

2024

A Review of the Effects of Early Sport Specialization on the Health of Adolescent Baseball Players

Robert C. Juniewicz

Thomas Jefferson University, rcj010@students.jefferson.edu

Follow this and additional works at: https://jdc.jefferson.edu/bone_bulletin

 Part of the [Orthopedics Commons](#)

[Let us know how access to this document benefits you](#)

Recommended Citation

Juniewicz, Robert C. (2024) "A Review of the Effects of Early Sport Specialization on the Health of Adolescent Baseball Players," *Bone Bulletin*: Vol. 2: Iss. 1, Article 11.

Available at: https://jdc.jefferson.edu/bone_bulletin/vol2/iss1/11

This Article is brought to you for free and open access by the Jefferson Digital Commons. The Jefferson Digital Commons is a service of Thomas Jefferson University's [Center for Teaching and Learning \(CTL\)](#). The Commons is a showcase for Jefferson books and journals, peer-reviewed scholarly publications, unique historical collections from the University archives, and teaching tools. The Jefferson Digital Commons allows researchers and interested readers anywhere in the world to learn about and keep up to date with Jefferson scholarship. This article has been accepted for inclusion in Bone Bulletin by an authorized administrator of the Jefferson Digital Commons. For more information, please contact: JeffersonDigitalCommons@jefferson.edu.

A Review of the Effects of Early Sport Specialization on the Health of Adolescent Baseball Players

By: Robert C. Juniewicz, Class of 2026

Faculty Advisor: Mark Lazarus, MD

Introduction

Participation in sports during adolescence is beneficial for participants as it improves fitness, enhances psychosocial development, increases academic performance, and boosts self-esteem.¹ One of the most popular sports among adolescent athletes is baseball, with nearly 500,000 high school players in the United States in 2020.¹ While participation in sports has been shown to have clear benefits and has been steadily increasing, recent decades have also seen a dramatic rise in the level of competition.² As a direct result, there has been an increase in the prevalence of early sports specialization (ESS) with an estimated 14–47% of adolescent athletes focusing on one sport.³ ESS refers to a prepubertal athlete who engages in rigorous training for a single sport for over 8 months annually, while refraining from participation in other sports to concentrate on their primary athletic pursuit.^{4,5} Although ESS is becoming increasingly prevalent across various sports, baseball stands out with the highest prevalence of ESS (12.1%).^{6,7} This practice has become more popular due to parents, coaches, and athletes' understanding of the common adage of the "10,000-hour rule", where 10,000 hours of dedicated practice on one skill is required to achieve mastery or expertise in that skill.⁶ Assuming this rule holds true in sports, it is logical to think more time spent training on one sport at a younger age will translate into more success in the form of better performance. Parents also assume that greater success enables increased opportunities to receive collegiate scholarships and a better likelihood of recruitment to play in Major League Baseball (MLB).^{1–3,8} However, recent research has shown that the "10,000-hour rule" has not been shown to translate to sports and ESS may be far more detrimental for adolescent baseball players than it is beneficial.^{3,6,7,9–15}

Misconceptions of ESS

ESS has shown a consistent rise over the past few decades, with one study spanning 1960–2018 revealing a notable and steady increase.² The motivations for ESS are clear as coaches and parents believe it will be advantageous for their athletes and give them a better opportunity for a successful athletic career. One study found that 76% of parents

with children who were ESS athletes cited their reasoning for pursuing ESS was to increase their child's chance of achieving elite status (college or MLB level).³ Additionally, athletes themselves stated that their reasoning for ESS was to have a better opportunity to play D1 baseball and achieve the skills needed to play in the MLB.⁸ Two recent studies tested this line of thought. One study surveyed current elite D1 college athletes and found these athletes had a significantly later onset of sports specialization than the current high school player average (14 vs 12 years old, $p < .001$).¹⁶ Additionally, Popkin et al. found that only 17.4% of 303 D1 athletes specialized in their sport before 12 years old.⁸ It has been noted that elite-level athletes were more likely to be multi-sport athletes during adolescence and delayed specialization in their primary sport.^{5,6,9} This is thought to be due to a phenomenon termed "transfer of pattern recall", where acquiring a broader skill set from multiple sports and free play can translate into greater success later when baseball is chosen as the primary sport.⁹ Thus, current literature suggests that ESS does not provide an advantage to achieving elite status.

Negative Effects of ESS

ESS is associated with a rise in overuse injuries, mental health illnesses, detriments in psychosocial development, and burnout in adolescent baseball players.^{3,6,7,9–11,13–15} The incidence of overuse injuries, which are broadly defined by a chronic gradual onset of injuries caused by repetitive stress, has increased in recent years.^{11,13,15,17} For example, the rate of UCL reconstruction, also known as "Tommy John's" surgery, has increased by 343% between 2004 and 2014 with the adolescent population demonstrating the greatest increase in incidence of all age groups.¹³ Furthermore, 57% of all UCL reconstruction surgery is performed on adolescent patients.¹⁵ The rise in injuries prompted the creation of MLB Pitch Smart and similar professional guidelines. These guidelines advocate for a minimum of four months' rest from pitching annually, delaying specialization until puberty, and restricting training to hours per week equivalent to the athlete's age, up to a maximum of 16 hours per week.^{5,9,13,14} There is also an association between the number of intense training hours per week and injuries, with 16 hours marking the maximum number of hours of intense training before there is a significant increase in the incidence of injuries in adolescent athletes.^{9,13} Pitchers face a heightened risk of overuse injuries with ESS, given this position's increased tendency to specialize, resulting in a 4–36 times greater risk of such injuries.^{6,13} Pitchers age 9–14 who exceed 8 months per year of pitching have 5x greater risk of sustaining injuries related to overuse.^{9,13} Furthermore, injuries not only occur more frequently in ESS athletes but

also entail longer recovery periods compared to non-ESS athletes.^{13,18} D1 college players that specialized before 13 were more likely to have a history of overuse injuries, injury within past year, and greater recovery times than their non-ESS teammates.¹⁴ Risk factors consistently associated with a greater risk of injury in adolescent baseball players include pitching with arm fatigue (greatest risk factor), exceeding game pitch counts, playing for more than 8 months per year, intense training for greater than 16 hours per week, year-round single-sport training, and playing on multiple teams.¹³ The goal of following the MLB Pitch Smart guidelines is to reduce these risk factors for adolescent baseball players.

ESS also has negative effects on adolescent psychosocial development and mental health.^{3,6,12} This is believed to stem from the preference for rigorous, baseball-specific training over engaging in "free play", which plays a crucial role in fostering social skills among adolescents.^{3,12} ESS has detrimental effects on adolescent mental health which is thought to be related to a decrease in social free play with their peers as well as the immense pressure that early specialization puts on the athlete to perform at an elite level.^{3,12} ESS athletes are more likely to develop anxiety, depression, and sport burnout which is the 2nd most common reason for adolescents quitting a sport.^{1-6,8,9,12,18} This is most likely due to the intense training schedule and lack of athlete autonomy regarding the skills they wish to practice.³ The lack of autonomy over training can lead to a lack of intrinsic motivation to practice and play baseball, leading to negative mental health effects and burnout.^{3,5,9,12}

Strategies to Prevent Harm due to ESS

Education regarding the risks of ESS is paramount to preventing its harmful effects on adolescent baseball players. Parents, coaches, and athletes should be educated on the MLB Pitch Smart guidelines and encourage adherence to those recommendations. For example, according to the MLB Smart Pitch guidelines a 12-year-old pitcher should not exceed 85 pitches per game. If this pitch count is reached, the athlete should take at least four days of rest before pitching in a game again.¹³ Additionally, it is important for training staff working with adolescent athletes to be knowledgeable about appropriate practices and scheduling to enhance the skills of adolescent baseball players while mitigating the risks of overuse injuries. During the immediate post-season, resting should be the priority to promote physical and mental recovery in all athletes.¹³ In the offseason, baseball players should prioritize strength training and stretching programs to prevent overuse injuries in future seasons.¹³ This training should focus on full body strengthening as the entire body is

involved in the kinetic chain necessary to generate power into throws.^{13,14} Moreover, it's important to recognize that offseason rest could also involve participating in another sport, specifically a non-throwing sport so the athlete can recover from throwing related fatigue while continuing to stay active and build skills to boost overall athleticism.¹³ Baseball specific training should occur both immediately prior to and during season to improve the skills that are utilized during games.^{13,14}

Mental health literacy is also an important step necessary to prevent the mental and psychosocial detriments that occur with ESS. Parents and coaches should be encouraged to build a supportive environment where their athletes are comfortable and encouraged to voice their thoughts and opinions on their mental health.^{3,12} Often, athletes keep mental health concerns to themselves or are not taught to recognize the signs of poor mental health so they can speak up when needed.³ ESS also instills in young athletes a pursuit of perfection, fueled by the competitive nature of youth sports, which could potentially exacerbate mental health issues leading to burnout.^{3,5} To prevent negative mental health outcomes, players should be educated about the signs of mental health struggles, taught coping strategies to deal with the pressure of competitive sports, given the opportunity to express concerns about their mental health, and informed about the pitfalls of perfectionism. Furthermore, parents and coaches themselves should be taught how to recognize the signs of declining mental health and encouraged to refer athletes for assessments by psychologists when necessary.³

Future Research

There is compelling evidence indicating that ESS negatively impacts adolescent baseball players, which prompted the creation of the MLB Smart Pitcher Guidelines. While these guidelines have been in place since 2006 and have been updated according to recent research, there have not been studies directly demonstrating the effectiveness of these guidelines in preventing overuse injuries in adolescent baseball players.¹⁴ Furthermore, many of the guidelines are focused on duration activities such as limiting the number of hours per week, number of pitchers per game, and number of months playing per year. Researchers have called for an investigation into the role of the specific activities performed, the intensity at which they were performed, and the frequency of those activities during training on overuse injuries.¹³ Another study discovered that pitch counts underestimate the arm stress experienced by 11 or 12-year-old pitchers, as these players engaged in 10 times more non-pitching throws compared to pitching throws. Thus, future research could focus

more broadly on total throws rather than pitches.¹⁴ Finally, the concept of the Acute to Chronic Workload Ratio (ACWR), which is the ratio of acute workload in the past week compared to the previous 4 weeks, has been implicated as a possible predictor of injury and fatigue.¹⁵ Thus, future research could be focused on the benefit of utilizing ACWR to help predict when athletes are at heightened risk of injury.

Conclusion

The negative impacts of ESS are more prevalent as the level of competition in youth sports increases. There is a growing need to educate the support system of athletes on the negative effects of ESS. Additionally, teaching training methods, emphasizing the importance of multiple sports in early childhood, and the importance of free play are important steps to improve player skills while minimizing harm. With improved implementation and knowledge of professional guidelines, measures could be implemented to enhance the adolescent athlete experience while mitigating the physical and psychosocial harm that can occur from ESS.

References

- Bell DR, Post EG, Biese K, Bay C, Valovich McLeod T. Sport Specialization and Risk of Overuse Injuries: A Systematic Review With Meta-analysis. *Pediatrics*. 2018;142(3):e20180657. doi:10.1542/peds.2018-0657.
- Rugg CM, Coughlan MJ, Li JN, Hame SL, Feeley BT. Early Sport Specialization Among Former National Collegiate Athletic Association Athletes: Trends, Scholarship Attainment, Injury, and Attrition. *Am J Sports Med*. 2021;49(4):1049-1058. doi:10.1177/0363546520988727.
- Daley MM, Shoop J, Christino MA. Mental Health in the Specialized Athlete. *Curr Rev Musculoskelet Med*. 2023;16(9):410-418. doi:10.1007/s12178-023-09851-1.
- Giusti NE, Carder SL, Vopat L, et al. Comparing Burnout in Sport-Specializing Versus Sport-Sampling Adolescent Athletes: A Systematic Review and Meta-analysis. *Orthop J Sports Med*. 2020;8(3):2325967120907579. doi:10.1177/2325967120907579.
- LaPrade RF, Agel J, Baker J, et al. AOSSM Early Sport Specialization Consensus Statement. *Orthop J Sports Med*. 2016;4(4):2325967116644241. doi:10.1177/2325967116644241.
- Anderson FL, Knudsen ML, Ahmad CS, Popkin CA. Current Trends and Impact of Early Sports Specialization in the Throwing Athlete. *Orthop Clin North Am*. 2020;51(4):517-525. doi:10.1016/j.ocl.2020.06.006.
- Campbell R, Weekes D, Mattson M, et al. The Effect of Single Sport Specialization in Youth Sports: A Prospective Cohort Study. *Orthopaedic Journal of Sports Medicine*. 2021;9(7_suppl4):2325967121S00250. doi:10.1177/2325967121S00250.
- Swindell HW, Marcille ML, Trofa DP, et al. An Analysis of Sports Specialization in NCAA Division I Collegiate Athletics. *Orthop J Sports Med*. 2019;7(1):2325967118821179. doi:10.1177/2325967118821179.
- Jayanthi N, Pinkham C, Dugas L, Patrick B, LaBella C. Sports Specialization in Young Athletes. *Sports Health*. 2013;5(3):251-257. doi:10.1177/1941738112464626.
- Post EG, Rosenthal MD, Pennock AT, Rauh MJ. Prevalence and Consequences of Sport Specialization Among Little League Baseball Players. *Sports Health*. 2021;13(3):223-229. doi:10.1177/1941738120970956.
- Wilkins SJ, Bell DR, Kahanov L, Martin M, Post EG. Early Sport Specialization and Long-term Throwing Arm Health in College Baseball Players. *Sports Health*. 2023;15(5):746-752. doi:10.1177/19417381221125719.
- Mosher A, Till K, Fraser-Thomas J, Baker J. Revisiting Early Sport Specialization: What's the Problem? *Sports Health*. 2022;14(1):13-19. doi:10.1177/19417381211049773.
- Zaremski JL, Zeppieri G, Tripp BL. Sport Specialization and Overuse Injuries in Adolescent Throwing Athletes: A Narrative Review. *J Athl Train*. 2019;54(10):1030-1039. doi:10.4085/1062-6050-333-18.
- Croci J, Nicknair J, Goetschius J. Early Sport Specialization Linked to Throwing Arm Function and Upper Extremity Injury History in College Baseball Players. *Sports Health*. 2021;13(3):230-236. doi:10.1177/1941738120986555.
- Post EG, Struminger AH, Hibberd EE. Sport specialization is associated with upper-extremity overuse injury in high school baseball players. *J Shoulder Elbow Surg*. 2020;29(9):1775-1782. doi:10.1016/j.jse.2020.01.092.
- Buckley PS, Bishop M, Kane P, et al. Early Single-Sport Specialization: A Survey of 3090 High School, Collegiate, and Professional Athletes. *Orthop J Sports Med*. 2017;5(7):2325967117703944. doi:10.1177/2325967117703944.
- Neil ER, Winkelmann ZK, Edler JR. Defining the Term "Overuse": An Evidence-Based Review of Sports Epidemiology Literature. *J Athl Train*. 2018;53(3):279-281. doi:10.4085/1062-6050-84-16.
- Ahlquist S, Cash BM, Hame SL. Associations of Early Sport Specialization and High Training Volume With Injury Rates in National Collegiate Athletic Association Division I Athletes. *Orthop J Sports Med*. 2020;8(3):2325967120906825. doi:10.1177/2325967120906825.