>Strength Cond J</i>	Graziano	Evidence-based application	Review article
Medline	2013	<i>Curr Opin Pediatr</i>	Ladenhauf	Young athletes- current concepts and review of literature	Review article
Medline	2009	<i>Pediatr Radiol</i>	Gaca	Basketball injuries in children	Review article
SPORTDiscus	2011	<i>Track Coach Winter</i>	Ebbets	Children and sport	Review article
Medline	2014	<i>Primary Care</i>	Heinke	Completing the preparticipation physical evaluation	Review article
PubMed	2017	<i>J Pediatr Health Care</i>	Palisch	Depressive symptoms in the young athlete after injury: recommendations for research	Review article
PubMed	2006	<i>Travel Med Infect Dis</i>	Benton	Diving medicine	Review article
CINAHL	2003	<i>Pediatr Exer Sci</i>	Caine	Gymnasts? Quite possibly	Review article
ERIC	2010	<i>Journal of Physical Education, Recreation, and Dance</i>	Mattson	Early specialization in youth sport: a biomechanical perspective	Review article
SPORTDiscus	2017	<i>Strength Cond J</i>	Blagrove	Athletes: risks and recommendations	Review article
SPORTDiscus	2017	<i>GAPHERD Journal</i>	Sluder	Early versus late specialization in sport	Review article
CINAHL	2006	<i>Oper Tech Sports Med</i>	Hennrikus	Elbow disorders in the young athlete	Review article
Medline	2013	<i>Pediatr Radiol</i>	Zellner	Elbow Injuries in the young athlete—an orthopedic perspective	Review article
Medline	2010	<i>Curr Sports Med Rep</i>	DiFiori	Evaluation of overuse injuries in children adolescents	Review article
ERIC	2010	<i>Journal of Physical Education, Recreation, and Dance</i>	Kaleth	Impact of early sport specialization: a physiologic perspective	Review article
SPORTDiscus	2017	<i>Strength Cond J</i>	Sugimoto	Implications for training in youth: is specialization benefiting kids?	Review article
CINAHL	2004	<i>Clin Sports Med</i>	Rudzki	Juvenile and adolescent elbow injuries in sports	Review article
SPORTDiscus	2015	<i>Sports Med Bulletin</i>	VanDeWeghe	Kids should play multiple sports and not just one	Review article
SPORTDiscus	2010	<i>Athl Train Sports Health Care</i>	Elder	Little league elbow	Review article
SPORTDiscus	2008	<i>Strength Cond J</i>	Johnson	Overuse injuries in young athletes: cause and prevention	Review article
SPORTDiscus	2013	<i>ACSM Fit Soc Page</i>	Gregory	Overuse injuries in youth athletes	Review article
CINAHL	2001	<i>Med Sci Sports Exer</i>	Hawkins	Overuse injuries in youth sports: biomechanical considerations	Review article
Medline	2007	<i>American Academy of Pediatrics Council on Sports Medicine and Fitness</i>	Brenner	Overuse injuries, overtraining, and burnout in child and adolescent athletes	Review article
Medline	2012	<i>Adv Pediatr</i>	Hoang	Pediatric overuse injuries in sports	Review article
Medline	2017	<i>Clin J Sport Med</i>	Feeley	Pitch counts in youth baseball and softball: a historical review	Review article
PubMed	2008	<i>J La State Med Soc</i>	Kerut	Prevention of arm injury in youth baseball pitchers	Review article
Medline	2013	<i>Orthop Clin North Am</i>	Paterno	Prevention of overuse sports injuries in the young athlete	Review article
CINAHL	2016	<i>Pediatr Ann</i>	Schlechter	Reducing cumulative arm overuse injuries in young throwers	Review article
ERIC	2015	<i>J Phys Sport Educ</i>	Stewart	Sport specialization: a coach's role in being honest with parents	Review article
PubMed	2002	<i>Pediatr Clin North Am</i>	Stricker	Sports training issues for the pediatric athlete	Review article
SPORTDiscus	2017	<i>Strength Cond J</i>	Jayanthi	The risks of sports specialization in the adolescent female athlete	Review article
SPORTDiscus	2005	<i>Sporting Goods Dealer</i>	Jacobsen	Too much, too soon	Review article
SPORTDiscus	2017	<i>Sports Med</i>	Stuelcken	Wrist injuries in tennis players: a narrative review	Review article
CINAHL	2008	<i>ACA News</i>	Schetchikova	Young, athletic and injured	Review article

TABLE 3 Continued

Database	Year	Journal	Lead Author Last Name	Title (Abbreviated)	Inclusion or Exclusion Reason
Medline	2011	<i>Int J Sports Physiol Perform</i>	Capranica	Youth sport specialization: how to manage competition and training?	Review article
Medline	2016	<i>Phys Sportsmed</i>	Fabricant	Of the literature	Review article

ATC, athletic trainer certified; MD, Doctor of Medicine; N/A, not available; —, not applicable.