Bridging the gap: A scoping review on early sport specialization and diversification recommendations

Dissertation

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Abstract

Youth sport is massive industry that is constantly growing and evolving. One of
the more prominent aspects of the current sport environment is attention to athletic
prowess and competitive success at a young age. In the pursuit of elite development,
many young athletes opt to intensively play a single sport from a young age, known as
early sport specialization. While there are positives to early specialization in terms of
skills development, research from sport scholars and medical practitioners has reached a
growing consensus that considerable physical, psychological, and sociological risk
factors accompany sport specialization. As such, organizations such as the International
Olympic Committee and the American Medical Society for Sports Medicine have
released statements with sport participation recommendations, but there is often a lack of
adherence to these recommendations (McLeod et al., 2010) or they go unnoticed (Bell et
al., 2020; Post et al., 2020).

Such a disconnect between scholarly messaging and what is happening in practice
demonstrates a research-practice gap. This is phenomenon is not specific to sport
specialization, instead, research-practice gaps are lamented across a variety of fields.
Evidence-based practice and implementation science are two approaches that work to
combat these disconnects and bridge the gap. This study draws on concepts from
evidence-based practice and implementation science to assess sport specialization
recommendations.

A scoping review of early sport specialization and diversification literature was conducted and analyzed using the i-PARIHS framework which posits that successful implementation of an innovation is predicated upon the interactions of recipients, context, and facilitation. In total, 37 articles were extracted from the review search. Findings indicated that sport specialization recommendations are produced from a variety of fields, but physical education and sport medicine were the most prominent. Articles that were categorized as narrative reviews had the highest representation in the study. There was also inconsistency in how the articles operationalized early sport specialization which may impact the effectiveness of implementation efforts.

In terms of the i-PARIHS framework, athletes, parents and coaches were consistently identified as recipients of the recommendations, however, athletes were not always discussed in conjunction with another stakeholder which might suggested a lack of athlete autonomy. In the local context, high school physical education programs were suggested as an environment that could have an impact on curbing intensive participation in sport specialization. Entities in the external sport context – operationalized as the wider sport culture inclusive of collegiate and professional sports – often speak out against specialization, but recruitment and talent identification are counterproductive to these efforts. Facilitators were identified, but there was minimal consistency in who could ideally fill the role to translate specialization recommendations into practice.

Dedication

This work is dedicated to my parents and brothers for their constant encouragement, and

to my grandmas who have always looked out for me no matter where they are.

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Fields of Study

Major Field: Kinesiology – Sport Management

Specialization: Graduate Interdisciplinary Specialization in College and
                                    University Teaching

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Chapter 1. Introduction

The youth sport industry is experiencing unbridled growth. A 2019 economic report valued the worldwide youth sport industry at $24.9 billion, with the United States (U.S.) market comprising $19.2 billion of that sum. Prior to the COVID-19 pandemic, economic forecasting predicted the industry will reach $77.6 billion by 2026 (Research and Markets, 2019). Even with the disruption caused by the pandemic, it was a matter of months before competitions resumed following the COVID-19 lockdown because youth sport complexes and club tournaments are often operated by private entities without an overarching governing structure (Bannon, 2020). Even amid periods of time when COVID-19 outbreaks were linked to youth sports, practices and games often continued (Miao, 2021; Turner, 2021).

The underlying message: youth sport is a massive industry that is hard-pressed to slow down operations. The industry's infrastructure was expanding prior to the pandemic (Broughton, 2019), and it appears still poised to adapt operations to a "new normal" and recoup losses due to economic stagnation (Sanderson & Brown, 2020). Responses to the pandemic undoubtedly showcased the resilience of youth sports. At the same time, the rapid rebound of club and travel sports – the industry's fastest growing sector – highlights the influence of another youth sport trend. Sport specialization.

Early sport specialization involves training in a single sport, at the exclusion of other sports, for a majority of the year beginning at age 12 or younger (LaPrade et al., 2016). While specializing at young ages has gained recent notoriety as a trend in youth sport, Smith (2015) argues early specialization dates back to the 1950s with individualized sports. For example, swimmers such as Sylvia Ruuska, Chris von Saltza, and Donna de Varona were active in the 1950s and 1960s, each swimming in the Olympic trials or as members of the Olympic delegation at 14 years old or younger (Smith, 2015).

A rough timeline of sport specialization research shows the idea of sport becoming a more specialized entity entered the literature with Guttman (1978) stating "specialization represents the beginnings of evil" (p. 67), but this reference was not directly related to the youth sport setting. Hill and Simons (1989) conducted some of the first empirical studies examining early specialization by surveying 152 high school athletic directors to elicit their perceptions of sport specialization. According to their results, 71.3% of the participants perceived specialization among high school athletes had increased over the previous ten years, and 60.5% predicted specialization would continue increasing, indicating the trend was garnering notice several decades ago.

Articles reviewing the effects of early specialized training emerged more consistently in the early 1990s (e.g., Barynina & Vaitsekhovskii, 1992; Tofler et al., 1996), followed by Wiersma's (2000) compilation of potential risks and benefits of early specialization. This review examined skill acquisition, motor performance, and sociological and psychological perspectives to assist practitioners with determining

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whether specialization was deleterious to athlete development, but ultimately concluded the potential risks of specialization outweigh the benefits (Wiersma, 2000). Baker and colleagues (2009) later reviewed the positive and negative associations with early specialization and examined early diversification as an alternative for acquiring expertise. Conversely, these authors determined that evidence favoring either approach was inadequate (Baker et al., 2009).

Interest in specialization research has continued to grow considerably, evidenced by the concentrated efforts that are devoted to exploring the topic. For example, special issues on sport specialization were released by the *Journal of Physical Education, Recreation, and Dance* in 2010, *Kinesiology Review* in 2015, and the *Journal of Athletic Training* in 2019 (Smith, 2015). As early specialization scholarship has expanded, the medical community and youth sport researchers have reached a strong consensus cautioning against early specialization due to concerns regarding increased musculoskeletal injuries (Bell et al., 2018), adverse psychosocial outcomes (Brenner et al., 2019), increased sport attrition among youth athletes (Witt & Dangi, 2018), and lower rates of continuing physical activity participation into adulthood (Waldron, 2020). Nonetheless, specializing in a single sport at a young age continues to gain popularity, despite the direct contradiction to recommendations from published research. The discrepancy between messaging from scholars that suggests delaying specialization comparatively to the culture of youth sport and the increasing prevalence of specialization among young athletes highlights a disconnect between sport researchers and practitioners – also known as a research to practice gap.

Research-Practice Gap

In many sectors, what researchers collectively know – the state of science – exists in a relatively separate and autonomous domain from what practitioners collectively do – the state of art (Dearing et al., 2012). A consequence of this autonomy is a considerable time lag between producing and applying knowledge. Within the medical field, the estimated time to translate research evidence into practice is 17 years, a gap that has become known as the "quality chasm" (Morris et al., 2011; Munro & Savel, 2016). However, this is not specific to the medicine as the research-practice gap is a commonly lamented phenomenon that spans across disciplines such as management (Bansal et al., 2012), public mental health (Dingfelder & Mandell, 2011; Ringeisen et al., 2003), special education (Greenwood & Abbott, 2001), and medical practices (Eaglstein, 2010; Lorencatto et al., 2014).

Often, this enduring topic is assessed in terms of identifying why research-practice gaps exist and barriers to bridging the gap (Bansal et al., 2012). Some barriers, such as the distribution of government funding, are sector-specific (Broekkamp & Van Hout-Wolters, 2007), while others consistently appear across disciplines. These more overarching barriers include identifying what applicable research is being produced and the connections between researchers and practitioners. Carter (2008) conceptualized contributors to the research-practice gap as misalignments with knowledge production and knowledge transfer. Essentially, the research-practice gap will persist if knowledge is produced that has minimal practical relevance or if relevant knowledge is generated that is not adequately transferred to practitioners.

From the knowledge transfer perspective, academics and practitioners are fundamentally positioned in two different environments with approaches and priorities that may be incompatible. Practitioners may desire scholarly findings that provide simplified, practical solutions while academics are incentivized to produce outcomes that are methodologically and theoretically rigorous but may not be as accessible to practitioners (Tucker & Parker, 2014). This dichotomy has been characterized using two-communities theory. Originally, this theory developed as a concept that described differences between natural sciences and humanities, suggesting these areas display variations in their norms, values, and beliefs which, in essence, develops into separate cultures (Snow, 1965). Similarly, Caplan (1979) applied this notion of contrasting worldviews to research utilization, suggesting that social scientists and policy makers "live in separate worlds with different and often conflicting values, different reward systems, and different languages" (p. 459). However, the two-communities view has received criticism for painting stark and unnecessary contrasts between academics and practitioners, particularly since a wide spectrum of interaction, communication, and cooperation between these two collectives has been observed (Newman et al., 2016).

Another contributor to the research-practice gap, related to knowledge production, is information overload. This describes the availability of high volumes of research knowledge that overwhelm an individual's processing capacity, impeding their ability to implement research into practice. When there is an absence of information, the quality of decision-making is lower (Ruff, 2002). As information availability increases, so does the quality of decision-making. However, there is a point where information processing

peaks, and additional information creates a cognitive overload, negatively impacting an individual's ability to process, prioritize, and integrate information (Ruff, 2002). This marks the point of information overload, and within areas such as generalized medicine, it can be particularly problematic as approximately 400,000 articles are added to biomedical literature annually (Davis et al., 2004). As massive amounts of research are produced, there is concern about low-quality evidence that results from small sample sizes, unreliable and unvalidated measurement instruments, or general study design and methodology flaws. Furthermore, even rigorously designed studies may not translate well to practical application due to highly controlled research environments (Trinder, 2008).

Since sport management is a relatively new field, it does not contend with the volume of literature present in the medical field, but it is not impervious to the research-practice gap (Zaharia & Kaburakis, 2016). As the field has grown, several interdisciplinary and topic specific sport management journals have been initiated (Shilbury & Rentschler, 2007). According to the NASSM website, as of Fall 2020, there were 100 journals serving sport management scholarship across areas including law, economics and finance, marketing, policy, teaching, and sociology (NASSM, 2020). This rapid increase in journals since the inception of the first journal dedicated to sport management in 1987 demonstrates growth of the discipline, but the volume of scholarship being produced may be challenging for practitioners to navigate.

Dissemination of findings via journal outlets is also a concern for utilization. Funk (2019) employed an S Curve of cumulative article citations to identify how long it takes for sport management articles and ideas to diffuse into the academic community

through journals. According to the S Curve, diffusion of an idea or trend is initially slow as early adopters begin using the information. As the idea gains traction, the curve begins a rapid and steep rise until it peaks and beings to decline again. This steep rise, frequently called the tipping point, represents the quickest and most successful period of diffusion. For some of the most highly cited sport management articles, the tipping point is nine years (Funk, 2019), underscoring the time it takes for academic research to passively diffuse among other sport management scholars, which subsequently influences the time required for ideas to diffuse to industry professionals and practice.

Several sport management scholars also acknowledge a disconnect between sport academics and practitioners that likely stems from "conflicting needs and long-standing attitudes on both sides" (King, 2013, para. 14). Gould (2016) identified sport scientists and coaches are communicating using approaches and terminology that do not relate well to the other faction. Ultimately, coaches are concerned with technical and tactical aspects of their sport while sport scientists often focus on explaining conceptual and theoretical foundations supporting findings. A roundtable with sport scientists emphasized the importance of communicating research in a clear and succinct manner to ensure relevant sport-science findings are impactful for sport stakeholders (Bishop et al., 2006).

The critical assessment of how effectively sport research is applied to practice is not a new concern. Locke (1969) discussed a need for specialized individuals that could act as linkage mechanisms to transport and communicate findings from researchers to practitioners. Lawson (1992) reviewed practitioners' tendencies not to use research and described how this can be derived from shortcomings by scholar and practitioner. Gould

(2016) reviewed knowledge integration and dissemination, the importance of this step, and why it can be challenging for researchers to undertake. Zaharia and Kaburakis (2016) identified barriers and facilitators acting on the research-practice gap within sport management, finding that transactional barriers such as locating applicable research publications, finding the right sport scholars for collaboration, and knowing the costs of collaboration are significant contributors to the challenge of translating research into practice. Overcoming these transactional barriers and developing more interactions between sport academia and practice would mutually benefit both entities.

Bridging the Research-Practice Gap

There is seemingly widespread agreement on why research-practice gaps exist, but only recently have efforts focused on mitigating this issue through strategies developed to facilitate the transfer of research knowledge into practice (Grimshaw et al., 2012). Bansal et al. (2012) identified evidence-based management, also referred to as evidence-based practice, as one of three major approaches to bridging the research-practice gap. Evidence-based management is a family of decision-making processes that involves a critical and mindful approach to assessing various sources of evidence, thus systematic reviews and other forms of research synthesis are a cornerstone of evidence-based management (Briner et al., 2009).

Implementation science is it another tool for bridging the research-practice gap that provides the foundation and theoretical constructs to guide evidence into practice. Instead of producing knowledge that tests the efficacy or effectiveness of an innovation, implementation science focuses on the factors influencing uptake of an innovation into

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practice (Bauer & Kirchner, 2020). This study drew on processes from evidence-based practice and frameworks from implementation science to examine how the research-practice gap related to youth sport specialization can be bridged.

Evidence-Based Practice

Evidence-based practice emerged in medical education and practice as evidence-based medicine which was defined as, "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients" (Sackett et al., 1996, p. 71). As core principles of evidence-based medicine were applied into contexts beyond medicine, the concept expanded to integrate a more interdisciplinary approach. At this point, it became known as evidence-based practice, a term defined as "a disciplined approach to decision making and action, the hallmark of which is attention to evidence quality and the use of the best available evidence" (Rousseau & Gunia, 2016, p. 668). Some researchers prefer the term evidence-based management over evidence-based practice or vice versa based on the perception of which term is more encompassing, but ultimately, the underlying concepts remain consistent. Evidence-based approaches synthesize research and enhance accessibility of the best evidence for practitioners while being cognizant of context as well as practitioner expertise and client values (Bansal et al., 2012; Spencer et al., 2012). For the remainder of this review, the term *evidence-based practice* (EBP) will be used.

Since EBP considers several sources of evidence to inform effective decision-making (Rousseau & Gunia, 2016), the synthesis of relevant evidence is a primary pathway to establishing best-practice guidelines. Research synthesis and reviews provide

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a whole that is more powerful than the parts due to viewing a set of primary studies in new ways that are complex, refined, and sophisticated (Suri, 2013). Straus et al. (2009) stated that "systematic reviews are the foundation of most activities related to knowledge translation, reflecting that the totality of evidence should be considered rather than the results of individual studies" (p. 167). Similarly, Lavis et al. (2003) suggested that actionable messages should be transferred from a body of research knowledge instead of results from single research report or study to enhance the possibility of uptake. While research synthesis is often synonymous with systematic reviews, the number of available review types and associated methodologies has expanded to enhance the uptake of evidence-based principles from diverse sources (Grant & Booth, 2009).

Implementation Science

Various terms are associated with bringing research knowledge into action including knowledge translation, knowledge exchange, knowledge utilization, and implementation. These are often used interchangeably, potentially resulting in a lack of clarity (Grimshaw et al., 2012; Tabak et al., 2012). Nonetheless, the general commonality among these terms is they reflect actions beyond simply disseminating knowledge and, instead, enter the realm of actively utilizing knowledge (Straus et al., 2009). For this study, *implementation* will reference any strategy that promotes the uptake of research and other evidence-based practices into the field (Eccles & Mittman, 2006).

Similarly, implementation science is the scientific study of methods used to transfer research into routine practice. Systematically facilitating research findings into the field, using evidence-based approaches, and improving the quality and effectiveness

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of practice are three key aspects of implementation science (Tabak et al., 2012). Rabin et al. (2008) described foundational activities of implementation science on a spectrum from passive (diffusion) to more active (implementation) approaches. Subtle differences between these approaches can influence how effectively research evidence and interventions are translated into practice which will be described in greater depth.

Diffusion is the process by which ideas, behaviors, and practices are communicated to a social system through various direct and indirect channels (Dearing et al., 2012; Rapport et al., 2018). This is inherently a passive process that is uncontrolled and unplanned, often making it so that diffused messages are only received by those actively seeking the information (Lomas, 1993). Since diffusion is the least focused and intense approach along the implementation continuum, it is most successful in situations with a high reward for finding the information and low costs associated with searching, such as a small informational pool (Lomas, 1993; Rabin et al., 2008). Comparatively, dissemination is an active process characterized by more aggressively passing information from source to recipient (Lomas, 1993). In addition, dissemination implies that information is targeted and tailored to a specific audience and delivered through intentionally planned channels (Lomas, 1993; Rapport et al., 2018).

Implementation is the process of "integrating evidence-based interventions within a setting" (Rabin et al., 2008, pg. 118). This implies tailoring a message to a specific audience, but also identifying barriers that might exist in using the knowledge and overcoming these barriers to promote a successful application of knowledge (Lomas, 1993). As implementation involves outlining procedures that are not guaranteed to take

hold in an environment, implementation efforts can result in unchanged systems and wasted resources. On the other hand, successful implementation can positively impact and optimize an entire system (Rapport et al., 2018). The final terms discussed are not related to the process of translating an intervention into practice, but they are part of the cycle that determines whether implementation is successful. Therefore, they are worth noting. Adoption is an organization's commitment to initiate an evidence-based intervention, and the degree to which these ideas, behaviors, and practices are integrated into the organization (Rabin et al., 2008; Rapport et al., 2018). Finally, sustainability describes the logical conclusion of new knowledge being accepted into a system and the degree to which this knowledge continues providing intended benefits to the organization (Rabin et al., 2008). Reaching sustainability requires the system develop feedback loops to continually monitor knowledge uptake and adoption until it become integrated into the culture of the organization, a point known as institutionalization (Rapport et al., 2018).

As in other disciplines that rely on theories to enhance understanding of a phenomenon or predict outcomes, implementation science also benefits from the application of models, theories, and conceptual frameworks. However, selecting one that can appropriately guide a study can be challenging given the sheer number of available possibilities. Tabak et al. (2012) identified 61 models ranging in their focus from pure dissemination or implementation models to a combination of the two strategies. Several models also were excluded from Tabak et al.'s (2012) study because they did not fit the review criteria (e.g., they were only applicable on a national but not local level of implementation). Similarly, Birken et al. (2017) found that implementation scientists

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across 12 countries recognized over 100 implementation theories and frameworks, emphasizing the robustness of the available resources as well as the challenge of choosing and appropriate theory. Considering the quantity and diversity of theories and framework available, Birken et al. (2017) also attempted to understand the criteria that implementation scientists use to select a theory. Survey results indicated no clear consensus on the most important criteria, and most researchers often employ multiple criteria in their selection, further highlighting the challenges associated with choosing an appropriate theory, model, or framework to support a project (Birken et al., 2017).

Selecting a framework for this study was guided by Handley and colleagues' (2016) methodological overview of implementation science that discussed three key phases of implementation science: 1) pre-implementation planning, 2) designing the intervention strategy, and 3) evaluating the implementation strategy. Since implementation science efforts are quite new to the realm of early sport specialization, there is an absence of previously designed interventions. Therefore, specialization needs to be approached using pre-implementation planning steps which involve describing the evidence-practice gap and the evidence that will be translated, identifying key stakeholders, and determining the stakeholders' readiness for change (Handley et al., 2016).

The integrated Promoting Action on Research Implementation in Health Services (i-PARIHS) framework identifies the innovation, recipients, context, and facilitation as four constructs that are necessary for successful implementation of an intervention. These constructs align with information that needs to be gathered in the pre-implementation

planning steps – for example recipients are similar to identifying key stakeholders. In addition, the i-PARIHS is one of the most common frameworks used in implementation science (Birken et al., 2017) and has undergone a series of refinements based on scholarly critiques and empirical testing (Kitson et al., 1998; Kitson et al., 2008; Harvey & Kitson, 2016). As such, the i-PARIHS framework was chosen to guide development of this study.

Problem Statement

As a whole, empirical research on sport specialization and diversification is quite underdeveloped and limited. While the amount and coverage of specialization research has increased dramatically over the last few years (Kliethermes et al., 2021), there are still valid concerns as researchers advance the knowledge base. Most notably, there is not an agreed upon definition with validated constructs to measure specialization (Jayanthi et al., 2020) and most literature is either based on expert opinion or retrospective data that relies heavily on participant recall (Butcher et al., 2002; Côté et al., 2009a; Farrey, 2010). The relationships between early sport specialization and adverse psychological or sociological outcomes – for example burnout and attrition – remain primarily theorized (Larson et al., 2019), and potentially positive developmental experiences of specialization may be overlooked because of the breadth of negative research and popular media reports (Livingston et al., 2016). Finally, there is a dearth of research on other important stakeholders in the youth sport environment, such as coaches and parents.

These shortcomings arguably stem from the rapid evolution of sport specialization research, and scholars are work toward filling these gaps. Jayanthi and colleagues (2015) developed a 3-point instrument to consistently categorize and measure degrees of

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specialization which are being expanded upon to address recognized limitations

(Downing et al., 2020). Empirical evidence using instruments that categorize degree of

specialization to directly assesses a range of physiological outcomes and their

associations with early specialization is becoming more prominent (e.g., Biese et al.,

2020; Dahab et al., 2019). Scholars have suggested taking a socioecological approach to

studying early sport specialization and diversification and assessing interactions between

social actors involved in the youth sport experience (DiSanti & Erickson, 2019, 2020).

Such examples point to undisputed progress in sport specialization research, however,

one area that has received far less attention is transferring this knowledge into action.

In 2019, the American Medical Society for Sport Medicine (AMSSM) hosted a

summit on early sport specialization to review current scientific knowledge and develop a

research agenda. The summit recognized that "current evidence-based guidelines are not

being effectively communicated to key stakeholders including young athletes, parents,

coaches and sport administrators" (Kliethermes et al., 2021, p. 141) and proposed

conducting dissemination and implementation research to assess the application of

evidence-based recommendations as one of six research priorities. Bell and Stracciolini's

(2019) five main questions for advancing sport specialization also noted the importance

of disseminating knowledge to multiple stakeholders to ensure informed decision-making

about sport specialization.

Sport organizations and medical associations are continually integrating research

and professional opinions to develop updated position and consensus statements that

provide practical recommendations. Such statements have been released from

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organizations such as the American Academy of Pediatrics (AAP; Anderson et al., 2000),

the National Association for Sport and Physical Activity (NASPE, 2010), the National

Athletic Trainers Association (NATA; Valovich McLeod et al., 2011), and the

International Olympic Committee (IOC; Bergeron et al., 2015). Recently, Jayanthi et al.

(2019) compiled and summarized recommendations from seven different position

statements to provide an overview of the current state of sport specialization evidence,

which included statements from several of the aforementioned organizations.

The consensus from Jayanthi and colleagues' review was that "specialization before

adolescence may increase the risks of overuse injury and burnout" (p. 1041). While there

is a lack of evidence supporting a specific age to begin specializing in a single sport,

these professional organizations advocated for delaying specialization and supported

early diversification due to the presumed health benefits associated with exposure to an

array of sports. However, it was noted by the IOC that specialization is not universally

detrimental, and the proper precautions, training, and support can still result in positive

experiences for athletes that specialize at an early age. Scholars have urged early

specialization research to move beyond the biased view that specialization is inherently

detrimental, but the recent proliferation of publications, in combination with existing

professional opinion, still generally advocate for an early diversification approach to

youth athletics and provide specific recommendations for athletes that are intensely

involved in sport training.

Yet over 80% of parents and nearly the same percentage of coaches in youth sport

may be unaware of these recommendations (Bell et al., 2020; Post et al., 2020).

Furthermore, Bell and colleagues (2020) stated that "despite the dissemination of the recommendations within medical journals, this information is not being disseminated at an impactful level to the general public" (p. 542). Herein lies a major concern for the burgeoning field of sport specialization research: will pertinent information related to the health, well-being, and longevity of athletes reach the intended audience to mitigate the disconnect between scholarly messaging and the current culture of youth sport?

Purpose of the Study

In the projected research priorities, Kliethermes et al. (2021) stated that effective dissemination and implementation science efforts would include all relevant stakeholders and address the contexts and complexities of youth sport specialization through the appropriate framework and methodologies. The i-PARIHS framework is viable for such an endeavor because it evaluates four constructs that are viewed as necessary for successful implementation of research into practice. Reviewing each of these constructs as they relate to sport specialization will provide researchers and practitioners with a better understanding of the unique characteristics that contribute to successful implementation of research evidence in this environment. Therefore, the primary purpose of this study is to assess early sport specialization and diversification recommendations in alignment with elements of the i-PARIHS framework to build a foundation for successful implementation of recommendations into practice.

Jayanthi and colleagues' (2019) narrative review of positions statements synthesized research recommendations from major medical and sport organizations. However, this review specifically focused on compiling the evidence that supports

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various recommendations which still only accounts for a single construct of the i-PARIHS framework (i.e., innovation). Position statements and systematic reviews also represent a small portion of the academic literature offering recommendations for youth sport. As such, this study will expand upon this work by conducting a scoping review that synthesizes recommendations from a larger and more diverse set of resources and identifies the recipients, context, and facilitators that may be necessary for successful implementation of these recommendations into practice.

Research Questions

Early sport specialization and diversification is a complex phenomenon that involves the interaction of several stakeholders across multiple contexts. Implementation science frameworks offer promising tools and strategies to surmount the challenges of bridging the research-practice gap in sport specialization. This scoping review was guided by several research questions that were developed to reflect the constructs of the i-PARIHS framework.

RQ1: What recommendations are available to be implemented for youth athletes based on outcomes of early sport specialization?

RQ2: Who have these recommendations been targeted toward to implement?

RQ3: When and where have these recommendations been implemented?

RQ4: What mechanisms have been used to implement these recommendations?

The first research question regarding available recommendations guided other methodological decisions that were necessary to develop the scoping review protocol.

Limitations

The main limitation of scoping reviews, as with other review types, is the subjective development of a search universe and search strategy. While the intent is to develop a comprehensive search, it is necessary to develop a search strategy that returns a high number of pertinent studies without simultaneously returning high volumes of irrelevant results. In attempting to increase the precision of a search, it is possible to exclude relevant references. Studies were also extracted by only one researcher which removes the system of reaching agreement on all the articles that are passing through the various screening stages. Quality reviews can still be conducted by a single researcher, but the application of inclusion and exclusion criteria has a higher chance of being inconsistent since the review is lacking another person with a different perspective to review the material. Similarly, the extracted material is not validated by a second reviewer which affects the rigor of the review.

Delimitations

As with any research synthesis methodology, the focus of the review is narrowed through the inclusion and exclusion criteria. With early sport specialization and diversification being a complex, interdisciplinary topic to review, the criteria for this scoping review delimited to sample to articles that included practical recommendations related to early sport specialization and diversification.

Key Terms and Definitions

Context: Construct of the i-PARIHS framework that encompasses the inner and outer environments that will influence implementation of an intervention (Harvey & Kitson, 2016)

Early sport diversification: Participation in a variety of sports and activities until approximately 12 years old, through which a young athlete develops multilateral physical, social, and psychological skills (Côté et al., 2007)

Early sport specialization: AOSSM determined that ESS should be defined by three criteria: 1) participation in intensive organized sports training and/or competition for greater than eight months per year, 2) participation in one sport at the exclusion of other sports, and 3) involving prepubertal children roughly 12 years of age or younger (LaPrade et al., 2016). Throughout the course of this review, the terms early sport specialization, sport specialization, and specialization are used interchangeably, but the focus always remains on athletes choosing to pursue a single sport at a young age.

Evidence-based practice: A disciplined approach to decision making and action, hallmarked using the best quality and best available evidence (Rousseau & Gunia, 2016)

Facilitation: Construct of the i-PARIHS framework that is considered the active ingredient to implementation and incorporates the role of a facilitator and the strategies and actions that are needed to guide implementation (Harvey & Kitson, 2016)

Implementation: Strategies that promote the uptake of evidence-based research into practice (Eccles & Mittman, 2006)

Implementation science: Facilitating research findings from evidence-based approaches into the field to improve quality and effectiveness (Tabak et al., 2012)

Innovation: Construct of the i-PARIHS framework that focuses on sourcing and applying available evidence (Harvey & Kitson, 2016)

Literature reviews: Distinct research design that synthesizes all the available evidence to draw robust conclusions (Siddaway et al., 2019)

Recipient: Construct of the i-PARIHS framework that focuses on people who influence and are affected by the implementation of an intervention (Harvey & Kitson, 2016)

Research synthesis: Overarching term that describes approaches of aggregating, integrating, and synthesizing primary research findings (Schick-Makaroff et al., 2016)

Scoping review: Evidence synthesis approach that is conducted to identify and map available evidence and is useful for examining evidence that has less clearly defined research questions due to the state of the literature (Munn et al., 2018)

Systematic review: Type of literature review that is characteristically comprehensive and replicable due to an explicit methodology (Siddaway et al., 2019)

Chapter 2. Knowledge Translation in Youth Sport

Doctor Neeru Jayanthi, the Director of Sports Medicine Research and Education at Emory Healthcare, specializes in youth sports health, injuries, and sports training. As one of the leading medical practitioners in youth sport that often works with individuals preparing to enter college athletics, he was quoted as saying "kids are broken by the time they get to college" (Holmes, 2019, para. 16). This is not an isolated opinion as others in sport medicine have expressed concern based on anecdotal evidence of youth athlete injuries and treatment.

In a 2013 interview, Dr. James Andrews, an orthopedic surgeon for professional level athletes, discussed witnessing a sharp enough increase in the incidence of sport-related injuries among youth athletes that he was compelled to write a book about injury prevention (Manoloff, 2013). Roughly six years later, Dr. Andrews' opinion was that little had improved because the youth sport culture still pressured athletes to specialize and play a single sport year-round (Bielik, 2019). The orthopedic surgeon has leveraged research by the American Sport Medicine Institutes into pitch count recommendations, financially supported the Sports Trauma and Overuse Prevention (STOP) Initiative, and recommended youth athletes take three to four months off from a given sport per year (Andrews, 2013). Yet, these efforts and others from academics and medical practitioners are not successfully shifting youth sport away from the narrative that early specialization

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is required for elite sport attainment. To further explore the implementation of recommendations within the competitive youth sport environment, this chapter will review: 1) youth sport and the rise of early sport specialization as a popular trajectory for pursuing elite athletic development, 2) implementation science and evidence-based practice, and 3) research methodologies that promote the synthesis of relevant evidence.

History of Youth Sport and Athlete Development

Youth sport is constantly evolving and has oscillated between youth-driven endeavors that support holistic development and more structured, competitive pursuits. When youth sport originally emerged, children were encouraged to play sport as a means of developing the mind and body while instilling feelings of group pride and loyalty, particularly among young boys (Albrecht & Strand, 2010). In this time, the Young Men's Christian Association was established, and, simultaneously, Luther Halsey Gulick and G. Stanley Hall championed the theory of play. During this time, youth sport continually became more organized and competitive, until professional educators in the 1930s discouraged competitive sports as they were perceived to overshadow academic pursuits and cause physical or emotional damage to children.

This stance considerably diminished the availability of youth sport through the educational systems until the early 1950s. Nonetheless, the establishment of volunteer-run youth sport groups continued to be supported, leading the way for organizations such as Pony League Baseball, the American Youth Soccer Associations, and the National Youth Sport Program to develop (Albrecht & Strand, 2010). In the 1950s and 1960s, participation in competitive youth sport surged as public and private organizations began

sponsoring programs (Coakley, 2015). Parents valued and believed in the positive aspects of sport, including physical fitness, sportsmanship, and character development, more than the negative aspects. Furthermore, the organization of youth sport was not questioned as parents – specifically fathers – became involved as coaches and administrators of teams (Albrecht & Strand, 2010).

At this time, sport opportunities were almost exclusively for young boys, however, the passage of Title IX in 1972 led to another surge in youth sport programming as girls and women were provided with more chances to participate in sport (Albrecht & Strand, 2010; Coakley, 2015). By the 1980s, youth sport and physical activity was occurring more often in adult-organized and controlled programs, a shift that was driven by a neoliberalist cultural ideology. Neoliberalism emphasized free markets, privatization, and the pursuit of individualism, self-interests, and material wealth. Coakley (2015) discussed how this cultural shift gave way to six social changes that considerably influenced the delivery of youth sport programming:

    1) Families with both parents working outside the home increased, leading to higher demands for supervised after-school and summer programs.

    2) The perception of a "good parent" changed to reflect parents that could constantly account for the whereabouts of their children, again leading to a demand for adult-supervised activities. Furthermore, parents often connected their worth as parents to visible achievements of their children which were easily observed through competitive sport accomplishments.

    3) Informal, child-dictated activities were viewed as threats to the social order that

would inevitably lead to troublemaking.

4) Organized sports offered protection from perceived threats (e.g., child

abductions) that parents were increasingly concerned about outside the home.

5) Competitive sport became more valued in society as high-performance,

professional sports gained visibility.

6) Childhood play faded as children were given less opportunities to engage in

spontaneous activity.

Through these social changes, competitive sport became inextricably linked to good

parenting and a willingness to invest considerable family resources into athletic

endeavors. According to Pruter (2013), "interscholastic sports during the 1980s began to

repeat the excesses of the 1920s, creating highly competitive, pressurized sports

environments, with increasingly commercialized programs that became national in

scope" (p. 322).

Early Sport Specialization and Diversification

The demands of an environment dominated by privatized, adult-driven sport

delivery systems that emphasize competitive excellence and athletic success gave rise to

early sport specialization (DiSanti & Erickson, 2019; Jones et al., 2018; Popkin et al.,

2019). Simply put, adolescent athletes are choosing to specialize in a single sport at

younger ages, some as early as seven or eight years old (DiFiori, 2014; Hecimovich,

2004; LaPrade et al., 2016; Myer et al., 2016; Valovich McLeod et al., 2011). Baker

(2003) described specialization as limiting childhood sport participation to a single sport

with a deliberate focus on training and development in that sport. Capranica and Millard-

Stafford (2011) operationally defined sport specialization as "the age or point in time when sport training and competition is restricted to and focused upon a single sport in the pursuit of elite performance" (p. 572). Hall et al. (2015) described sport specialization as intense year-round training in a single sport at the exclusion of other activities.

There are commonalities in these definitions that essentially revolve around athletes partaking in high volumes of intense and structured training at a young age, an emphasis on physical development and obtaining elite status, and an exclusion of all other sports. Most recently, a symposium convened by the American Orthopaedic Society for Sports Medicine (AOSSM) determined that early specialization should be defined by three criteria: 1) participation in intensive organized sports training and/or competition for greater than eight months per year, 2) participation in one sport at the exclusion of other sports, and 3) involving prepubertal children roughly 12 years of age or younger (LaPrade et al., 2016).

On the other side of the spectrum, early diversification reflects participation in a variety of sports and activities until approximately 12 years old, through which a young athlete develops multilateral physical, social, and psychological skills. This pathway can optimize athletic success while reducing the risk of injury (LaPrade et al., 2016) and other negative developmental consequences linked to early intensive training (Baker et al., 2009). Côté et al. (2009) also advocate for a diversification pathway suggesting it allows for more enjoyable adolescent sport experiences. Since children frequently cite enjoyment and fun as reasons for sport participation, this may foster increased intrinsic motivation to continue participation later in life (The Aspen Institute, 2018).

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While early diversification offers an option that can reduce many major concerns associated with early specialization, as the system stands, there is a major challenge facing athletes, parents, and sport administrators that favor early diversification – a fear of falling behind. Specialized athletes experience performance improvements in a target sport more rapidly than diversified athletes, however, the capabilities of diversified athletes can eventually equal or surpass their specialized counterparts, if given the time (Fransen et al., 2012). However, in a sport culture that prioritizes and celebrates individual performances, the early identification, recruitment, and development of talent is also encouraged (Hainline, 2019), making it possible that an athlete will be cut from a team before developing to their fullest potential in a specific sport.

Models Associated with Early Sport Specialization and Diversification

Early specialization and diversification are concerned with athlete development, and several models, such as the long-term athlete development model, address critical stages in youth athlete development. However, most of these models are not directly associated with early specialization and diversification and their subsequent outcomes. Goodway and Robinson (2015) identified three models that are relevant to the examination of early sport specialization: 1) mountain of motor development framework, 2) spirals of engagement trajectory, and 3) developmental model of sport participation (DMSP). The mountain of motor development framework (Clark & Metcalfe, 2002) is valuable in considering the early years when an athlete is choosing to specialize or diversify. This framework visualizes skill attainment across five phases of development beginning with reflexive behaviors as the mountain base and skillfulness as the mountain

summit. In between this base and summit, a learner will experience a preadapted period, fundamental motor patterns, and a context specific period, each of which are influenced by an individual's biology and environment (Clark & Metcalfe, 2002).

The spirals of engagement (Stodden et al., 2008) is a conceptual model that proposes a relationship between the development of motor competence and physical activity engagement. The model proposes early physical activity experiences provide an opportunity for young individuals to develop motor competencies, specifically, those who engage in sport sampling will obtain a wider range of motor skills. As fundamental motor skills improve, children are more likely to continue pursuing engagement in physical activity (i.e., positive spiral of engagement). Those with lower motor skill competence are more likely to disengage from physical activity (i.e., negative spiral of engagement). This attrition from physical activity can subsequently lead to adverse health outcomes, such as obesity, through adolescence and likely into adulthood. Connecting to early specialization and diversification, it is unclear whether athletes that specialize are drawn into a positive spiral of engagement (Goodway & Robinson, 2015). While they are immersed in physical activity, only participating in a single sport may have potential limitations on motor skill development, leading to a negative spiral of engagement.

Finally, Côté and colleagues (2007) developed the DMSP from an examination of how varying developmental experiences can impact attainment of exceptional athletic performance. To establish their model, the researchers combined the concepts of deliberate practice and deliberate play with retrospective information from training questionnaires and interviews with athletes and parents. Deliberate practice is defined as

highly structured activities designed to monitor performance, provide feedback, develop

expertise (Ericsson et al., 1993), while deliberate play is defined as inherently enjoyable

activities that may contribute to expert development (Côté et al., 1999). This model

depicted two different entries into sport participation, early specialization and early

sampling (i.e., diversification) and described three distinct sport participation trajectories

or pathways that can result in either recreational participation or elite performance.

Goodway and Robinson (2015) specifically identified the DMSP as a valuable

model for examining various developmental trajectories available for youth athletes to

pursue. A scoping review conducted by DiSanti and Erickson (2019) also identified the

DMSP as the most prominently used framework among studies on specialization that are

guided by a theoretical model or framework. Furthermore, the originating article for the

DMSP (i.e., Cote, 1999) was the most cited article in a citation network analysis related

to seven models of athlete development indicating the concept that eventually gave rise to

the DMSP has substantially influenced the overall network of athlete development

literature (Bruner et al., 2010). As such, the DMSP will be considered in greater depth

comparatively to the previous two models.

The first pathway – elite performance through sampling – is characterized by

movement through three distinct developmental phases (i.e., sampling, specializing, and

investment years; Côté et al., 2007). When children are in their sampling phase at

approximately 6 to 12 years old, they engage in a wide variety of sports involving high

levels of deliberate play but low levels of deliberate practice. Children interested in elite

development then will enter specializing years which have a narrowed sport focus and are

characterized by approximately equal amounts of deliberate practice and deliberate play. Finally, around 16 years old, athletes will start their investment years where more time is spent in deliberate practice, and the athlete is primarily engagement in a single sport.

If an athlete completes the sampling years and chooses not to pursue elite sport development, they enter the second pathway – recreational participation through sampling. This trajectory is characterized by age-appropriate competitions at continuously low levels of deliberate practice. An athlete that is pursuing elite development may adjust their involvement in sports and enter this recreational pathway at any time during their sport career, or cease involvement in sports altogether (Côté et al., 2007). The third and final pathway – elite performance through early specialization – involves specializing in a single sport without a major sampling phase. In the early specialization pathway, athletes engage in their sport of choice as young as six years old and focus on extensive amounts of deliberate practice with minimal engagement in other sports or deliberate play.

One of the major propositions of the DMSP is that elite attainment can be achieved through either an early specialization or early diversification entry into sport. Subsequent research that developed seven postulates in association with the different DMSP pathways highlight the effectiveness of programs developed around sport sampling and deliberate play, supporting a diversification approach (Côté et al., 2009b). The postulates include statements such as, "early diversification (sampling) does not hinder elite sport participation in sport where peak performance is reached after

maturation" and "early diversification (sampling) is linked to a longer sport career and has positive implications for long-term sport involvement" (Côté et al., 2009b, p. 11).

Evidence supporting these postulates was reviewed to evaluate the strength of the claims made in each postulate (Côté & Vierimaa, 2014). For each postulate, the related studies were evaluated based upon study design, study quality, consistency across multiple studies, and directness. Only one postulate received a rating of "low" across all four evaluation criteria while the other six received a "moderate" or "high" rating on a majority of the evaluation criteria (Côté & Vierimaa, 2014). This systematic evaluation of evidence quality related to the postulates also supports the overall conceptualization of the DMSP as a theoretical framework to guide studies relates to early sport specialization and diversification.

Sport Specialization and Diversification Outcomes

While early sport specialization has become a popular route for pursing elite sport performance, it has also been criticized by researchers and health professionals that are focused on the links between early intensive training and negative developmental consequences (Baker et al., 2009). DiSanti and Erickson's (2019) systematic scoping review highlighted three major outcomes of sport specialization: physiological, psychosocial, and talent development outcomes, and the major findings for each of these outcomes will be discussed in the following sections.

Physiological Outcomes

Physiological concerns for adolescent athletes emerged as research emphasized critical periods of physiological and biological development that make adolescents

uniquely vulnerable to injury, such as growth plate vulnerability (Caine et al., 2006), the adolescent growth spurt (Caine, et al., 2014), and muscle-tendon imbalances (Mersmann et al. 2014). Physical activity or sports-related injuries account for approximately 1 in every 5 injury episodes for individuals between 5 and 24 years of age (Bell et al., 2016), and approximately 50% of patients that report to pediatric sport clinics present with chronic injuries (Valovich McLeod et al., 2011). Position statements caution against sport specialization due to the perceived association with physiological consequences (e.g., Bergeron et al., 2015; Difiori et al., 2014; LaPrade et al., 2016; Valovich McLeod et al., 2011). However, inconsistencies in defining and categorizing athletes as specialized in addition to determining injury classifications among adolescent athletes makes the hypothesized connection between sport specialization and increased injuries tenuous (Ahlquist et al., 2020; Difiori et al., 2014; Kaleth & Mikesky, 2010).

More recent empirical studies have provided evidence that specialized athletes have a higher propensity for sustaining musculoskeletal injuries. Consistent with medical position statements, investigations on weightlifters (Bush et al., 2019), ice hockey players (Sheppard, et al., 2020), and female adolescent athletes (Hall et al., 2015) show that early specializing athletes sustained injuries more frequently or reported more pain and symptoms of dysfunction in daily life. Among a sample of 232 National Collegiate Athletic Association (NCAA) Division I athletes, individuals that specialized in a single sport before the age of 14 were more likely to report multiple college injuries, a higher number of total injuries, and more time spent out due to injury comparatively to athletes that specialized later in their career (Ahlquist et al., 2020). Bell et al. (2016) found similar

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trends among a high school population with athletes in the highly specialized group being more likely to report overuse knee injuries.

Results from a systematic review and meta-analysis found highly specialized athletes were more likely to sustain overuse injuries compared to low and moderately specialized athletes by 81% and 18%, respectively (Bell et al., 2018). Moderately specialized athletes were 39% more likely to sustain injuries than individuals categorized as low specialization athletes (Bell et al., 2018). This study categorized specialization as low, moderate, or high based on the scale developed by Jayanthi et al. (2015). While the systematic review provided evidence that consistently suggests musculoskeletal overuse injuries are higher among specialized athletes, with only four studies in the meta-analysis, it also displayed that there are limited high-quality studies in this area (Bell et al., 2018). Despite indications that a relationship exists between degree of specialization and injury, high school athletes tend to believe that specialization will not considerably increase their chance of injury (Brooks et al., 2018).

It is worth noting that the most recent review studies published on specialization outcomes and recommendations (e.g., Bell et al., 2018; Carder et al., 2020; DiSanti & Erickson, 2019; Fabricant et al., 2016; Giusti et al., 2020) may have largely missed the most recent wave of specialization literature published. There has been a considerable uptick of literature in 2019 (Kliethermes et al., 2020), but since only two reviews had search strategies that went into April and May of 2019, it is necessary to conduct updated systematic reviews to confirm these relationships.

Psychological Outcomes

Research on the psychosocial aspects of early specialization have typically investigated indicators of burnout/withdrawal (Butcher et al., 2002; Fraser-Thomas et al., 2008) and stress associated with high level performance and expectations (Harwood & Knight, 2009). Baker et al. (2009) reviewed negative consequences potentially linked to specialization including decreased sport enjoyment, attrition and burnout, and compromised social development. The studies reviewed by DiSanti and Erikson (2019) echoed that these are the major psychosocial concerns for specialized athletes, however, there is still inconsistency regarding the findings comparing the psychosocial well-being of early specialized athletes to early diversified athletes.

Strachan et al. (2009) found these two groups did not differ in terms of their psychosocial profile or sport enjoyment, but specialized athletes were more likely to report burnout and physical or emotional exhaustion. Additionally, some elite athletes have expressed high levels of career satisfaction while others have reported difficulty balancing their athletic schedule with other commitments including school, friends, and social activities (Dubuc et al., 2010). Comparatively to injury studies, the psychosocial dimensions appear more complex, particularly since they are affected by several factors including peers, coaches, and parents that can influence the stress or pressure associated with an adolescent's athletic career.

Talent Development

Sport is inherently a competitive enterprise driven by talent identification and development as sport teams and organizations focus on their own growth and success

(Pankurst & Collins, 2013). Talent identification processes have been heavily researched, beginning in the 1970s when researchers attempted to predict sport performance based on physical, psychological, technical, and physiological aptitude (Durand-Bush & Salmela, 2001). Bar-Or (1975) proposed a five-step talent-identification approach which utilized a multiple-regression analysis model to predict performance. Jones and Watson (1977) predicted performance using expressly psychological variables, while Gimbel (1976) analyzed talent from a three-pronged approach that included physiological variables, trainability, and motivation.

While this research eventually shifted toward more holistic and developmental approaches, talent identification remains a fixture in sport, evidenced by the early recruitment strategies of college and professional teams. Although sport programs may appear to suggest, or even support, the value of playing several sports during developmental ages, they are simultaneously selecting advanced players to train on elite teams at an early age. For example, in 2011, Real Madrid signed a seven-year-old soccer prodigy to their youth academy after seeing him in tryouts (Associated Press, 2011). However, this identification process is underscored by the unproven assumption that future talent and performance is predicted by characteristics that are measured during a developmentally unstable period of growth and maturation (Abbott et al., 2005).

An application of dynamic systems theory to talent identification and development highlights the theoretical flaws associated with identifying talent based upon physical and performance characteristics at a young age (Abbott et al., 2005). Dynamic systems theory was developed from a branch of mathematics and is essentially

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the science of complex systems. The guiding principle of the theory is that complex systems, such as a developing individual, are composed of innumerable interacting variables. As a whole, the system is characterized by complete interconnectedness and, therefore, a change in one variable of the system will impact or alter all other variables (De Bot et al., 2007). As a result, outcomes variables in a developing system cannot be calculated exactly because variables are continually changing and interacting (De Bot et al., 2007). Applied to sport, when coaches attempt to make predictions about future talent or performance based on micro-level variables (e.g., physical characteristics or hand-eye coordination), there is a distinct possibility that aging and maturation will alter these variables in an unexpected and non-linear pattern (Abbott et al., 2005). Nonetheless, as sport organizations seek to acquire and develop talent before their competitors, athletes are drawn into a system where policy recommendations often contradict with practice (Pankhurst & Collins, 2013).

A natural counterargument to concerns about early specialization is that specialized training at an early age in necessary to acquire elite skills and a competitive advantage, thereby boosting the opportunity to obtain a collegiate or professional athletic career (Pruter, 2013). Many reviews on early specialization have contended that college scholarships and elite success are motivators for early specialization (Bergeron et al., 2015; La Prade et al., 2016), but this claim is mainly supported by anecdotal evidence and observations of the increasing competitiveness, size, and commercial nature of the youth sport industry. Few studies have analyzed the allure of scholarships or elite development among the athlete population. Those that have support the notion that

perceived development and enhanced scholarship potential are drivers of early sport specialization.

Brooks et al. (2018) analyzed survey responses from 974 youth athletes across 15 sports and found approximately 91% of the athletes strongly believed specializing in a single sport increased their chances of improving. Additionally, 16% of the athletes reported being "very or extremely likely" to receive an athletic scholarship, a belief that was strongest among highly specialized athletes (Brooks et al., 2018). Among a sample of NCAA Division I athletes, 33% reported their reason for specializing was enjoyment of the sport, 23% indicated obtaining a scholarship, and only 6% were seeking a competitive advantage (Ahlquist et al., 2020). Statistics report that only 7 percent of nearly 8 million high school athletes will play a varsity sport in college (NCAA, 2019), with approximately 2 percent awarded some form of athletic scholarship (NCAA, 2018). Fewer than 2 percent of athletes playing in the NCAA will continue their careers at the professional level (NCAA, 2018). The discrepancy between the percentage of athletes expecting to receive a scholarship comparatively to the percentage of athletes that are awarded scholarships illuminates potentially inflated expectations.

Early specialization is often viewed as a mechanism for elite skill development because it provides an opportunity for athletes to immerse in a specific sport and accumulate substantial hours of practice. This perceived connection is related to a robustly supported relationship in behavioral science between the amount of time spent practicing and increased levels of achievement (Bloom, 1985; Ericsson et al., 1993; Newell & Rosenbloom, 1981; Simon & Chase, 1973). From investigations into the theory

of expertise, and in developing the theory of deliberate practice, Ericsson et al. (1993) posited that objectively measurable music performances could be gradually improved by engaging in training activities specifically designed to enhance a particular aspect of performance (i.e., deliberate practice). Furthermore, the researchers established the most accomplished group of violinists in their study accumulated significantly more hours of practice than the two less accomplished violinist groups. On average this group accumulated 10,000 hours of practice by the age of 20 (Ericsson et al., 1993).

Findings from their study have since been extrapolated and applied to a variety of different domains, including sport. However, a specific quantity of practice became known in mainstream sport development literature after these results were popularized by the book *Outliers*. In this book, Malcolm Gladwell generalized that obtaining excellence in complex tasks requires a critical minimum amount of practice which researchers agreed upon is – 10,000 hours (Gladwell, 2008). Ericsson (2013) has since refuted these claims, indicating it is a misrepresentation of their research into expert development. The primary thrust of the research was not to focus on a magical and steadfast number of hours required to become an expert, but instead acknowledge that participating in deliberate practice is more beneficial to improving performance than simply engaging informally with the activity of interest (Ericsson, 2013).

A review of studies that examined cumulative quantities of deliberate practice in sport ultimately concluded that deliberate practice impacts skill development and is necessary to obtain expertise (Baker & Young, 2014). While this demonstrates the value of deliberate practice for athlete development, Baker and Young (2014) noted there was

insufficient evidence to conclude whether deliberate practice alone explains an athlete's level of expert attainment. Additionally, there is minimal evidence supporting the need for high amounts of deliberate practice during childhood to become an elite performer as an adult (LaPrade et al., 2016). On the contrary, athletic success that results from early specialization during adolescence is not necessarily sustained into adulthood (Güllich & Emrich, 2006). Brenner et al. (2019) stated:

> Those who specialize in a single sport may develop skill-related physical fitness relative to their sport at an early age. However, those who engage in multiple sports likely enhance their overall physical fitness. Training various muscle groups by participating in different sports during childhood may facilitate greater overall athletic development (p. 5)

Studies have also highlighted athletes that delay specialization until later in their adolescence can still rise to an elite level (Baker et al., 2005; Güllich & Emrich, 2006; Hayman et al., 2014). Specifically, comparisons of national-level athletes with world-class athletes showed a greater proportion of world-class athletes participated in multiple sports during their adolescence and spent more time practicing sports outside of their dominant sport. Furthermore, onset of specialization occurred later for the world-class athletes – at an average of 14.4 years old – compared to the national-level athletes at 12.1 years (Güllich & Emrich, 2014).

It should be noted that specialized training at an early age may be necessary in certain technical sports (e.g., gymnastics, figure skating, swimming) that require elite-level development prior to full maturation (Jayanthi et al., 2013). Although a select

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number of sports may require specializing in early adolescence, for the majority of sports, specializing in middle adolescence is considered optimal. For some sports, such as endurance sports or distance events, specializing during late adolescence is suggested (Jayanthi et al., 2013). Collectively, these findings highlight the complexity of talent development literature, making it understandable that many stakeholders of youth sport associate elite development with selecting a sport early to accumulate appropriate amounts of practice.

Sport Specialization and Diversification Recommendations

Researchers have recognized limitations in the scope of current literature on sport specialization. Empirical studies are gaining traction as far as physiological outcomes, but there is still a lack of data related to psychological and sociological health outcomes (Waldron et al., 2020). Nonetheless, evidence-based sport training recommendations are being developed from available evidence, expert opinion, and anecdotal experiences.

One of the earliest position statements, released from the AAP (Anderson et al., 2000), recognized concerns with specializing athletes, but simultaneously acknowledged that minimal information was available to support or refute these risks. The only direct recommendation was that an adolescent athlete involved with intensive training should be regularly monitored by a pediatrician for appropriate nutritional intake and evidence of emotional distress or symptoms of overtraining. Another notable recommendation came from NASPE which proposed athletes should play multiple sports until age 15 as diverse opportunities would promote more positive development across physical, psychological, and social domains (Coakley, 2010). Similarly, NATA advocated for delayed

specialization "despite little evidence-based research demonstrating this practice [early sport specialization] has negative physical and psychological outcomes" (Valovich McLeod et al., 2011, p. 215).

The IOC identified specialization as a challenge to health, well-being, and performance, with increased competition causing an escalation in sport-related injuries and health problems, positing that diversity in sport participation would lead to enhanced motor development and athletic capacity (Bergeron et al., 2015). The statement encouraged children to partake in unstructured deliberate play and age-appropriate activities to develop athletically and socially. However, this IOC position statement also indicated a need for more definitive and consistent evidence to reinforce whether sampling sports can still result in reaching elite levels of play (Bergeron et al., 2015). Finally, the American Orthopaedic Society for Sports Medicine (ASSOM) has released two statements, the first calling for more research on the injury pattens of specialized versus diversified athletes to support or refute suppositions regarding connections between early specialization and long-term success in sport, overuse injury, and burnout (DiFiori et al., 2014). During the second consensus meeting, a working definition of specialization was proposed (LaPrade et al., 2016).

While this is not a complete review of all statements and recommendations from the sport and medical community, there are striking similarities that recognize early diversification as a safer and more appropriate alternative for youth athletes until they are more physically and psychologically matured to engage in specialization.

Nonetheless, these recommendations are seemingly not heeded as nearly 75% out of 746 athlete respondents in a cross-sectional survey were exceeding current participation recommendations (McLeod et al., 2019). In addition, nearly 80% of parents and coaches have been found unaware of sport participation recommendations (Bell et al., 2020, Post et al., 2020). In the increasingly professionalized and commercialized youth sport environment, the prevalence of sport specialization continues to grow. Scholars agree that improved messaging channels between research and practice are necessary to ensure that athletes, parents, coaches, and others involved in youth sport are adhering to training recommendations to promote healthy athletic participation (Feeley et al., 2018, McLeod et al., 2019; LaPrade et al., 2016). As such, it is important to identify the best methods of disseminating evidence-based recommendations to the appropriate stakeholders (Bell, 2018). To begin addressing this gap, this study utilized an implementation science framework to explore constructs that are central to the successful implementation of recommendation and interventions in conjunction with a research synthesis strategy related to evidence-based practice.

Implementation Science Models, Theories, and Frameworks

Implementation science is the study of methods used to systematically transfer research findings into routine practice (Tabak et al., 2012). The field coalesced into a self-sustaining area of study when practitioners, specifically in medical fields, became aware that evidence-based innovations were not being adopted by clinicians (Bauer & Kirchner, 2020). Thus, implementation science has evolved into a field that seeks understanding of the factors that dictate whether the uptake of innovations and

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interventions will be successful. Since studies that involve implementation endeavors often involve a complex set of considerations and subjects, they make use of theories, models, or conceptual frameworks that account for a variety of interactions in the process of knowledge translation (e.g., Holt et al., 2018). Theories, models, and conceptual frameworks are similar, but each of these plays a specific role in advancing knowledge translation (Rapport et al., 2018) and provides insights into mechanisms that make implementing research into practice more likely to succeed (Nilsen, 2015). Therefore, distinctions are necessary.

Theories are a set of principles that structure our understanding of the world, and theories that provide a clear and specific explanation of relationships between events and subsequent outcomes are most effective. Models are similar in their purpose, but often have a more narrowly defined scope and can be utilized to simplify a phenomenon or a singular aspect of a phenomenon. However, these parallels make differentiating the two difficult. Frameworks provide an overall outline of a system through concepts, constructs, and variables as well as the relationships that exist between them, but they do not provide an explanation for these relationships. Within dissemination and implementation science, theories are typically applied for their predictive capabilities and to specify mechanisms of change, whereas frameworks and models highlight factors that are relevant to the implementation process. More specifically, models describe the process of translating research into practice, while frameworks relate factors that are thought to influence implementation outcomes (Nilsen, 2015). Despite technical differences in their terminology and application, these terms are often used interchangeably.

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Nilsen (2015) proposed five categories of theoretical approaches that are applied to implementation science based around three overarching aims. The first aim is to describe or guide the implementation process which is assessed through process models that specify stages for translating research into practice. This practical guidance provides a stepwise plan of targeted activities that collectively accomplish implementation goals (Damschroder, 2020). For example, the Iowa Model of evidence-based practice (Titler et al., 2001) is essentially a process map for improving patient care through the steps of identifying areas for improvement, synthesizing and critiquing relevant research, changing practices accordingly, and monitoring outcomes. Overall, Nilsen's (2015) review identified 14 frequently applied process models.

The second aim is understanding and explaining what factors influence implementation outcomes which can be assessed through determinant frameworks, classic theories, or implementation theories. Determinant frameworks assess sets of facilitators or barriers (i.e., determinants) to the implementation process. Determinants typically function as independent variables to the overall system while outcomes of the implementation process are the dependent variables. These frameworks recognize relationships between the determinants, highlight moderating variables that confound or amplify the outcome, and hypothesize relationships between the determinants (Damschroder, 2020; Nilsen, 2015). Three frameworks identified by Birken and colleagues' (2017) as widely utilized are classified as determinant frameworks – i-PARIHS, Consolidated Framework for Implementation Research (CFIR), and Theoretical Domain Framework (TDF). Despite sharing the same categorization, these three

frameworks take into consideration a variety of barriers and facilitators to implementation, emphasizing the variability of determinants that can act upon implementation outcomes.

Classic theories also function to understand and explain what affects implementation outcomes, but they do not bring about change. Instead, classic theories describe how changes occur and propose mechanisms for these changes. Since these theories explain instead of facilitate change, they come from other well-established disciplines – such as psychology and sociology – instead of originating within implementation science. Diffusion of innovation (Rogers, 2003), the theory of reasoned action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), and social learning theory (Bandura, 1977, 1986) are some of the most frequently cited classic theories (Birken et al., 2017; Nilsen, 2015).

The last category of theoretical approaches related to understanding and explaining outcomes are implementation theories which are developed by modifying existing theories to prioritize the assessment of critical issues related to implementation. While these are more specific to implementation science than classic theories, they are emerging and less frequently used in the field (Birken et al., 2017).

Finally, the third overarching aim is evaluating the efficacy of the implementation process through, aptly named, evaluation frameworks. These frameworks identify various outcomes expected from implementation endeavors and provide structure for how to appraise these respective outcomes. For example, Proctor et al. (2011) proposed eight conceptually distinct outcomes – acceptability, adoption, appropriateness, feasibility,

fidelity, implementation cost, penetration, and sustainability which were viewed as indicators of the implementation process as well as overall success. Another popular evaluation framework is RE-AIM which provides criteria for evaluating reach, effectiveness, adoption, implementation, and maintenance (Glasgow et al., 1999). While these evaluation frameworks provide benchmarks to assess the efficacy of an implementation process, identifying the appropriate outcomes for a context can present a challenge. Moreover, any models and frameworks from the previously discussed categories that operationalize constructs can also serve as evaluation tools (Nilsen, 2015).

Selecting an Implementation Model, Theory, or Framework

Considering the number of models, theories, and frameworks available to support knowledge translation, it is important for researchers and practitioners to identify their aims (i.e., describe implementation process, understand what factors influence outcomes, or evaluate implementation) and corresponding theoretical approaches. Birken et al. (2017) created a survey instrument that identified 19 criteria for selecting an appropriate theory, model, or conceptual framework to guide an implementation project. This survey was administered to attendees of an implementation science conference to determine which criteria were most frequently considered in choosing a theory.

Results indicated that, on average, implementation science researchers considered 7 of the 19 criteria in choosing an implementation theory, but there was little consensus on which criteria were the most important and instead the selection process was based more on prior exposure and convenience (Birken et al., 2017). Nonetheless, the top four criteria which were selected by more than half of the sample were considered. These top

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criteria were: 1) analytical level: for example individual, organizational, system level; 2) logical consistency/plausibility: inclusion of meaningful, face-valid explanations of proposed relationships; 3) description of change process: a provided explanation of how changes in process factors lead to changes in implementation-related outcomes; and 4) empirical support: results relevant to the framework or theory, contributing to cumulative theory-building.

For this project, a framework was a better option than a theory because predictive capabilities were unnecessary given the budding state of dissemination research in early sport specialization. The i-PARIHS framework was fitting because it broadly assesses factors that are relevant to the implementation process and considers several analytical levels. Additionally, it is a commonly used, empirically supported framework that has undergone several refinements based on scholarly critique (Kitson et al., 1998; Kitson et al., 2008; Harvey & Kitson, 2016).

Promoting Action on Research Implementation in Health Services Framework

One criticism of early implementation models was they reduced the potential for achieving successful implementation because their linear and logical nature did not adequately capture the complexities of the implementation process (e.g., Haines & Jones, 1994). Thus, Kitson et al. (1998) developed a multidimensional framework for research implementation based on the notion that successful implementation of research into practice is a function of the interactions between evidence, context, and facilitation. The researchers proposed that the interaction and interdependence of these three dimensions

could account for complexities within the processes of change, offering more insight and understanding.

Within the health settings Kitson et al. (1998) studied, evidence was defined as a combination of research, clinical experience, and patient preferences; context as the environment or setting for the proposed change to be implemented; and facilitation as the technique by which a person makes things easier for others. Each of these dimensions exists on a low to high spectrum. For example, research evidence that is anecdotal or unsystematically derived is considered low evidence while rigorous quantitative or qualitative studies are high evidence. Divided personal clinical experiences or professional opinions constitute low evidence while professional consensus is high evidence. This same spectrum exists for the context and facilitation constructs, and it was hypothesized that implementation success would increase in situations with high evidence, context, and facilitation (Kitson et al., 1998).

Four implementation studies were examined where evidence quality was controlled and considered high, but the context and facilitation dimensions were manipulated to represent four different positions: 1) high evidence, low context, low facilitation; 2) high evidence, low context, high facilitation; 3) high evidence, high context, low facilitation; and 4) high evidence, high context, high facilitation. Results of testing this multidimensional framework indicated the most successful implementation resulted when all three dimensions were high, as hypothesized. Even in situations with high evidence sources, implementation uptake was unsuccessful when facilitation and context were both low. However, one major finding was that high facilitation may be

enough to overcome a low context, suggesting facilitation is a key variable within the framework (Kitson et al., 1998).

This multidimensional conceptual framework became the popular determinant framework known presently as the Promoting Action on Research Implementation in Health Services (PARIHS) framework. The PARIHS framework rapidly gained traction because it adeptly reflected practical experiences associated with implementing evidence into practice. However, it has been refined several times to integrate new theoretical developments and address critiques. The first revision was achieved through a concept analysis of the dimensions to enhance their clarity (Rycroft-Malone et al., 2002).

Notably, the sources of evidence remained the same as in the original framework and were still conceptualized on a low to high spectrum, but it was acknowledged that evidence should be critically apprised prior to implementation. Additionally, in the first iteration, the research dimension of evidence considered systematic reviews and randomized controlled trials as the preferred "gold-standard" or high-ranking evidence. After the concept analysis, Rycroft-Malone et al. (2002) advised that "what is critical to implementation is that well conceived, designed, and conducted research is drawn upon, whether quantitative or qualitative" (p. 175), expanding the type of evidence that was highly regarded. Similar depth and expansion were achieved for the clinical experience and patient preferences dimensions of evidence. A more specific breakdown of what constitutes evidence within each of these dimensions (i.e., research, clinical experience, and patient preferences) is discussed in later sections (see Evidence-Based Practice).

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The context dimension was refined by assessing key characteristics of an environment that lead to research utilization. Contextual attributes that were considered integral to successful implementation included a learning environment that values individual contributions, shared decision-making, and quality organizational systems. Implementation is further enhanced by clarifying roles, demonstrating staff are valued, and cultivating a facilitative and innovative organizational culture (Bate, 1994; Rycroft-Malone et al., 2002). Finally, the facilitation dimension was still maintained as crucial to helping individuals and/or teams understand what changes must occur for new evidence to be integrated into practice. However, there were few evaluations of the concept of facilitation, and while it was refined to include the purpose, role, skills, and attributes of the facilitator, Rycroft-Malone et al. (2002) concluded this dimension required further examination.

After wide application and testing of the framework, it continues to evolve based on critical analysis to isolate limitations. Tabak et al. (2012) reviewed over 60 implementation models and frameworks along three categories, one being the socioecological model, and suggested the PARIHS framework lacked a focus on the outer system and policy levels. Flottorp et al. (2013) also systematically reviewed and synthesized several frameworks and taxonomies, indicating the PARIHS failed to devote attention to the individual health professional as well as the social, political, and legal context of implementation. As such, the framework continues to undergo refinement and validation.

Integrated PARIHS Framework

In the most recent iteration, known as the integrated-PARIHS (i-PARIHS) framework, each of the central constructs was extended and an additional construct was added. The researchers felt the original evidence construct did not account for the process whereby knowledge is adapted for a specific setting. Instead of focusing solely on information from research, clinical practice, and stakeholder experiences, the evidence construct was renamed *innovation* and incorporated the natural processes that might occur to align knowledge with a specific context to enhance compatibility (Harvey & Kitson, 2016).

Recipient was a new construct that was added to the framework to account for people that are influenced by and who can influence implementation efforts. This construct was added to account for how individual views, beliefs, and established ways of functioning can directly impact how successfully an innovation is accepted into practice.

Context was still a core construct in the new framework, but it was expanded to incorporate a wider range of contextual layers that can promote or constrain implementation. Harvey and Kitson (2016) distinguished between the inner and outer context. The inner context is comprised of the people and environment in the immediate implementation setting, while the outer context is the infrastructure of the wider system that encapsulates the inner context. In the case of health care, examples of inner context are a specific hospital unit or ward and all the associated stuff, organization, and culture. Meanwhile, the outer context incorporates the social, regulatory, and political factors of the wider health system, and their impact on the inner context.

Finally, the facilitation construct was retained, but it was determined that facilitation is the "active ingredient of implementation" (Harvey & Kitson, 2016, p. 11). Essentially, the innovation or evidence should be aligned with recipients at local, organizational, and system-wide levels to holistically understand contextual needs, thereby increasing the chances of successful implementation efforts (Harvey & Kitson, 2016). In order to "action" the framework, the role of facilitator must be defined and filled with a facilitator that has the experience necessary to tailor an implementation approach and a set of strategies and actions to guide them.

Evidence-Based Practice

Rooted in concepts of evidence-based medicine which emerged in the 1990s, EBP is frequently discussed in terms of health care policy and practice, but at its core is a decision-making process that conscientiously and judiciously uses four sources of information (Briner at al., 2009). While it often uses terminology and procedures specific to medical environments, many underlying concepts are adopted across other disciplines, including public and mental health, social work, education, and human resource management to apply evidence and scientific inquiry to professional decision-making (Reynolds, 2008; Rousseau & Gunia, 2016).

Historically, EPB developed from a problem-based teaching method for medical education at McMaster University. During this time, physicians regularly prioritized medical traditions and personal experiences in determining treatment, leading to considerable variation in treatment experiences and quality (Barends & Briner, 2014). Furthermore, the medical curriculum was characterized by individual schools teaching

and emphasizing their own clinical approaches that were not necessarily linked to scientific evidence (Rousseau & Gunia, 2016). In response, educators at McMaster University designed programming that encouraged the systematic integration of medical research into clinical decision-making, initiating a shift in the medical practice paradigm (Barends & Briner, 2014).

One of the main tenets of EBP is utilizing the most relevant evidence that has a high degree of certainty (Spencer et al., 2012). Thus, a reciprocal relationship exists between EBP and implementation science: an adequate implementation process must exist for effective uptake of EBP recommendations, and reliable evidence must be produced before it can be implemented into practice. More so, a deep connection exists between EBP and the i-PARIHS framework specifically, as evidence is a constituent construct that is central to successful implementation within the multidimensional i-PARIHS framework (Harvey & Kitson, 2016; Kitson et al., 1998; Rycroft-Malone et al., 2004). The i-PARIHS framework recognizes that several forms of evidence are available, and it is the integration of these sources that support effective EBP. The subsequent paragraphs provide descriptions of the characteristics of evidence and consider its various sources in greater depth.

What Constitutes Evidence

Knowledge from scientific research is the first form of evidence and is often considered the preeminent and priority source. While research evidence is important, producing a definitive answer is unlikely as the research base is constantly evolving (Rycroft-Malone et al., 2004). Despite attempting to obtain objective research results,

therein lies the possibility of generating competing and conflicting knowledge about the same topic. In a review that delineated credible information, Dopson et al. (2002) described that "there are multiple interpretations by different stakeholders, varying by individuals within one group, by group, and by profession. Evidence therefore has to be conceived of as malleable and eclectic" (p. 42). As such, research evidence should be considered only a singular aspect of several that are necessary to successfully generate and implement EBP.

Knowledge from professional experience is the second form of evidence and is described as expertise that practitioners develop through their practical experiences and interactions with other individuals in the field. Rycroft-Malone et al. (2004) suggested EBP requires application of this professional knowledge but, in addition, this professional knowledge provides the ability to integrate types of evidence. Evidence is also derived from patients and client experiences. Clearly, this is specific to a medical context, but in terms of sport management it could involve reflecting on the feedback and experiences of individuals such as sport consumers, fans, and athletes depending on the specific context. This source of evidence provides insight into an element of the human experience from a perspective outside of the practitioner (Rycroft-Malone et al., 2004). The final source of evidence is knowledge from the local context which is obtained from understanding organizational culture, social and professional networks, local and national policy, or performance data from a unique setting. Continuing to explore the potential interactions between these four evidence sources will lend to the credibility and applicability of EBP (Rycroft-Malone et al., 2004).

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Proponents of EBP consistently argue that it is a valid approach to overcoming research-practice gaps, information overload, poor quality of some research, and the use of practice which is not evidence based (Trinder, 2008). For example, EBP is a tool that can assist with closing the research-gap and avoid using poor quality evidence by inspiring rigorous reviews and research synthesis to inform practice, while still considering the local context and practitioner knowledge and expertise (Bansal et al., 2012). In terms of information overload, EBP can mitigate these concerns by supporting mechanisms and resources that remove the burden of evidence identification and appraisal from the practitioner. Barends and Briner (2014) suggested the future of EBP might be mechanisms for systematized critical appraisals that can scan databases for articles meeting a pre-specified set of criteria and notify practitioners through targeted push services to reduce their resource overload.

There are clear advantages of an EBP approach, but it is also pertinent to discuss potential concerns. Just as many of the earliest sources and applications of EBP originated in the medical field, so do the primary criticisms. The major critiques are concerned with EBP stifling critical thinking and employing a hierarchical approach to determine the best evidence which is an inherently exclusive approach (O'Halloran et al., 2010). These arguments are based in the postmodernist ideology that producing an accurate representation of reality is nearly impossible. Therefore, attempting to develop best practices is driven by political and economic agendas as opposed to promoting scientific knowledge and enhanced understanding. It is further argued that EBP guidelines over-simplify a complex environment and do not allow individual practitioners

to use personal experiences or practical knowledge to shape responses and actions in the field (Trinder, 2008).

Other arguments that expose potential weakness of EBP include the shortage of consistent scientific evidence and limits on the amount of time practitioners can allocate to sifting through and critically appraising research studies to determine which evidence should be applied (Straus & McAlister, 2000). These concerns run parallel to factors that contribute to the research-practice gap. Additionally, the nebulous nature of EBP and its application makes it challenging to design empirical evidence to test its efficacy (Straus & McAlister, 2000; Trinder, 2008).

Nonetheless, as comprehensive implementation frameworks are continually developing and advancing to test outcomes of EBP, these concerns might be addressed. Advocates also counter by noting that EBP is evolving to adopt a more inclusive perspective on research methodologies (O'Halloran et al., 2010) which is supported by a rapidly expanding pool of knowledge synthesis approaches to synthesize relevant resources and best available evidence. Supporters of EBP assert that through this process of assessing and integrating knowledge, EBP establishes best practice guidelines that are cognizant of potentially limited resources and still allows for professional autonomy (Trinder, 2008).

Research Synthesis

Systematically aggregating and integrating data is a core tenet of EPB, but the need for research synthesis was recognized far before the idea of EBP was officially coined. Mills (1959) observed that social science studies were being conducted

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excessively without enough consideration for how the studies would coalesce into a cohesive body of knowledge. Similarly, Forscher (1963) penned a letter published in *Science* that likened scientific research to creating bricks (facts) and assembling them into durable edifices (explanations or laws), but his primary point was that as the research process evolved, it simultaneously became chaotic:

> It became difficult to find the proper bricks for a task because one had to hunt among so many. It became difficult to find a suitable plot for construction of an edifice because the ground was covered with loose bricks. It became difficult to complete a useful edifice because, as soon as the foundations were discernible, they were buried under an avalanche of random bricks. And, saddest of all, sometimes no effort was made even to maintain the distinction between a pile of bricks and a true edifice. (p. 339)

More recently other scholars have made similar acknowledgements. Within the medical field, synthesized summaries of evidence in a particular domain are as integral to informed clinical decision-making as the production of primary studies (Grant & Booth, 2009). Briner and Denyer (2012) noted that continued emphasis on empirical contributions rather than reviews and syntheses has resulted in a voluminous, fragmented, and contested fields. Gould (2016) stated that "while new knowledge is certainly needed, there is even a greater need to integrate and disseminate what is already known" (Gould, 2016, p. 198). As such, research syntheses are particularly important because they can provide more powerful explanations than those available from a single study which, in

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turn, advances knowledge in a field by identifying transcendental features and patterns (Dixon-Woods et al., 2004; Suri & Clarke, 2009).

To fully appreciate the scope and applicability of the extensive pool of research synthesis methods available, it is necessary to clarify terminology. Siddaway et al. (2019) delineated between conducting a literature review and the task of reviewing literature. Reviewing literature – as is done at the beginning of journal articles – involves selectively discussing literature to argue the necessity and contribution of a new study. Literature reviews are a distinct set of research designs that synthesize available evidence to draw robust conclusions. This is an important distinction since the term literature review, applied as a research design, is often interchanged with terms, such as research synthesis and systematic review. For this paper, the term *research synthesis* will be used as an overarching term to "describe approaches to combining, aggregating, integrating, and synthesizing primary research findings" (Schick-Makaroff et al., 2016, p. 174).

Systematic review is another widely applied term related to research synthesis but potentially ambiguous as it is relatively undefined. Systematic reviews are frequently associated with meta-analysis of empirical medical research, most often randomized controlled trials. Similarly, Schick-Makaroff et al. (2016) specifically categorized systematic reviews as a quantitative synthesis approach. Meanwhile, Siddaway et al. (2019) defined systematic review broadly as a type of literature review that is characteristically comprehensive and replicable due to an explicit methodology and included qualitative narrative reviews and meta-syntheses under this umbrella term. For

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the remainder of this writing, the broader definition of *systematic review* will be used

instead of referencing a singular quantitative synthesis method.

Systematic reviews represent a rigorous approach to synthesizing and evaluating

research that minimizes researcher bias through comprehensive and reproducible

searches (Lichtenstein et al., 2008; Tod & Eubank, 2017). Researchers establish

transparency of a systematic review by developing a predetermined, replicable protocol

(Tod & Eubank, 2017) and providing detailed documentation of the decision-making

process through all stages of the review (Lichtenstein et al., 2008). Rigor is also enhanced

by assessing methodological quality of the studies and general strength of the overall

body of knowledge (Lichtenstein et al., 2008). Systematic reviews are particularly

valuable as they are capable of appraising, summarizing, and communicating

implications from otherwise unmanageable quantities of research data (Green, 2005).

Additionally, they serve as a cornerstone to EBP and some knowledge translation

frameworks, making systematic reviews an important aspect of bringing research closer

to policy, practice, and overall decision-making processes (Dixon-Woods et al., 2006;

Thomas & Harden, 2008).

Several additional categorizations exist to delineate between review types and

determine the most appropriate method based on the purpose, questions, and desired

outcomes of the systematic review (Schick-Makaroff et al., 2016). Dixon-Woods et al.

(2005, 2006) expanded upon a distinction between integrative and interpretive reviews

set forth by Noblit and Hare (1988). As the name implies, the purpose of any research

synthesis is to summarize and integrate findings from a diverse set of studies. However,

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integrative reviews combine results from primary studies using techniques that require the outcomes of interest to have basic comparability, ultimately resulting in statistically aggregated data. Interpretive reviews synthesize through a process of "induction and interpretation" (Dixon-Woods et al., 2006, p. 46), amalgamating concepts from primary studies into a higher-order theoretical structure. Gough et al. (2012) described a similar dichotomy wherein synthesis approaches are either aggregative or configurative. Aggregative reviews are driven by a realist philosophy that are seeking to uncover a singular truth through the aggregation of homogenous studies using *a priori* methods. Configurative reviews are informed by an idealist philosophy and identify patterns among heterogenous studies, resulting in the enlightenment of a concept.

Another major characteristic of different synthesis designs is the structure and components of the review (Gough et al., 2012). Reviews can be comprised of a single specific question that gives rise to a single review. In more complex situations, the review can contain multiple components, essentially starting with a broad question that will prime subsequent, more specific reviews. Gough et al. (2012) described three multi-component reviews. In the first structure, a broad question is posed which leads to a systematic map or account of the research field. An assessment of the resulting map helps to determine what additional subsets of the map should be synthesized. In the second structure, a broad review question is developed, and then separate synthesis approaches are used to generate answers regarding different aspects of the same issue (e.g., meta-analysis of a randomized controlled trial and a conceptual synthesis of patient experiences in the trial). The results from these two separate syntheses are combined in a

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third and final synthesis. Finally, the third structure is similar to the previously described approach except, a research synthesis is combined with another form of primary knowledge, such as surveys. Results from these two data collections are also combined in a final synthesis step.

Scoping Reviews

Despite concerns for the increasing rate of primary knowledge production and an awareness of the importance of research synthesis, detailed methods that account for a variety of study designs have only recently developed. In reviewing synthesis types, Schick-Makaroff et al. (2016) provided an overview of four overarching categories – conventional, quantitative, qualitative, and emerging – and applied Popay's (2003) enhancement and epistemological models to categorize different reviews. Popay's (2003) models reflect how quantitative and qualitative data are valued in relation to one another with the enhancement model suggesting that qualitative research merely supports and adds to quantitative findings, an "unequal handmaiden role" (p. 60). Meanwhile, the epistemological model identifies a more equal relationship between qualitative and quantitative approaches where both provide unique contributions (Popay, 2003).

Among the emerging synthesis review types, scoping reviews are an effective methodology for structured preliminary searches to map out a general body of knowledge when narrow and specific questions for a systematic review are not feasible (Munn et al., 2018). The scoping nature of these reviews also allows various article types and sources of data to be included (e.g., commentaries, primary studies). While there are similarities in how systematic and scoping reviews are conducted, there are key differences between

the two reviews that allow them to serve quite different purposes. Namely, systematic reviews rely on a rigorous, narrow protocol that is determined *a priori*. This allows them to confirm or refute evidence about the efficacy of an intervention or clinical guideline. Scoping reviews have a more iterative design that leaves room for adjustments to the protocol as the review is conducted. As such, scoping reviews are more effective for mapping out evidence about a given topic or field, clarifying concepts, and identifying key characteristics of concepts (Munn et al., 2018). Scoping review are also adept at identifying knowledge gaps and can serve as a precursor to a full systematic review.

As discussed throughout this chapter, early sport specialization is a growing trend that can significantly impact youth athletes and their sport experiences. Research endeavors continue to shed light on the various aspects of specialization and connections to outcomes, which includes extending evidence-based recommendations. In order to answer calls to effectively translate these research findings into practice, it is necessary to develop a better understanding of the sport specialization context and actors that can impact dissemination and implementation. This chapter reviewed two tools – implementation science and EBP – that can be useful for bridging the research-practice gap related to early sport specialization. This study combines the research synthesis methodology characteristic of EBP with the i-PARIHS framework from implementation science to explore the innovation, recipients, context, and facilitation within youth sport specialization to support improved uptake of research into practice. The following chapter provides additional information about the scoping review research design selected for this study.

Chapter 3. Methodology

This review was designed to scope the literature related to early sport specialization and diversification recommendations and assess the recipients, context, and facilitation within those recommendations. To accomplish this, a scoping review protocol was designed and is discussed in detail below.

Research Design

One of the challenges associated with developing a research synthesis protocol is distinguishing between review types and determining which design will most effectively answer a specific set of research questions. There are many well-known and established synthesis approaches (e.g., meta-analysis, meta-aggregation, and meta-narrative synthesis), however, multiple new synthesis methods have emerged to accommodate the expanding scope of research synthesis. Choosing a synthesis method is largely dependent on the purpose of the review and the questions it is being designed to answer (Kastner et al., 2016; Schick-Makaroff et al., 2016). The primary purpose of this review was to broadly assess recommendations related to sport specialization and diversification in alignment with constructs of the i-PARIHS framework to build a foundation for developing implementation strategies and interventions.

Another secondary consideration in choosing a review type is the nature of the evidence, essentially the balance of research methodologies expected in the review (Mays

et al., 2005). Sport specialization and diversification literature is currently a disparate body of knowledge that draws on expertise from several fields in the academic community including sport psychology, sport medicine, athletic training, and sport sociology (DiSanti & Erickson, 2019). Due to the range of disciplines involved in producing sport specialization and diversification research, the unique contributions of qualitative and quantitative studies must be considered to accurately capture a holistic understanding of the context and phenomenon. Furthermore, a variety of methodologies are represented in this body of literature, making it necessary to select a synthesis method that is equipped to integrate qualitative and quantitative studies to avoid unnecessarily restricting the inclusion criteria. Pure quantitative or qualitative synthesis approaches focus on a singular data type and align with the enhancement model wherein qualitative data is viewed as simply supportive of quantitative data (Popay, 2003; Schick-Makaroff et al., 2016). Therefore, only conventional and emerging synthesis types were considered as they can incorporate multiple methodologies and more equally value all data types.

Emerging syntheses "challenge the more traditional types of synthesis, in part by using data from both quantitative and qualitative studies with diverse designs for analysis" (Schick-Makaroff et al., 2016, p. 179). The unique purposes of emerging syntheses were explored to identify a methodology that would align with the research purpose and questions. A variety of emerging synthesis methods have developed in order to synthesize complex review questions that diverge from traditional systematic reviews which are often conducted to evaluate interventions and guide clinical decision-making (Munn et al., 2018). For example, Tricco et al. (2016) identified 25 unique emerging

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synthesis methods in a review of 409 articles. Although not part of Tricco and colleagues' review due to the nature of their exclusion criteria, scoping reviews are another emerging synthesis that are intended to "find key concepts, examine the range of research in an area, and identify gaps in the literature" (Schick-Makaroff, 2016, p. 179). Scoping reviews are relatively new and, as such, not yet consistently defined.

Arksey and O'Malley (2005) provided a definition that draws attention to how these reviews characteristically are used to comprehensively scope key concepts and evidence available within a research area. Munn and colleagues (2018) further expanded upon indicators that are helpful for determining when a scoping review is an appropriate undertaking, noting that the most important consideration is how the results of the review will be utilized. Scoping reviews should be employed to identify and categorize concepts within a field of study instead of assessing the feasibility or effectiveness of specific clinical practices or treatments (Munn et al., 2018). Since this project was focused on generally identifying and examining the presence of constructs needed for successful implementation of sport specialization recommendations into practice, a scoping review was deemed the most appropriate research design. A scoping review also allowed for the integration of data from a breadth of research designs and assessment of a range of research evidence. In addition, this review type provided the flexibility to iteratively adjust the protocol which was necessary since the overarching purpose of the study was not conducive to developing a strict protocol a priori.

Ontology and Epistemology

Evidence-based practice "integrates the best available evidence, professional judgement, and client values and context" into a decision-making model that should be applied across professional practice (Spencer et al., 2012, p. 129). The EBP movement strongly encouraged researchers to conduct systematic reviews as the cornerstone of delivering high-quality policy and practice recommendations grounded by empirical evidence (Heyvaert et al., 2016). As EBP initially stemmed from medical research, the studies considered the highest standard – and therefore included in systematic reviews – were largely quantitative. Systematic reviews became characterized by a priori protocols that clearly established objectives of the study, predefined eligibility criteria for selecting studies, and described a detailed, reproducible methodology. As a result, research synthesis has traditionally aligned epistemologically with positivist traditions that seek to uncover and explain a singular reality from an objective position (Suri, 2013; Yilmaz, 2013), often precluding the integration of qualitative studies in a systematic review.

Suri (2013) contested the "hegemony of positivist research syntheses" (p. 890) by exemplifying that associating research synthesis with a singular paradigm allows space for problems to arise. One such concern is that being exclusive to quantitative studies and a positivist paradigm negates important contextual insight supplemented by rich narratives from qualitative studies. Using this viewpoint, Suri (2007) developed the methodologically inclusive research synthesis (MIRS) framework to illustrate diverse paradigmatic orientations in research synthesis and their potential contributions to this methodology. The MIRS framework identifies how interpretivist, participatory, and

critical orientations can serve distinct purposes in guiding the development of research syntheses. In summary, interpretive synthesis allows the researcher to reveal and interpret a specific phenomenon from several perspectives and stakeholders, constructing an understanding that may contain incongruous realities of the same phenomenon. A participatory orientation allows for the ideas and theories of stakeholders to be directly integrated into the development of relevant policy and practice. Finally, critical synthesis scholars draw on existing systems and structures of inequity to critically analyze the implementation of policy and its alignment with life experiences (Suri, 2013).

The MIRS framework clearly summarizes the advantages of moving beyond a positivist paradigm to conduct research syntheses. More scholars continue advocating for synthesizing qualitative methodologies as it allows for a more holistic understanding of the diverse and complex literature used to inform policy and practice (Heyvaert et al., 2016; Suri & Clarke, 2009). However, with this shift comes the challenge of reconciling the epistemological assumptions of a positivist paradigm with those of qualitative research. For example, an interpretivist orientation might value developing questions using a holistic and iterative process to account for the presence of qualitative studies. While this approach would be epistemologically closer to primary qualitative research, an iterative approach also suggests the questions are modified in response to search results (Dixon-Woods et al., 2006). This is a considerable shift away from the systematic methods recommended for research synthesis that are reliant on the development of pre-determined, rigid protocols. Another challenge to determining the epistemology guiding qualitative research syntheses is that, oftentimes, authors do not expound upon the

underlying assumptions that shaped their methodological choices (Lockwood et al., 2015; Schick-Makaroff et al., 2016).

Overall, there is reluctance to establish overarching rules for the philosophical foundations of qualitative synthesis. Instead, the suggestion is that the methods of synthesis should not violate the underlying paradigm of the approach used in the reviewed studies (Sandelowski & Barroso, 2007). As Lockwood et al. (2015) noted, "it is evident then that while synthesis is a different process to primary research, the principles and processes of qualitative synthesis must be sensitive to the core assumptions of the critical and interpretive paradigms" (p. 180). The differences between systematic and scoping reviews highlight the importance of understanding and appreciating the philosophical and epistemological foundations that give rise to the distinct methodological characteristics of each type of research synthesis.

As previously noted, systematic reviews frequently integrate quantitative studies to confirm or refute evidence-based practices and assess the quality of evidence (Munn et al., 2018), as such they align with positivist traditions. Conversely, scoping reviews identify the coverage of a body of literature and broadly consider all available studies (Munn et al., 2018). Thus, scoping reviews are typically subjectivist in their epistemological approach due to their exploratory nature and method of compiling several data sources that do not seek a singular truth or reality (Thomas et al., 2020). For this review, an interpretive orientation that ontologically assumes there are multiple realities was adopted to allow for the inclusion of several perspectives and evidence sources (Yilmaz, 2013). Epistemologically, this study had a subjectivist foundation to

explore how knowledge related to sport specialization is constructed and developed which was accomplished by the researcher interacting with relevant articles and texts through each stage of the scoping review. This subjective closeness of researcher to the phenomenon being researched highlights how the lived experiences of researchers can have more influence on knowledge generation and interpretation comparatively to an objectivist orientation (Thomas et al., 2020).

Reflexivity and Positionality

Reflexivity is important to qualitative research as it involves the researcher understanding how their involvement with conducting empirical research might shape the final outcomes (Corlett & Marvin, 2018). This involves taking time to assess the relationship between knowledge production and the knowledge producer by systematically reflecting on personal, methodological, and philosophical orientations. Suri and Clark (2009) identified guiding principles to strengthen a research synthesis based on reflexivity. First, the researcher must make informed methodological choices by aligning the synthesis purposes, methods, and philosophical foundation. Second, the researcher must be aware of how the methodological orientation influences how other forms of research are viewed, particularly when synthesizing diverse methodologies.

Reflexivity while conducting a scoping review was an interesting, and at times confounding, process for me as this study essentially involved interpreting other interpretations. This was my first experience interacting with secondary data as opposed to participants, making it a particularly challenging prospect to negotiate. Until this study, I have engaged in primary qualitative research and have assumed a constructivist

epistemology to align with my belief that a singular reality does not exist, and instead, our realities are subjective and socially constructed (Lincoln & Guba, 2013). However, this scoping review required negotiating with the feeling that I was searching for a singular truth about early sport specialization and prescriptive best practices which fundamentally felt like a positivist orientation. This negotiation exposed my greatest bias related to this study and sport specialization research as a whole.

My position is inherently biased toward a sport diversification model largely due to my personal experiences as a multi-sport athlete that participated in three sports all four years of high school. Since I attended a small school, it was typical for most athletes to diversify throughout their careers as interscholastic athletes. Furthermore, the isolated location of my hometown made it challenging to access supplemental training or club team outlets, so the diversification model was the cultural norm and expectation. Having conducted primary research on sport specialization, specifically related to coaches and parents, I also developed biases and expectations about these stakeholders and their perceptions toward early specialization and diversification.

I was confronted with the fact that, in essence, I was looking for a singular reality and a distinct set of recommendations that would rectify this reality. I had fallen into the belief that sport specialization is inherently negative. This bias was exemplified by one of my earliest iterations of a research question – "What recommendations are available to be implemented in youth sport to assist in preventing overuse injuries and psychological burnout?". Such phrasing would have included articles that addressed solely negative outcomes. Identifying this bias helped clarify why I was experiencing considerable

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conflict between my ascribed philosophical orientation, the primary epistemology guiding scoping reviews, and the purpose of my study. I realized that I needed to allow space for multiple perspectives on early specialization and associated recommendations to be present. As Thomas and colleagues (2020) wrote, scoping reviews "bring together the myriad of information on the topic that is available, allowing researchers to offer a subjective interpretation of what is known about that topic" (p. 992).

As such, it was important to consistently reflect during the early stages of this scoping review, specifically while refining the research questions and inclusion criteria. To have a more balanced conceptualization of early specialization and its manifestation, I implemented processes to avoid seeing only negative associations with sport specialization and searching for support that diversification was the only reasonable sport trajectory to pursue. These included having meetings every other week with a peer debriefer that was familiar with systematic and scoping review protocols but did not have a research focus related to sport specialization. I also went through several rounds of revising my inclusion and exclusion criteria to identify language that was biased toward sport diversification. Once I finalized the criteria, my peer debriefer reviewed the criteria to assess clarity and applied the criteria to a selection of articles as an independent pilot test. Finally, I kept a research journal to document the challenges I experienced in the process of developing my review protocol. In the analysis, my bias could have led to developing themes that were more favorable to diversification, unintentionally cultivating a confirmation bias. This possibility was primarily alleviated by using a framework analysis that was deductive and less reliant on inductively developing themes.

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Recommended Data Collection

Due to scoping reviews being newer and less developed than more traditional syntheses (e.g., systematic review and meta-analysis), the suggested method for conducting one is still being refined. Arksey and O'Malley (2005) proposed the first methodological framework for a scoping review which Levac et al. (2010) later expanded upon by examining challenges within the framework and proposing recommendations and clarifications to address these challenges. The Joanna Briggs Institute (JBI), an international healthcare research organization that specializes in research translation and conducting research syntheses, continued refining the scoping review protocol in the *JBI Manual for Evidence Synthesis*.

This scoping review was developed using the Arksey and O'Malley (2005) framework as a foundation. Recommendations from Levac and colleagues (2010) as well as the JBI scoping review methodology (Peters et al., 2020) also supplemented design of the protocol. Therefore, the review included the following steps: 1) identifying the research questions, 2) identifying relevant studies, 3) study selection, 4) charting the data, and 5) collating, summarizing, and reporting the results (Arksey & O'Malley, 2005; Levac et al., 2010).

There is an optional sixth consultation step that is intended to enhance the review by integrating insights from practitioners. Levac et al. (2010) suggest this step should be an essential component of scoping review methodology, but it is not often incorporated. For the consultation step to be effective, it needs to have a clearly established purpose that articulates which stakeholders will be included and how the data will be collected

and integrated into the review (Levac et al., 2010). While there are several stakeholders that would provide valuable insight for this type of review (e.g., athletes, coaches, athletic trainers), it was unclear at the outset of the project how to best integrate stakeholders and for what reason. Therefore, this consultation step was not pursued but will be revisited for future steps and publications of the data.

The *Cochrane Handbook for Systematic Reviews of Interventions* was another resource used for building the review protocol (i.e., Higgins & Green, 2011; Higgins et al., 2019). The Cochrane Collaboration is an organization founded in 1993 that promotes evidence-based guidelines by producing and disseminating high quality research syntheses. As one of the first organizations to publish systematic reviews, Cochrane developed a well-known and rigorous methodology that explicitly details how to conduct a review. While this handbook was specific to systematic reviews instead of scoping reviews, it still offered clear directions for steps that overlap between the two methodologies, such as establishing research questions and a search strategy. It should also be noted that DiSanti and Erickson (2019) conducted a systematic scoping review that also approached early sport specialization from a broad perspective. Considering this review's similarities in terms of population, phenomenon, and breadth, the DiSanti and Erickson protocol was utilized as a guide for some methodological decisions.

Identifying the Research Questions

The first stage was to identify the central questions guiding the scoping review as these research questions were essential to making subsequent methodological decisions in the protocol (Anderson et al., 2013). The scope of quantitative systematic reviews is often

framed by detailing the population, intervention, comparison, and outcomes of interest, also known as PICO (Higgins & Green, 2011; Higgens et al., 2019). While establishing clear questions based on the PICO criteria is applicable to systematic review and meta-analysis studies, particularly in medical research, the pneumonic is not sufficient for reviews that seek to include methodologically diverse primary research. Lockwood et al. (2015) suggested the PICO mnemonic be revised for reviews that incorporate qualitative research to PICo, framing the review questions around the population, phenomenon of interest, and context as the key components. Similarly, JBI suggested using population, concept, and context elements to describe the scope of a review (Peters et al., 2020).

Population

The DMSP (Côté et al., 2007) illustrates sport development trajectories through early specialization and early sampling pathways. For both pathways, entry into sport is estimated at 6 years old. Athletes that choose a sampling trajectory, experience the sampling phase of sport participation from ages 6 to 12, followed by the specializing years from 13 to 15, and finally the investment years at 16 and older if they opt to pursue elite development. LaPrade et al. (2016) indicated that early sport specialization involves prepubescent athletes selecting a single sport at or before age 12. To encompass a full range of sport specialization and diversification experiences, articles were extracted that discussed or studied adolescent sport participation between the ages of 6 and 18. Eighteen was selected as the upper range limit because this age marks an approximate transition into late adolescence and is typically when students graduate from high school sports.

Concept

Concepts of interest were derived from the i-PARIHS framework (innovation, recipients, context, and facilitation) and directly aligned with the research questions. More specifically, the concepts were: 1) the recommendations that are available regarding sport specialization and diversification, 2) the recipients that are ideally influencing or being influenced by implementation of the recommendations, 3) the context that is most conducive to application of the recommendations, and 4) what entities can be utilized to facilitate these recommendations from research into practice.

Context

As noted in the previous section, context is one of the concepts of interest for this study, per the i-PARIHS framework. Generally speaking, the context of interest is the youth sport environment, but this was not limited to a specific sector. Instead, all entities within youth sport, such as interscholastic, club, or community sport experiences, were considered a valuable part of the context element.

Using the population, phenomenon of interest, and context described above, one research question was developed to guide the search strategy and study selections: "What recommendations are available to be implemented for youth athletes based on outcomes of early sport specialization?" This research question (i.e., RQ1) aligns with the innovation construct of the i-PARIHS framework (Harvey & Kitson, 2016). Once the relevant studies were identified and selected through a series of screening steps, the remaining research questions (i.e., RQ2-RQ4) were addressed through the analysis of these recommendations.

Identifying Relevant Studies

Determining the Search Universe

The first step of comprehensively identifying relevant studies is establishing the search universe. Higgins and Green (2011) suggest using bibliographic databases, journals, and other non-database sources as well as unpublished or ongoing studies to comprehensively assess the available literature. Siddaway et al. (2019) recommend searching at least two different databases that are relevant to the topic of interest. Utilizing a special-topic database related to a review topic (e.g., CINAHL) is also encouraged (Bramer et al., 2017). Sport specialization and diversification is a multi-disciplinary topic that is researched by scholars in areas that include sport psychology, medicine, sociology, and pedagogy (DiSanti & Erickson, 2019). As such, searching a variety of electronic databases was required to obtain a breath of literature that was representative of the specialization phenomenon.

To begin determining a search universe, I assessed eleven systematic reviews related to youth sport – five of which were centered around sport specialization – to find which databases they utilized for the literature retrieval step. All the reviews included between three and six databases apart from one study (i.e., Raabe et al., 2019) which used twelve databases. PubMed (or MEDLINE) was present in every review, and PsycINFO was the next most frequently utilized database, both of which have been recognized as important databases related to conducting reviews (Jahan et al., 2016). SPORTDiscus is a special topic database and indexes references directly related to sport science and other sport topics and was selected for its topic specificity (Chiasson, 1997). Using this

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information, SPORTDiscus, PubMed, and PsycINFO were identified as possibilities for the search universe.

The *Cochrane Handbook* (Higgins & Green, 2011; Higgens et al., 2019) describes several other sources that are important to consider for identifying relevant literature that may not be available through traditional publishing outlets – termed gray literature. Gray literature is defined as "that which is produced on all levels of government, academics, business, and industry in print and electronic formats, but which is not controlled by a commercial publisher" (Paez, 2017, p. 233). This includes dissertations, theses, conference reports, white papers etc. Historically, gray literature has been challenging to obtain since it is not systematically indexed in major bibliographic databases, as with peer-reviewed articles. However, as comprehensive search engines have been refined, this is less problematic (Mahood et al., 2014).

There is debate surrounding the inclusion of gray literature for research synthesis since it is not peer-reviewed. While it does not undergo the strenuous peer-review process, gray literature is considered important to reducing the risk of introducing bias into the review (Mahood et al., 2014; Paez, 2017; Pappas & Williams, 2011). For example, publications have a propensity to report only positive findings (i.e., publication bias), and there is a significant lag time between submission of manuscript and publication (Paez, 2017; Pappas & Williams, 2011). Therefore, including gray literature is necessary for a complete and comprehensive research synthesis.

Several databases have been identified for the retrieval of gray literature including OpenGrey, WONDER, SCOPUS, CPI, and ProQuest Digital Dissertations (Paez, 2017).

Siddaway et al. (2019) also recommended *Open*DOAR, WorldCat, and Google/Google

Scholar for accessing gray literature. ProQuest and WorldCat are databases that can

search dissertations and theses. A comparison of the content returned by each database

indicated they exhibit enough uniqueness in their returned results that it is difficult to

recommend one over the other (Procious, 2014). *Open*DOAR is an open-access

repository populated with resources from universities around the world (Siddaway et al.,

2019), and SCOPUS is an abstract and citations database through Elsevier that also

includes a range of global resources (Paez, 2017).

      With a considerable number of search resources available and a diverse body of

literature to navigate, I consulted with a library scientist specializing in systematic

reviews to finalize the selection of databases; she will be referred to with the acronym SS.

Librarians are a valuable resource for building review protocols as they have

methodological and informational management expertise and can often provide content

expertise. This combination of skills helps to mitigate the possibility of missing relevant

literature during the data retrieval steps or creating unmanageable searches (Morris et al.,

2016; Schick-Makaroff et al., 2016). In our first consultation, SS concurred with my

decision to include SPORTDiscus, PubMed, and PsycINFO. However, since a substantial

amount of sport specialization research comes from sport medicine and sport sciences

(DiSanti & Erickson, 2019), she recommended adding Embase as it is commonly used

for biomedical and health-related systematic reviews. SocINDEX was included in the

review to incorporate a sociological perspective which is referenced in sport

specialization research (e.g., Wiersma, 2000), albeit less frequently than physiological and psychological perspectives.

For a source that would retrieve more gray literature, we considered ProQuest, WorldCat, and SCOPUS. During the development of a comprehensive search strategy, researchers must contemplate how to optimize the *recall* and *precision* of a search. Recall refers to the amount of relevant material the search retrieves comparatively to all relevant material available in a search universe. Precision is how much of the material returned from a search is relevant (Bramer et al., 2016; Dieste et al., 2009). As the recall ratio increases, the search is obtaining a higher percentage of relevant literature, and as the precision ration decreases, the search is less accurate and generating more irrelevant data. However, oftentimes improved search recall comes at the expense of precision, therefore it is necessary to find a balance between two (Dieste et al., 2009).

To achieve enough recall without sacrificing too much precision, we followed the choices of DiSanti and Erickson (2019) and decided upon ProQuest over WorldCat. However, ProQuest is an overarching search interface that is comprised of several specialized databases. To further narrow the scope of the review, ProQuest Dissertations and Theses was the only database from the ProQuest interface that was selected. Finally, a cursory pilot test of SCOPUS was conducted using the SPORTDiscus search strategy (see Determining the Search Strategies) and only returned a single unique result. We determined the combination of SPORTDiscus, PubMed, PsycINFO, Embase, SocINDEX, and ProQuest Dissertations and Theses provided enough coverage, and these six databases comprised the finalized search universe.

Checking reference lists, hand-searching key journals, and utilizing existing

networks and relevant organizations are other useful strategies for developing a

comprehensive search universe (Arksey & O'Malley, 2005). In terms of reference lists,

backward and forward citation searches are employed to supplement electronic database

results that may have excluded pertinent articles due to search term limitations (Briscoe

et al., 2020). Both methods rely on exploring a source's citation network either through

studies cited in the source (i.e., backward searching) or studies that subsequently cited the

source (i.e., forward searching). Briscoe et al. (2020) determined that backward searching

is reported more often in Cochrane systematic review protocols and is a more uniform

method than forward searching. Therefore, only a backward search was conducted.

The backward search was completed in a three-step process. Arksey and

O'Malley (2005) noted that synthesis studies are valuable for finding additional relevant

resources. As such, my first step was to identify systematic and scoping reviews that were

part of the full text screening; eight articles were identified that fit this criterion. Then, for

each of these studies, I reviewed their references lists using the list of keywords below:

- Youth sport or adolescent sport;
- Youth athlete or adolescent athlete;
- Athlete development or sport development;
- Developmental activities; and
- Specialization and/or diversification/sampling.

Any reference titles that included one or more of these keywords were cross-checked for

duplicates against the articles already in my data management program. Articles that

were not duplicated were included in the review at the title and abstract stage for

screening. While unique references were uncovered, this method reached a saturation

point after approximately six studies because only one new reference was identified from each of the final two reference lists.

Determining the Search Strategies

After establishing the search universe, a series of search strategies specific to the different databases were developed. DiSanti and Erickson's (2019) scoping review utilized three broad groupings of search terms: *sport*, *youth*, and *specialization*. The authors then extended these broad groupings to include similar and related words. For example, the *sport* grouping was comprised of the search terms "sport, training, practice, elite sport, competitive sport, competitive youth sport, competition, recreation, recreational, recreational sport, performance, skill, skills" (DiSanti & Erickson, 2019, p. 2103). These broad groupings were foundational for developing the search strategies in this review and were shared with the same library scientist who assisted with refining the search universe. Her expertise was particularly necessary for this step of the review to accurately develop Boolean operators, truncations, wildcards, and other database operators (e.g., Medical Subject Headings [MeSH]) to refine the search strategies while ensuring they were still thorough (Jahan et al., 2016; Morris et al., 2016).

As a starting point, SS piloted the string of terms from DiSanti and Erickson (2019) in each of the databases chosen for this review. However, since the exact search strategies and syntax used for these terms was unclear, the individual searches returned an overwhelming number of results, leaving two options for moving forward: 1) restrict the dates of the search to only include articles published after the DiSanti and Erickson protocol was completed, or 2) make minor adjustments to the terms to maintain a

representative and comprehensive search without returning an unmanageable number of articles. Option 2 was chosen to avoid missing earlier relevant literature.

SS then identified terms she considered problematic – such as *skill*, *practice*, and *positive youth development* – based on her knowledge of how databases handle searches. For example, *practice* is a widely applicable term which could relate to athletic practices and sport training but also would return articles that reference general medical practices. Similarly, databases might search for each word in *positive youth development* individually without the appropriate syntax to connect them. Appendix A outlines the terms from DiSanti and Erickson's (2019) protocol that were retained, adjusted, or removed. Once the terms were modified, SS created full search strategies, specific to each database, using a combination of search operators for each term.

A pilot test of the search strategies led to the following information and subsequent refinements. SPORTDiscus, PsycINFO, and SocINDEX were all accessed through the EBSCO*host* research platform which allowed the same search strategy (Strategy 1) to be applied for all three databases without any additional restrictions. Strategy 1 was also used for ProQuest Dissertations and Theses, however, it initially returned nearly 180,000 results. Dieste et al. (2009) analyzed effectiveness – in terms of recall and precision – of different search field combinations (e.g., title only, abstract only, title and abstract). When the title and abstract fields were used, the search results had 76.6% recall and 19.6% precision. The only search that yielded a greater recall (i.e., 82.2%) was when all document fields, including the full text, were combined. However, precision was reduced to only 12%, leading the authors to conclude that a search field

combination of title and abstract was the best strategy for having acceptable ratios across recall and precision (Dieste et al., 2009). As such, it was concluded that restricting the search field to "anywhere except full text" for the ProQuest Dissertations and Theses database was a reasonable parameter.

Strategy 1 was the basis for the PubMed search to which SS added syntax and operators to enhance the search, but no additional restrictions were required. Finally, Embase had the largest and most unique search strategy based on how the database identifies and categorizes terms. Due to the size of the search, conference abstracts were excluded using syntax since that restriction narrowed the results by 271 articles, and conference abstracts did not provide enough substantive content to code in relation to RQ2-RQ4. Appendix B provides the full search strategies and additional restrictions for each database.

Study Selection

Before conducting the database searches, it was necessary to familiarize myself with a data management tool specific to research syntheses. Covidence is an online tool that supports sorting, extracting, and managing sources for systematic evidence reviews. Covidence utilizes a four-step process which begins with importing references into the program. Once references are imported, the program automatically screens for and removes duplicate articles. Articles are then moved through two separate screening phases and an extraction step to obtain the final sample for analysis. I started working with Covidence by conducting a mock review on a pilot set of data to learn the system

and how to manage different steps of the review. This was supplemented by attending an *Introduction to Covidence* workshop instructed by a Research and Education Librarian.

The search protocol was officially initiated February 9, 2021. For each database, all articles returned from the search were collected and converted into PubMed or RIS files for compatibility with Covidence and then individually imported into the title and abstract screening phase. Best practice guidelines suggest two separate reviewers should screen the literature to produce quantitative measures of inter-rater reliability related to article inclusion (Higgins & Green, 2011; Siddaway et al., 2019). However, in situations where it is not possible to have multiple reviewers, a singular reviewer can still produce a high-quality review by providing sufficiently detailed information on the review protocol and processes to ensure the review was designed and conducted using best practices (Siddaway et al., 2019). In addition to the review protocol, detailed documentation was maintained regarding: 1) refining the inclusion and exclusion criteria, 2) challenges to applying the criteria consistently, and 3) reasons for exclusion during the full text review.

Inclusion and Exclusion Criteria

Upon importing the retrieved articles, the articles were screened in various stages using a set of inclusion and exclusion criteria. Peters et al. (2020) suggest pre-specifying the criteria in the protocol, and as such, inclusion and exclusion criteria were developed in alignment with the population, concept, and context being studied. However, the study selection phase of a scoping review is recognized as an iterative process based on the researchers developing increased familiarity with the literature (Arksey & O'Malley, 2005; Levac et al., 2010).

Despite the scoping nature of this search, it quickly became obvious that the original criteria were still too generalized and would not effectively screen for relevant sources. Often, articles with recommendations did not explicitly reference *guidelines* or *recommendations* in the title or abstract which would lead to their exclusion from the study. Since a primary focus of the review was assessing recommendations of early sport specialization and how they have been facilitated into practice, it was essential to accurately identify this content. I refined the criteria by reviewing 20% of the abstracts from each database as outlined in the following section. It should be noted that no articles were excluded during this phase as the intent was to solidify inclusion and exclusion criteria that could be uniformly applied to the dataset.

The first draft of the criteria was developed from the research questions prior to reviewing any titles or abstracts. Subsequently, the refinement process started with 129 titles and abstracts randomly chosen from the PubMed search which led to several considerations regarding the inclusion and exclusion criteria. Namely, I was concerned about distinguishing articles that would contain a substantial enough section of recommendations for coding and whether my criteria would catch different types of recommendations, such as specific training volume guidelines, treatment strategies, and suggestions for different stakeholders.

Instead of making refinements that immediately addressed these concerns, I noted challenges to the sorting and selecting process and moved onto reviewing abstracts from SPORTDiscus. In total, 197 titles and abstracts from the SPORTDiscus search were reviewed to continue refining the inclusion and exclusion criteria. There was still a

lingering concern regarding the identification of recommendations and factors related to facilitating these recommendations into practice. At the point, I made considerable revisions to the criteria and pilot tested them with 207 abstracts from the Embase search which highlighted the criteria has gotten nuanced for the purpose of the scoping review. The criteria were refined once more to stay within the purview of the research questions and piloted a final time using a total of 109 articles from a combination of SocINDEX, PsycINFO, and ProQuest searches. The progressive iterations and finalized inclusion and exclusion criteria are found in Appendix C.

Additionally, the exclusion criteria limited study selection to articles that are in English as the primary researcher is not fluent in other languages. Morrison et al. (2012) found no evidence of systematic bias in the results of systematic reviews when English-language restrictions are placed on the search and suggested only extending the search strategies to additional languages if appropriate time and resources are available.

Using the finalized inclusion and exclusion criteria, the imported studies were screened through the title and abstract phase. During this phase, it was not necessary to provide a corresponding rationale for every exclusion. For the second stage of screening, a full-text PDF of each article was collected and imported into Covidence for review. To retrieve the full-text documents, I first searched Google Scholar and the online university library collections. Next, for full-text PDFs that could not be retrieved using these search databases, I requested each outstanding document through the university's interlibrary loan service. For article requests that could not be fulfilled by interlibrary loan, I received an email that indicated, "this book, volume, and/or issue is currently not available." At

this point, it was determined that all resources to retrieve the full-text PDFs were exhausted, therefore, the article was removed from the study and labeled as *Full Text Unavailable*. Unlike the title and abstract screening, each article that was excluded during the full-text screening was accompanied by a reason for exclusion based on the criteria that were associated with the full-text screening (see Figure 1). Articles that passed through these screening stages were extracted and analyzed.

Charting the Data

Extracting data for a scoping review – often referred to as data charting – is the process of identifying and recording key characteristics and information from the study that will answer the research questions (Khalil et al., 2016; Peters et al., 2020). Several types of information can be extracted from the sources depending on the research questions and intended outputs. Khalil and colleagues (2016) provided a list of suggestions for types of data to extract which included: "author(s), year of publication, source origin, country of origin, aims, purpose, study population and sample size (if applicable), methodology, intervention type and comparator (if applicable), concept, duration of the intervention (if applicable), how outcomes are measured, key findings that relate to the review question" (p. 121). The JBI also provided a basic template to use as a data extraction instrument. These two resources, in combination with the research questions, guided the development of the charting table (see Appendix D).

A critical appraisal of the extracted studies is considered another major step for systematic reviews. However, recommendations for the critical appraisal differ based on a study's synthesis method. For example, the JBI views critical appraisal as a required

step when conducting a meta-aggregation but not necessary for a meta-ethnography (Porritt et al., 2014). For scoping reviews, Arksey and O'Malley's (2005) framework noted that an attempt to present the weight of evidence is unnecessary. Munn and colleagues (2018) concur that critical appraisals for scoping reviews should not be mandatory but suggest a risk bias assessment could be conducted at the researchers' discretion. Meanwhile, Levac et al. (2010) acknowledged that a critical appraisal tool would further legitimize scoping review methodology, but simultaneously recognized the challenge of a quality assessment on a widely varied sets of literature. Ultimately, the updated JBI guidance states that a critical appraisal does not align with the intent of scoping review methodology to map available evidence on a specific topic (Peters et al., 2020). Considering that methodological guidance generally appears to favor omitting the critical appraisal step, combined with the assortment of literature included in this review, a critical appraisal of the extracted studies was not performed.

Collating, Summarizing, and Reporting the Results

With the presence of diverse methodologies and types of articles in the review, it was necessary to determine a data analysis plan that could effectively summarize the extracted variables and present the findings. Two separate analytical methods were applied to the extracted studies. Scoping reviews often utilize frequency counts on concepts and characteristics of the studies to highlight basic trends that describe the extracted articles (Peters et al., 2020). To achieve this, I completed a descriptive content analysis which aims to identify tendencies (Dincer et al., 2018). The descriptive content analysis was primarily used on citation details (e.g., year of publication), the evidence

source details (e.g., article type), and some early specialization content (e.g., definition of specialization) to generate frequencies and percentages regarding different categorizations of the data. However, it was also used to chart how frequently recipients, context, and facilitation were discussed across all the articles (see Tables 4 and 5). These tables do not reflect the number of times a concept appeared, instead they were intended to be dichotomous yes/no variables.

A more complex analysis was necessary for the recommendations variables to explore this content in greater depth and meaningfully collate the information. Since the research questions were developed directly from the i-PARIHS framework, a framework synthesis approach was a fitting analysis method to answer the research questions. A framework synthesis utilizes an existing model to deductively map and code the extracted studies, but it also provides flexibility to augment the framework if the researcher inductively identifies themes in the data that do not align with the framework. The framework synthesis was only conducted on content from the recommendation sections and no other areas of the articles. Nvivo qualitative data analysis software was used to organize and manage coding for the framework analysis.

Trustworthiness was still established throughout this study, albeit differently than for primary qualitative research studies. Since this study was comprised of secondary data, credibility and dependability was established by clearly establishing a research protocol and tracking any changes as the study progressed. As the inclusion and exclusion criteria were refined, I engaged in bi-weekly peer debriefing sessions with another researcher that has experience with systematic reviews. These debriefing sessions

helped ensure the criteria were clear and understandable to another researcher and could be applied to the dataset by somebody that was not as familiar with sport specialization content. Additionally, they helped me reflect on my biases toward sport specialization and diversification and how that was impacting development of my search criteria.

Reproducibility is characteristic of systematic and scoping reviews, so a clear audit trail was maintained by detailing each step of the process. This included recording how many studies were acquired through each database and backward search, how many studies were excluded at each stage of the review, and a detailed rationale for why studies were excluded at the full-text review phase. Transparency of the overall process will ultimately enhance the credibility and transferability of the findings (Suri & Clark, 2009).

Data Reporting

As systematic reviews initially gained popularity, studies began evaluating the quality of reporting. The value of systematic reviews not only depends on what is done and found but also on the clarity of reporting the results (Moher et al., 2009). Reporting was generally found to be suboptimal, so an international group was convened to develop guidelines for reporting systematic reviews, which was eventually revised and renamed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement (Page & Moher, 2017). The process of developing the PRISMA Statement involved a systematic review to examine the reporting quality of other systematic reviews, a comprehensive review of methodological literature, and an international survey (Moher et al., 2009). From this, a 27-item checklist and four-phase flow diagram

were developed for authors to utilize to improve the clarity of reporting their systematic review findings.

The PRISMA Statement was designed for reporting meta-analyses of randomized controlled trials, but an updated iteration has since been developed that is appropriate for scoping reviews (PRISMA-ScR). This checklist includes 22 items related to the introduction, methodology, literature selection, appraisal, and synthesis of findings (Tricco et al., 2018). A completed PRISMA-ScR checklist for this scoping review protocol is included in Appendix G. The PRISMA flow chart was also used to track the number of studies that were retained through each successive step of the screening protocol (see Figure 1).

Chapter 4. Findings

The purpose of this scoping review was to assess sport specialization and diversification recommendations in alignment with elements of the i-PARIHS framework. Since scoping reviews are intended to be exploratory endeavors, the inclusion and exclusion criteria evolved post hoc as greater familiarity with the content of retrieved studies was developed in relation to the research questions. This chapter is separated into the following three sections to adequately describe this naturally iterative process: 1) selection process and results, 2) study characteristics, and 3) findings of the framework analysis. The first section details how many sources were selected at each phase of the review and the process of selecting or excluding articles with a focus on the full text screening phase. The second section contains aggregated, descriptive information about the extracted studies which served to generally map where sport specialization recommendations are originating. Finally, the third section presents findings from the framework analysis that answered the research questions.

Selection Process and Results

Search terms for the six databases yielded a total of 3,211 articles with an additional 36 sources identified through a backward search of the reference lists in key articles. Table 1 summarizes the search results which are presented in the order they were imported into Covidence. After removing the duplicates and applying the inclusion and exclusion criteria to titles and abstracts, 271 articles were eligible for full text review. It

should be noted that Covidence identified 822 duplicates prior to the title and abstract review, but throughout the article screening process, an additional 49 articles were manually identified as duplicates with one article having three copies – bringing the total duplicates to 872 for the entire search.

Table 1. Database Search Results

Database	Date Ranges Returned	Publication Types Returned	Articles Returned	Duplicates Removed	Articles Imported
PubMed	1957-2021	Unavailable	644	1	643
Embase	1957-2021	11	1,041	497	544
SPORTDiscus	1970-2021	6	985	200	785
PsycINFO	1940-2021	4	334	99	235
SocINDEX	1937-2020	3	44	16	28
ProQuest Dissertations and Theses	Unavailable	2	163	9	154
Total	**-**	**-**	**3,211**	**822**	**2,389**

To achieve the overall purpose of assessing sport specialization and diversification recommendations in alignment with the i-PARIHS framework, an additional exclusion criterion was added at the full text point of the review. Since it was difficult to accurately extract articles with recommendations based solely on titles and abstracts, the criteria were left intentionally broadened for the first screening phase. Once full texts were available for review, a stricter criterion could be applied uniformly. Articles were only extracted if they contained a standalone section designated as

recommendations or another analogous term (e.g., practical implications) or had content that was preceded by the term *recommendations* in the discussion or conclusion. This study was not focused on synthesizing results from empirical studies to develop recommendations, instead its purpose was to map the characteristics of existing recommendations to approach disseminating sport specialization knowledge through an implementation science approach. Adding this criterion ensured the extracted studies had enough content directly related to practical recommendations for a robust analysis. Articles that only had future research recommendations were also excluded.

The full text studies were screened using this criterion in addition to the existing inclusion and exclusion criteria found in Appendix C, resulting in identifying 67 studies for extraction. However, reviewing this collective of studies revealed that many studies only had a one or two sentences with a very sweeping recommendation for practitioners. An excerpt from Rauh et al. (2020) – one of these 67 studies – demonstrates this: "parents, coaches, physicians, and sports health care professionals must work together to ensure the safe participation of adolescent runners, especially given that early sport specialization is increasing in the United States" (p. 1244). Similarly, the recommendation from Field et al. (2019) was only, "we also need a cultural change on the norms of physical activity in our society: We need fewer hours of practice for young athletes overall" (p. 6).

A pattern emerged that these recommendations – dubbed "single-line recommendations" – came largely from empirical research manuscripts. Empirical studies are often structured to include Introduction, Methods, Results, and Discussion

(IMRAD) components. Within this IMRAD structure, brief takeaway messages related to implications may be included as part of the discussion or conclusion, but it is suggested that these messages remain short and are not over extrapolated (Liumbruno et al., 2013; Weinstein, 2020). As such, it was determined empirical studies that were not exclusively focused on assessing awareness or adherence to sport specialization recommendations would not contain sufficient content to fulfill the study's purpose and were also excluded from the analysis. At this point, the 67 articles underwent a final screening that resulted in 37 articles being extracted for the final analysis (Figure 1). While this final review was prompted by reflecting on the inclusion of empirical articles with single-line recommendations, it also acted as a confirmation checkpoint for all articles that were still included at the phase of the screening. This was particularly helpful for methodological rigor given the absence of a second reviewer. A list of all the extracted articles and additional information about each article is found in Appendix E.

Since a large number of studies were passed onto the full text screening, I created a flow chart to assist with the review process and deciding whether articles met all the inclusion and exclusion criteria (Figure 2). This chart was also a useful resource for managing the full text screening phase more efficiently and adding systematization to the process since I was the sole reviewer. Furthermore, I inductively developed a basic set of keywords and definitions to provide more detail regarding the full text reasons for exclusion and continue increasing my familiarization with the literature base (see Appendix F).

Identification

Records identified through database search
($n = 3,211$)

Additional records identified through other sources
($n = 36$)

Records after duplicates removed
($n = 2,425$)

Duplicate articles removed by Covidence
($n = 822$)

Screening

Records screened
($n = 2,425$)

Articles excluded after title and abstract screening
($n = 2,154$)

Eligibility

Full text articles assessed for eligibility
($n = 271$)

Articles excluded after full text screening
($n = 234$)
Reasons:
  Not in English ($n = 5$)
  Conference abstract ($n = 3$)
  Manually identified duplicate ($n = 10$)
  Full text unavailable ($n = 14$)
  Irrelevant ($n = 24$)
  Specialization not primary focus ($n = 34$)
  No recommendations included ($n = 126$)
  • Review of specialization ($n = 29$)
  • Antecedents of specialization ($n = 6$)
  • Prevalence of specialization ($n = 4$)
  • Stakeholder perceptions ($n = 13$)
  • Specialization profiles ($n = 11$)
  • Specialization measures ($n = 1$)
  • Outcomes of specialization ($n = 54$)
  • Commentary on other articles ($n = 8$)
Empirical studies ($n = 18$)

Final review of full text articles assessed for eligibility
($n = 67$)

Included

Articles included in analysis after final review
($n = 37$)

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Flow Chart
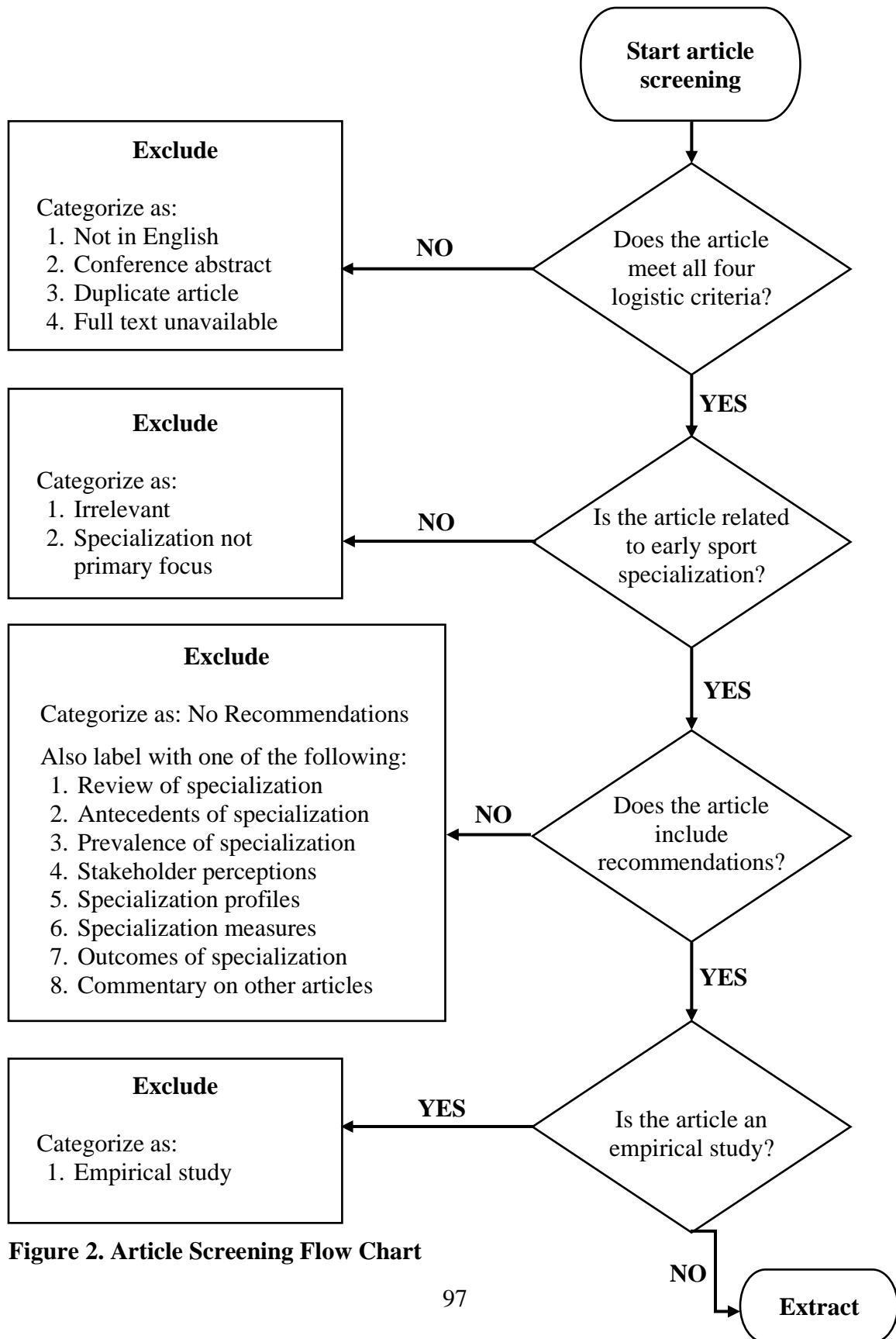
Figure 2. Article Screening Flow Chart

Article Characteristics

The 37 articles came from 25 different journals with the greatest number of articles (four) published in the *Journal of Athletic Training*. There were three articles in both *Sports Health* and the *Journal of Physical Education, Recreation and Dance,* while *British Journal of Sport Medicine*, *Interscholastic Athletic Administration*, *Pediatrics, Strategies: A Journal for Physical and Sport Education,* and *Strength and Conditioning Journal* each had two articles. Only eight articles were published prior to 2010, and 21 articles (57%) were published in the last five years (2016-2021; Figure 3). Thirty publications were written by authors with affiliations in the United States, and for the remaining articles, at least one author had an international affiliation.
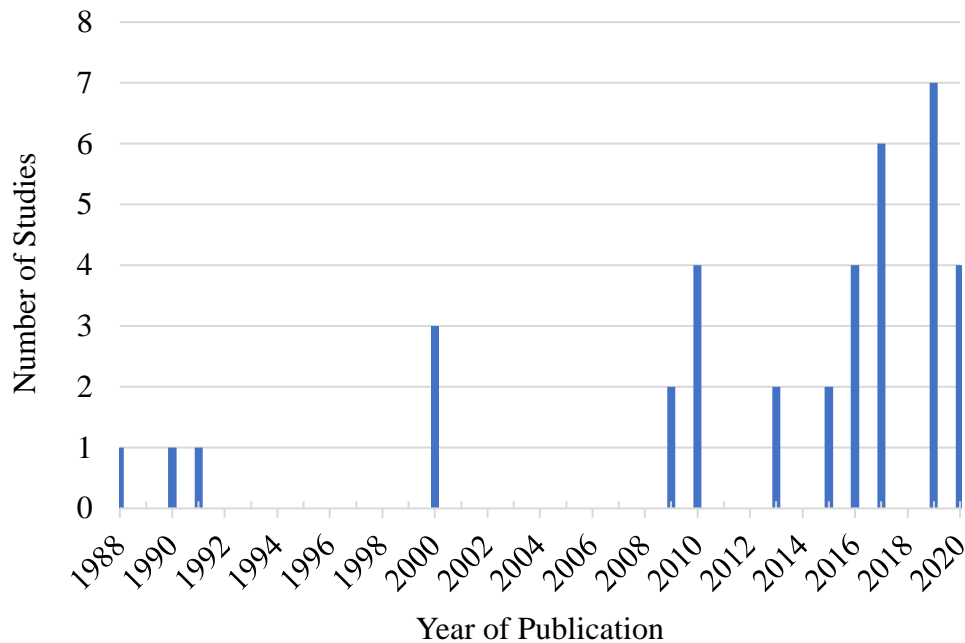
Figure 3. Distribution of publication dates for extracted articles

Classification schemes were developed to summarize the article types (Table 2) and prominent fields of study that were included in the review (Figure 4). Eight categories for fields of study were developed and applied to the articles based on their journal titles which allowed for more nuance than using pre-defined categories generated by one of the databases. This process was completed by scanning all the journal titles collectively and identifying recurring areas of study.

Five of the categories (i.e., physical education, sport medicine/health, athletic training, strength and conditioning, and sport psychology) had the field of study verbatim in the journal title (e.g., *Journal of Physical Education, Recreation, and Dance* categorized as Physical Education) or an analogous term (e.g., athletic administration categorized as Sport Management) for all the included articles. Other categories were intentionally broader in scope. The general medicine category was developed to incorporate journals that were oriented toward medical practitioners but not specifically toward sport medicine (e.g., nurses). Sport sciences encompassed titles connected to optimizing physical activity and sport performance that were not specific to athletic training or strength and conditioning. Finally, "None" was for articles with a publication outlet that did not relate to a field of study (e.g., US News and World Report). Physical education (24%) followed by sport medicine/health (22%) were the most prominent in the sample. Figure 4 shows the frequency distribution across all fields of study categories.

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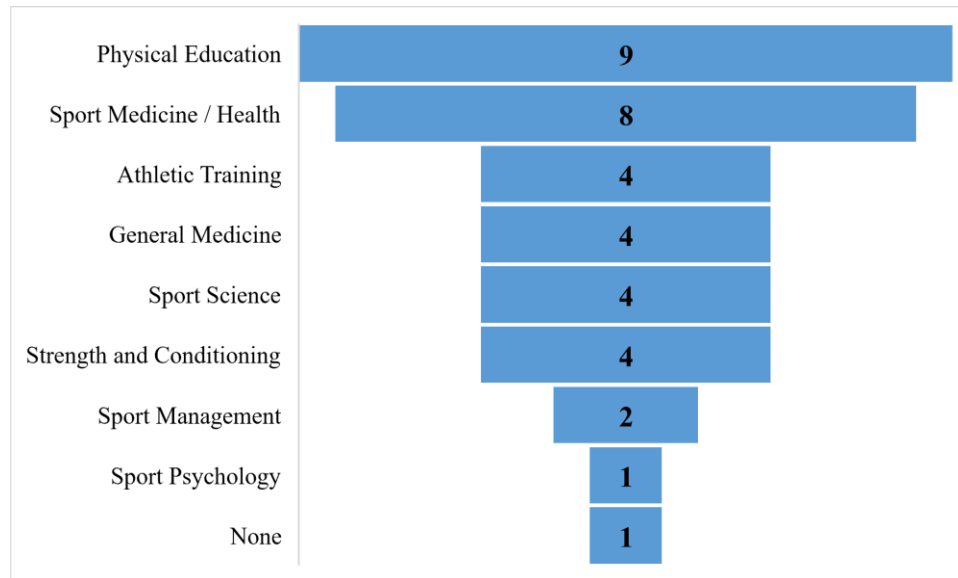
Figure 4. Number of studies for each field of study category

The initial classifications for article type were developed using the designations that some articles provided which were then modified into a stable scheme by consulting the literature. Narrative reviews were most common (49%) considering the focus on articles that contained substantive recommendations, but there was variation in terms of their rigor and depth of analysis. Articles that were classified as commentary/opinion were the next most frequent in the analysis (16%) followed by clinical reports, position statements, and knowledges syntheses (8%). Empirical research represented 5% of the articles, and finally there was one article in each of the editorial and book chapter categories (3%). Table 2 provides definitions for each of these article types, and Figure 5 highlights the intersection of article types and fields of study.
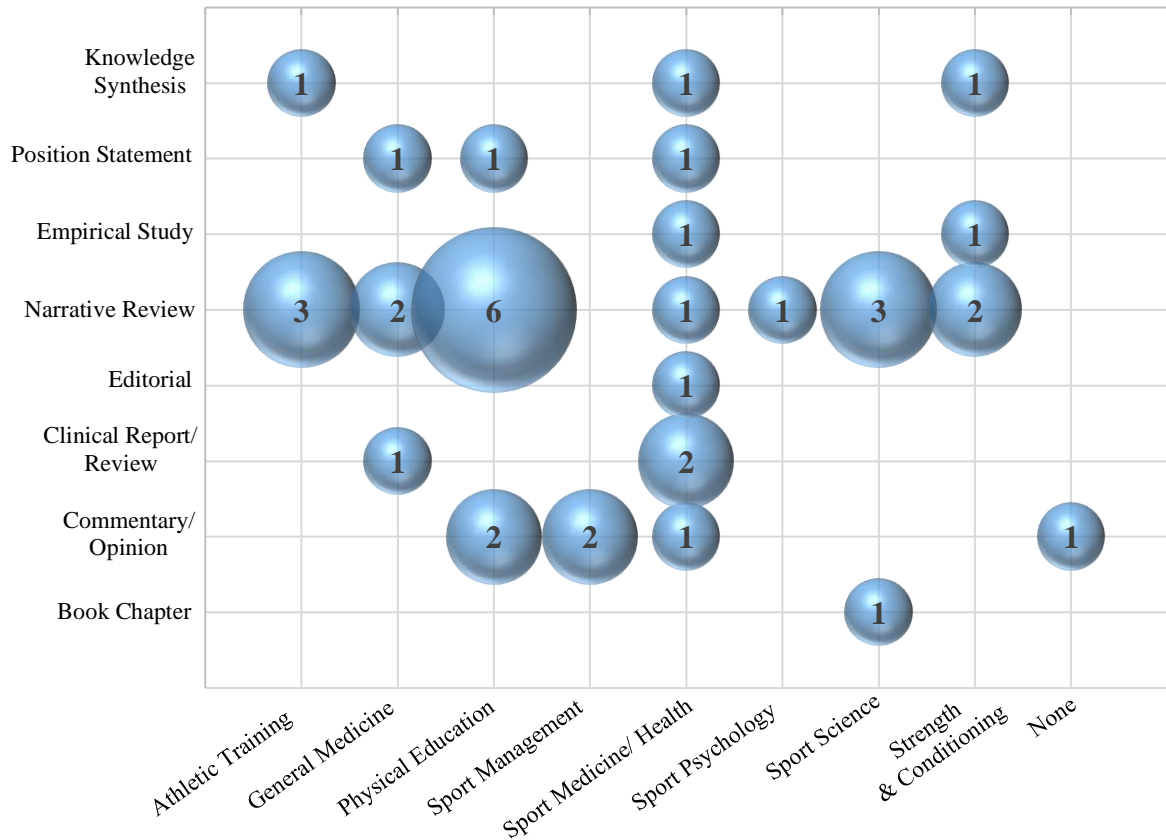
Figure 5. Articles per field of study category combined with article type.
Note. Bold numbers in the center of each bubble represent the number
of articles at each category intersection.

The final characteristic that was charted across the extracted articles was how they

defined early sport specialization because researchers have noted inconsistency and the

need for an evidence-based definition (e.g., Jayanthi et al., 2020). Due to the variation in

how definitions were phrased, only four categories could be reasonably distinguished and

consistently applied (Table 3).

Fifteen articles used the Three-Point definition (A2; A3; A5; A8; A9; A18; A19; A20; A21; A22; A23; A27; A28; A34; A36), which also included three articles that listed this definition as one of several (A20; A21; A23). Only two articles had the ASSOM definition (A25; A33), one of which was the original position statement that established the definition criteria (A25). Seven articles were labeled as Other (A1; A7, A11; A12; A13; A15; A16) which had definitions such as "Early specialization is characterized by investing in one sport on a year-round basis from a young age with the goal of developing expertise" (A13) and "implies a focused involvement in one sport and a large number of hours of deliberate practice with the goal of improving sport skills and performance outcomes during childhood" (A16). Finally, thirteen articles did not clearly include a definition of sport specialization (A4; A6; A10; A14; A17; A24; A26 A29; A30; A31; A32; A35; A37), although one of these was a review of specialization studies that considered the presence of a definition as part of the inclusion criteria (A24).

Table 2. Categorization Scheme and Descriptions for Article Types

Article Type	Description
Book Chapter	Content that was sourced from a published book instead of a journal, newspaper, magazine, etc.
Commentary/Opinion	Articles that contribute an individual(s) perspective that is not intended to be an unbiased representation of the topics.
Clinical Report or Review	Articles that are developed by an independent panel of subject matter experts that convene to develop best practice guidelines (Roukis, 2015).
Editorial	Articles developed by a member of publication's editorial staff and are specifically and clearly labeled as an editorial.
Empirical Research	Research that collects and analyzes primary data.
Narrative Review	Articles that provide a critical analysis of published literature on a topic from a theoretical or contextual point of view. These review articles do not list the databases or search strategies used to find relevant literature nor do they outline a specific methodological approach (Rother, 2007).
Position Statement	Articles that suggest a particular course of action or form of care. These documents provide background information and explanations to support the suggestions and are authored by an organization (Roukis, 2015).
Knowledge Syntheses (e.g., systematic review)	Research with clearly formulated questions that collect, appraise, and synthesize data using methodical, transparent, reproducible procedures (Kastner et al., 2016; Siddaway et al., 2019).

Table 3. Categorization Scheme and Descriptions for Definitions of Specialization

Specialization Definition	Description
Three-Point	Definitions that reflected the following three parts: 1) year-round intensive training, 2) participation in a single sport, and 3) exclusion of other sports. These were chosen because they eventually were used by Jayanthi and colleagues' (2015) to develop a three-point measure to categorize degree of sport specialization.
ASSOM	Definitions that cited the following criteria established in the 2016 position statement from the American Orthopaedic Society for Sport Medicine: "(1) Participation in intensive training and/or competition in organized sports greater than 8 months per year (essentially year round), (2) Participation in 1 sport to the exclusion of participation in other sports (limited free play overall), and (3) Involving prepubertal (seventh grade or roughly age 12 years) children" (LaPrade et al., 2016, p. 1).
Other	Articles that provided a definition of sport specialization, but it did not reflect the criteria to meet either the Three-Point or ASSOM definitions listed above.
None	Articles did not provide any clear definition of sport specialization.

Framework Analysis of i-PARIHS Constructs

This section explores early sport specialization recommendations through an implementation science perspective using a framework analysis. Harvey and Kitson's (2016) i-PARIHS framework guided the development of four research questions that correlated to the four constructs of successful implementation (i.e., innovation, recipient, context, and facilitation). The findings are presented in alignment with these four constructs and their respective research question. In the process of conducting the analysis and organizing the findings, I recognized it would be challenging to present

meaningful findings for the recipient, context, and facilitation constructs independently of innovation. This challenge is highlighting using a recommendation from Judge and Gilreath (2009) and denoting the i-PARIHS constructs in bold:

> Parents must sign documents allowing athletes to play sports at the grade school and high school level **(local context)**. Along with these documents a simple way to inform parents **(recipients)** is by also including a flyer with the information presented in this article that must also be signed **(innovation)**. (p. 9)

To avoid unnecessary overlap and improve clarity, the innovation section contains training recommendations for athletes. Then, recommendations that were directed at implementing these training recommendations were presented in the remaining three sections based on the primary i-PARIHS construct addressed. For example, recommendations that targeted a specific stakeholder were presented in the *Recipients* section, while strategies to facilitate implementation of the recommendations were presented under the *Facilitation* section.

Innovation

In the original PARIHS framework, the innovation construct was labeled *evidence* and broadly encompassed research, expert knowledge, and stakeholder preferences and experiences (Kitson et al., 2008). One of the refinements in the latest version of the framework was the acknowledgement that practitioners rarely take evidence in its original form (e.g., clinical guidelines) and directly implement it into practice (Harvey & Kitson, 2016).

Many of the recommendations consistently came from position statements that included the AAP, the AOSSM, and the IOC. Three position statements were included in this review because of their direct relationship to sport specialization (A1; A12; A25). However, other statements that contained suggestions which were applicable to specialization were excluded because they were not specific to specialization, such as those originating from the IOC and NATA. Jayanthi et al. (2019) synthesized a more extensive selection of position statement recommendations that were related to injury.

Since the recommendations were analyzed using a framework analysis, it would have been appropriate to organize the findings according to different sources of evidence. However, research and expert opinion were often integrated given the number of position statements and clinical reviews in the sample, making a distinction between the two tenuous and presumptive. Additionally, most of the articles that comprised stakeholder beliefs were ineligible for this review because they did not provide recommendations for practice (see Figure 1). Instead, the recommendations were organized under participation volume recommendations and culture recommendations as they are associated with two main areas that are represented in sport specialization literature, physiological and psychological outcomes.

Sport Participation and Volume Recommendations

Participation recommendations were common in the articles and developed from research that has been conducted on physiological and psychological outcomes as they relate to specialization. Encouraging athletes to delay specialization and opt to participate in multiple sports throughout the year was a common and straightforward

recommendation (A2; A4; A5; A8; A12; A15; A16; A19; A21; A22; A23; A27; A32; A34; A37). The decision to sample sport was promoted to prevent overuse injuries, minimize the potential for sport attrition, and protect against psychological concerns including burnout and social isolation.

Despite the general agreement to delay specialization, this recommendation was often stated very broadly with minimal guidance for instituting this suggestion. As such, there was inconsistency designating an appropriate age to begin specializing. Some articles indicated sport sampling should continue until at least puberty is completed (A8; A10), throughout grade school (A5), and late adolescence (A21). Others provided a more specific timeline, suggesting diversification until age 12 or 13 at which point the option to specialize could be considered (A6; A22; A26). Finally, there were recommendations that indicated specialization was disruptive before the age of 15 (A12), and others that suggested meeting the needs of different trajectories (i.e., sampling vs. specializing) could happen during the high school years (A16). Specialization of adolescent baseball players was discouraged, and pitchers were encouraged to wait until 13 or 14 years old to begin throwing curveballs (A37).

Unfortunately, this general guidance can pose challenges because it does not account for differences among sports, such as gymnastics and figure skating, that likely benefit from an earlier age of specialization because peak performance in these sports occurs before skeletal maturity. Interestingly, approximately one-third of the articles acknowledged sport-specific differences, but quantifiable recommendations to navigate these differences were absent.

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There was more specificity in terms of recommendations that were centered around rest and recovery which can be widely applied, regardless of an athlete's age or degree of specialization. Experts suggest that athletes take a minimum of two months per year off from participating in their primary sport (A5; A8; A9; A20). Other recommendations were more conservative and suggested taking three months off from a sport per year (A4) or not engaging in one sport more than eight months per year (A3). Relatedly, athletes should have 1-2 days per week away from organized sport-related activities (A4; A5; A6; A8, A9; A20). It was often suggested to take time off from a primary sport using an incremental pattern throughout the year of 2-3 months participating and one month off (A6; A8; A9). Additionally, strength and conditioning programs (A5; A6) as well as periodization of training (A25; A29; A36) are strategies to mitigate experiencing adverse effects of intensive sport engagement.

Berstein et al. (2020) suggested that athletes should get at an average of nine hours of sleep to promote recovery and consider strength training programming which could mitigate preventable injuries. Jayanthi and Dugas (2017) additionally recommended that "the total hours of organized sports (training, practicing competition, etc.) per week should be less than or equal to a child's age in years," and "the total hours of organized athletic activity (sport + gym) should be less than 16 hours per week." Athletes should not participate in more hours of organized sport per week than their age, for example a 13-year-old athlete should only participate in up to 13 hours of organized sport (A3; A6; A25). Since these are actionable sport training behaviors that can be widely applied across sports for athlete health, regardless of specialization or

diversification, they could be readily adapted to a context or population.

Despite clear participation recommendations, there were still articles that recognized the likelihood of young athletes surpassing the aforementioned guidelines. In these situations, athletes need to be monitored closely for symptoms of overuse injury and burnout (A1; A8; A25; A29). As such, individuals that are consistently in contact with athletes, particularly parents and coaches, should be trained to recognize signs of overtraining (A20).

Culture Recommendations

Another important aspect these article recommendations touched upon were the expectations and environment in youth sport. Coaches and parents were directed to reflect on their own actions to determine the sport culture these actions might be cultivating. Foremost, athletes should have autonomy to choose their sport pursuits (A10; A19). However, it is important that athletes are provided with opportunities to discuss the differences between sport specialization and diversification, including the potential benefits and detriments of each pathway (A7; A10; A18). For athletes that genuinely desire to specialize, coaches need to be comfortable initiating conversations with athletes to discuss goals and motivations for their desired sport participation (A7; A8; A11) and provide less formal and organized opportunities for athletes to engage with their sport of interest (A15).

Athletes should also perceive autonomy in their off-season schedules which might, subsequently, develop a culture where athletes desire to autonomously engage in off-season activities that promote development and maintain the enjoyment of their

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pursuits. Even well-intentioned coaches can drive pre-mature specialization by holding practices year-round that are not mandated but are perceived by the athletes to be necessary for future participation on the team (A11; A12). Therefore, coaches need to be cognizant of sending contradictory messaging about diversification and specialization which may also impact whether young athletes view their sport atmosphere as developmental- or performance-based.

Regardless of the selected pathway, it is important that coaches and parents create a positive emotional climate for athletes that incorporates opportunities to sample a diverse range of sports or physical activities and engage in free, unstructured play (A6; A12; A28; A29). Coaches need to be aware of planning age-appropriate training that is consistent with levels and abilities of their athletes (A1; A9). Individuals that comprise an athlete's social support system should also help young athletes continually evaluate the intention of their sport participation and focus on enjoyment of the sport (A12) and development of a broad range of skills that will support continued participation into adulthood (A16; A27).

Recipient

Recipients are critical to a process of implementation because they are the individuals being affected and can influence uptake of the implementation (Harvey & Kitson, 2016). In the case of sport specialization, there are a variety of recipients that were identified, the most obvious of which are the athletes. Interestingly, athletes were rarely independently targeted to receive information about specializing. Obviously, athletes need to physically adhere to the previously discussed sport participation and

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volume recommendations, however, suggestions regarding education and awareness of these guidelines were often targeted toward several recipients simultaneously. For example, articles often phrased recommendations toward a combination of recipients, such as adolescents and their parents/guardians (A5) or parents, coaches, athletes, and sports medicine providers (A3). In order to answer RQ2 and identify which stakeholders should be the targets of sport specialization recommendations, Table 4 was created to visualize which stakeholders were discussed in each article. This chart indicates athletes, parents, and coaches were frequently and consistently discussed as recipients of recommendations. Additionally, it shows the range of stakeholders that are vital to the youth sport system but may be underutilized in terms of implementing sport specialization recommendations. Major recipient groups are discussed in greater depth.

Table 4. Recipients for Youth Sport Recommendations

Reference	Athletes	Parents	Coaches	Physicians	Trainers	Educators (PE)	Sport Admins	School Admins	Community	Youth Sport Orgs	Sport NGBs	Miscellaneous
Anderson et al. (2020)	X	X	X	X	X							
Bell et al. (2019)	X	X	X									
Bell et al. (2020)	X	X	X									
Bergeson (2019)		X	X							X		
Berstein et al. (2020)	X	X	X				X		X			
Blagrove et al. (2017)	X	X	X									X
Bodey et al. (2013)			X									
Brenner (2016)	X	X	X									
Brenner et al. (2019)												
Carson et al. (2010)		X	X			X						X
Chase & DiSanti (2017)	X	X	X									
Coakley et al. (2010)	X	X	X			X						
Côté et al. (2009)	X		X									
DiFiori et al. (2017)		X										X
Ford & Williams (2017)			X			X						X
Goodway & Robinson (2015)												
Gould (2010)		X	X									
Hill & Hansen (1988)	X	X	X					X				
Hill (1990)	X	X										
Jayanthi & Dugas (2017)	X											
Jayanthi et al. (2013)												
Jayanthi et al. (2019)	X		X								X	
Judge & Gilreath (2009)	X	X	X									
Kliethermes et al. (2020)												
LaPrade et al. (2016)												
Lord (2000)	X											
Matzkin & Garvey (2019)	X	X	X									
Myer et al. (2015)	X	X				X						X
Myer et al. (2016)		X				X						
Post et al. (2020)			X									
Read et al. (2016)												X
Santa (2010)	X	X										
Sleiman (2019)		X	X	X								
Sluder et al. (2017)	X	X	X	X	X							X
Whitehead (1991)	X	X										
Wiersma (2000)	X	X	X				X			X	X	
Zaremski et al. (2019)										X		X

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Athletes

When athletes were the sole recipient without another stakeholder group directly mentioned, the recommendations often had an alternate, implicit recipient as seen in the excerpt from Anderson et al. (2000): "Children are encouraged to participate in sports at a level consistent with their abilities and interests. Pushing children beyond these limits is discouraged as is specialization in a single sport before adolescence." Ultimately, athletes were directed to engage in free play (A6; A12; A28; A29), avoid working through injuries and pain (A1), and explore a variety of sports before committing exclusively to one (A2; A4; A5; A8; A12; A15; A16; A19; A21; A22; A23; A27; A32; A34; A3).

Occasionally, a more specific athlete population was targeted. In one case, the decision to specialize was noted as particularly important for minority athletes that may have college or professional aspirations with the hope of shifting into a different social or socioeconomic environment (A19). Recommendations were also made directly for female athletes and their parents in terms of physical training and appropriate nutritional requirements at various stages of maturational development (A6; A36). More specifically, there are growing concerns about awareness of the female athlete triad. Therefore, it was suggested that young female athletes involved with intensive sports training should "be provided with dietary intake guidance and advised that menstrual dysfunction is a sign of inadequate energy intake" (A6).

Parents and Coaches

As with athletes, parents were rarely discussed independently as a recipient group. They were typically mentioned in tandem with coaches or educators for broadly stated

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recommendations such as, "parents and coaches of young athletes must take a more active part in deciding when a child is mature enough to understand the competitive process and demands of specialized sport programs" (A36). Parents and coaches were often identified as targets for increased education on a plethora of topics that included the changing youth sport culture (A2), understanding the concept of developmental readiness (A4), best practices for youth development (A8; A33), risks of early specialization (A23; A27; A34), prevention and identification of overtraining (A6; A27; A34; A37), and training volume recommendations (A3).

There were few recommendations directed solely toward parents, and those that were often reflective in nature. For example, one article suggested that parents need to consider their child's motivation and injury history prior to allowing engagement in focused training (A7). Other recommendations specifically for parents were to monitor the training and coaching environment of elite youth sports programs (A8) and determine their access to well-trained coaches if specialization is being pursued (A7). On a blunter note, one final suggestion for parents from an opinion piece authored by a sport medicine practitioner and parent was to "back off and let our kids choose their own path" (A4).

Much like with parents, the coaches were not usually independent targets of recommendations, but they are integral in athlete development, as Bodey et al. (2013) stated, "the coach is in a unique position to share insight and help parents reflect on a variety of related factors." Their direct connection with athletes and parents in addition to their influence over team culture and the sport experience positions them in a spot of great responsibility. With this wide range of expectations, coaches were identified as the

recipients of a variety of recommendations that pertained to their own knowledge and continuing education. Bergeson (2019) suggested that coaches should receive training in positive, developmentally appropriate coaching to understand how to "create an environment where kids feel safe to make mistakes as they are essential to eventually mastering a skill. Keep the emotional tanks of our children filled with positive feedback that fosters a growth mindset." Post et al. (2020) recommended that coaches have knowledge to improve sport safety and reduce injury risk, and Bodey et al. (2013) provided guidance for coaches to learn how to effectively engage with athletes and parents to ensure sport motives are appropriate and realistic. Such guidance was thought to help athletes make informed decisions about their future sport experience.

Additional Recipients

Throughout the articles in the review, eight other entities were identified as recipients of at least one recommendation. With the exception of community members, these recipients could be categorized as either medical professionals or athletic organizations and administrators. The miscellaneous designation was reserved for when an overly broad term could not be categorized elsewhere without making significant assumptions (e.g., practitioners [A10], those involved with youth sport [A14], and caregivers [A37]).

Recommendations targeted toward medical professionals primarily centered on ensuring young athletes are properly monitored and evaluated, especially those that are in higher risk categories (A1; A27; A34), Meanwhile, athletic administrators were essentially tasked with combatting misconceptions about sport specialization and

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diversification, specifically through the public school system. Santa (2010) stated that "athletic administrators need to destroy the scholarship fallacy that is so prevalent." There was also a specific recommendation for community and nonprofit organizations to make concerted efforts to fund more organized sport endeavors aimed at youth athletes from families with lower income (A2). Although several additional recipients were identified, the recommendations for these stakeholders were typically short and ambiguous.

This review also illuminated the importance of improving the consistency of messaging between youth sport stakeholders (A2; A30). Enhancing communication and messaging requires adopting a multi-disciplinary approach to training and implementation of recommendations that coordinates several perspectives (A5; A24; A30). One suggestion was to create more effective public health messaging to increase awareness of recommendations (A2; A27), particularly for young athletes that might be at-risk of the female athlete triad (A6). Other content might include communicating that multisport participation will not "diminish athletic capabilities" (A25).

Context

The i-PARIHS framework defined the context "in terms of the resources, culture, leadership, and orientation to evaluation and learning" (Harvey & Kitson, 2016, p. 37). Furthermore, the authors made specific distinctions between local and external contextual factors, recognizing the local context as an individual or organization's immediate setting and the external context as the wider system in which the setting is positioned which can reflect political, social, and regulatory structures.

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In this review, schools and sport opportunities in the surrounding community comprised the local context. In the American sport system – where athletics is intimately tied to the educational system – ascending to an elite or professional level often happens through success at the interscholastic and club level followed by college sport and then professional opportunities. The social influences on athletes and parents alike were described as powerful motivators to commit to a single sport, particularly where the potential for collegiate scholarship was perceived. Articles also identified the desire to compete at elite levels, such as with national or Olympics teams, contributed to specializing early because athletes felt that the additional commitment would result in enhanced technical skill development. This aspiration to compete at higher levels, combined with the cultural relevance of sport, allows collegiate and professional athletics to influence policy, priorities, and regulations at lower levels which is characteristic of the external context, according to the i-PARIHS framework. Thus, the structure and culture of sport beyond an individual team or community was considered the external context. See Table 5 for a summary of which articles included local and external context as part of their recommendations.

Local Context

Schools were identified as environments that are well-positioned to influence specialization trends, specifically through a reinvestment in physical education curricula designed to promote widespread youth participation in physical activity that is not focused on performance. LaPrade et al. (2016) suggested "a focused effort toward the importance of physical education as an opportunity for noncompetitive play and put it

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back into school curriculums." Similarly, Bell et al. (2019) stated that "school districts need to reinvest in school-based physical education and extracurricular sports to provide daily recreational activity and promote the acquisition of physical literacy."

In addition, schools can be a prime context to influence specialization trends since they can set guidelines that can dictate how athletic teams are operated and managed. Judge and Gilreath (2009) surmised that such regulations would "limit the use of the athletic facilities and not allow sport teams to practice year-round." This approach could mitigate excessive practice hours in one context, however, there was little discussion of youth club and travel teams which operate independently and would not be held to the same restrictions as public schools (A37). A philosophy that welcomes participation in multiple sports at the interscholastic level was viewed as integral to youth athlete experiences, and athletic administrators at the middle and high school level were identified as key individuals to promoting such an environment.

The mechanisms schools have available to distribute information to an entire student body was another reason they were viewed as an optimal context for implementing recommendations. Several articles recognized that materials such as policy handbooks are annually given to students and parents, and flyers or other infographics about specialization and diversification could be included with these materials to ensure the information is getting to appropriate stakeholders (A23; A19; A32). Parental consent is also necessary for interscholastic athletic participation, so these consent documents could be accompanied by best-practice guidelines and suggestions. One article went beyond simply using school-based materials to inform athletes and parents and advocated

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that schools "develop a multiple-sport philosophy and include it in athletic handbooks and student-parent handbooks. Regularly communicate this policy in meetings, press releases, memos, e-mails, etc." (A32). Parents are presumably inundated with school policies and guidelines, so including specialization recommendations with this material does not guarantee it will be reviewed. However, using school-wide materials could be an avenue to target the appropriate recipients.

External Context

The greater sport environment was not often directly discussed, but it is particularly important to the uptake of new information because the intensity and expectations of youth sport culture is posited to influence parents and athletes who, in turn, socially influence one another. Bergeson (2020) summarized this proposition from the perspective of a sports medicine physician and parent:

> We all inspire and influence each other. We sit in the stands at our kids' games and commiserate about the intensity and politics of youth sports culture. We all know that it is an unhealthy environment, yet we allow it to persist. It is a fascinating social phenomenon. The perpetuation of our current youth sports culture is due to parent-to-parent peer pressure. There is a constant (often unsolicited) stream of parental advice from friends, family, experts, and social media.

In addition, ranking and recruiting athletes at progressively younger ages compounds the pressure to achieve high level performance. Brenner (2016) pointed to these methods of early talent identification and development as factors that drive the specialization trends,

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showing how the external context is an integral influence. The article (A8) stated:

Talented youth are starting to be ranked nationally as early as sixth grade. As

colleges start to look at middle school and early high school athletes, more

pressure is created for the athlete and parent to do everything possible to succeed.

As such, suggestions related to the external context encouraged a top-down effort

where collegiate and professional sport organizations "promoted solutions for a healthier,

long-term athlete development strategy" (A4). These recommendations included creating

policies that endorsed cooperation between high school, club, community, and

professional sport organizations (A2) and having stakeholders advocate for banning

national ranking of athletes and college recruitment before the later years of high school

(A4; A8). Likewise, sport governing bodies could shift away from using chronological

age to determine competition eligibility and instead use maturational age (A10). These

types of adjustments in the external sport context would ideally impact the uptake of

recommendations in the youth sport environment.

Facilitation

Within the i-PARIHS framework, facilitation is viewed as the active ingredient to

implementation (Harvey and Kitson, 2016). In other words, facilitation activates the

implementation process which requires individual(s) that can act as a facilitator in

addition to strategies and actions for implementation. Several practitioners and

stakeholders were prompted to act as conduits of pertinent information and provide

insight and education to athletes, parents, and coaches (Table 5). Notably, many of the

suggested facilitators are individuals with medical training or substantial knowledge of

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human anatomy and physiology, including athletic trainers (A3), strength and conditioning coaches (A30), school nurses (A27), pediatricians (A1; A8), sport medicine clinicians (A2; A4), and general medical practitioners (A5; A30).

Educators and schools were also identified as important to facilitating knowledge into action, but these terms were used rather ambiguously (A15; A18). For example, Ford and Williams (2017) indicated that "educators must equip coaches, physical education teaching, and any adults working with children in sport with the knowledge and skills required for them to lead this activity [safe, playful sports activities]." Therefore, more detail is necessary to ascertain who would be fulfill the designation of educator in this situation. Coaches appeared to be a lynchpin in the youth athletic environment as they were often referenced alongside parents as one of the most targeted recipients of sport specialization recommendations and education. However, they were simultaneously recognized as a central mechanism for educating parents and/or athletes (A6), providing honest assessments to parents of athlete strengths and weaknesses (A7), and assisting their athletes to achieve balance between sport participation and other aspects of their lives and identities (A11).

Generally, stakeholders were only identified as well-positioned to transfer research knowledge to the appropriate recipients. Rarely was this suggestion accompanied by strategies or actions for implementation. The most in-depth discussion of a facilitator was related to the impact sport organizations can have on increasing awareness and education about the concerns of early specialized training. DiFiori et al. (2017) outlined the efforts taken by the National Basketball Association (NBA) to

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support the concept of sport sampling at younger ages. Specifically, the NBA and USA Basketball have formed partnerships with youth basketball organization (e.g., Amateur Athletic Union) to promote recommendations, such as getting enough weekly rest and taking time off from basketball throughout the year. While the precise mechanisms and educational strategies utilized by the NBA to form these alliances were not detailed, this spotlights the importance of a cohesive, top-down implementation strategy.

While effective facilitation requires an appropriately placed and prepared facilitator, it is also imperative for the facilitator understand the factors that may help or hinder implementation efforts (Harvey & Kitson, 2016). First and foremost, there is simply a lack of awareness – among coaches and parents specifically – that detailed recommendations have been developed by medical professionals and sport organizations (A2; A30). Even where there is awareness and attempted application of training recommendations, there may be lack of compliance by athletes. Anderson et al. (2020) pointed to overcommitment by the athletes as a potential contributor to non-compliance. LaPrade et al. (2016) noted another barrier is a lack of acceptance by athletes, parents, and coaches that the concerns related to early specialization apply to them and their sports. Finally, recommendations and resources may not be appropriately tailored to the intended audience reducing buy-in from these stakeholders (A30).

Table 5. Context and Facilitators of Youth Sport Recommendations

Reference	Local Context	External Context	Parents	Coaches	Educators	Medical Clinician	Athletic Trainers	Strength Coach	Sport Admins	Schools	Sport Organizations	Miscellaneous
Anderson et al. (2020)						X						
Bell et al. (2019)	X	X				X					X	X
Bell et al. (2020)							X				X	
Bergeson (2019)		X				X						
Berstein et al. (2020)												
Blagrove et al. (2017)				X								
Bodey et al. (2013)			X	X								
Brenner (2016)		X				X						
Brenner et al. (2019)												
Carson et al. (2010)		X										
Chase & DiSanti (2017)	X			X								
Coakley et al. (2010)	X		X	X	X							
Côté et al. (2009)	X				X							
DiFiori et al. (2017)											X	
Ford & Williams (2017)					X							
Goodway & Robinson (2015)	X	X										
Gould (2010)												
Hill & Hansen (1988)										X		
Hill (1990)	X									X		
Jayanthi & Dugas (2017)						X						
Jayanthi et al. (2013)												
Jayanthi et al. (2019)												
Judge & Gilreath (2009)	X			X	X					X		X
Kliethermes et al. (2020)												
LaPrade et al. (2016)	X	X										
Lord (2000)						X						
Matzkin & Garvey (2019)	X					X				X		X
Myer et al. (2015)												
Myer et al. (2016)												
Post et al. (2020)						X		X				
Read et al. (2016)									X			
Santa (2010)	X											
Sleiman (2019)												
Sluder et al. (2017)										X	X	X
Whitehead (1991)	X								X			
Wiersma (2000)												
Zaremski et al. (2019)											X	

Chapter 5. Discussion

Academic investigation of early sport specialization has gained attention and grown considerably, particularly in the last decade. A cursory search of the term *sport specialization* in PubMed by Kliethermes and colleagues (2020) returned 166 articles before 2010 and 87 articles in 2019 alone. While several reviews of sport specialization literature have been conducted, few examined the specialization phenomenon from a dissemination and implementation perspective. The purpose of this scoping review was to map sport specialization recommendations using the i-PARIHS framework to determine which of the factors necessary for successful implementation (i.e., innovation, recipients, context, and facilitation) were present.

Article Characteristics

Findings from charting article characteristics showed trends related to the types of sport specialization evidence available. First, health care fields were the most represented in the sample, which is unsurprising since a considerable amount of sport specialization research is directed toward physiological implications, such as risk factors for injury and biomechanical outcomes of specializing early. Physical education publications were also prevalent while sport management and psychology were the least common in the study. In comparison, DiSanti and Erickson's (2019) scoping review of sport specialization

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charted sport psychology followed by sport medicine as the primary fields of publication. This stark difference in fields of publication represented in each review is noteworthy.

The two scoping reviews had noticeably different purposes with one seeking to map the available empirical evidence on specialization and the other focusing on implementation constructs and sport specialization recommendations. Differences in the fields of publication could indicate that certain disciplines are more adept at knowledge creation and others for knowledge application. Perhaps the discrepancy is related to how sport specialization was operationalized or how articles with related concepts, such as athlete and/or talent development were treated in each review. This possibility highlights another concern – early sport specialization lacks a consistent definition.

Jayanthi and colleagues (2020) have noted that a "validated definition with testable constructs does not exist" (p 196), and this lack of consistency was apparent in this review. Not only were there several definitions used across the extracted articles, over one-third of the articles did not give an explicit definition. Articles were not excluded from the review based on quality or type of evidence, though, and this could have contributed to the absence of a definition in some cases. The Three-Point definition was the most consistently used which likely results from its association with the 3-point sport specialization scale (Jayanthi et al., 2015). Studies that are using the measure to determine degrees of specialization would presumably also utilize the definition that informed development of the scale.

Nonetheless, consistency needs to be established for the field to move forward cohesively and effectively. The heterogeneity of definitions has been credited with

contributing to issues conducting systematic reviews and meta-analyses which negates the power of methodologies that are designed to pool results and quantify effects (Kliethermes et al., 2020). Even for reviews that are not as reliant on developing specific inclusion and exclusion criteria a priori, the inconsistency makes screening studies challenging because the term sport specialization is often applied to a variety of contexts. For example, in this review, it was observed that sport specialization often referred to an elite athlete selecting a single sport but was not specific to whether that athlete specialized early. As such, a broader search strategy that retrieves less precise results might be required which could strain resources, specifically time. Potentially more problematic is the possibility that relevant studies might get excluded from reviews, effecting the accuracy of the results. Extrapolated to dissemination and implementation efforts, these inconsistencies could prevent the application of an effective EBP approach to sport training recommendations since EPB practice is built upon well-constructed systematic reviews and research syntheses.

Regarding the article types and fields of study, the greatest diversity in article types came from the sport medicine and health sector. Although much early research related to specialization came from scholars in physical education (e.g., Hill, 1987; Wiersma, 2000) or sport psychology (e.g., Côté et al., 1999), medical practitioners and scholars have contributed significantly to filling the calls for empirical evidence to understand the connections between early specialization and youth sport outcomes. However, this resulted in articles that are concentrated on physiological risk factors and outcomes. Meanwhile, evidence related to psychosocial domains is less abundant (Larson

et al., 2019). To ensure a well-rounded perspective of specialization, interdisciplinary research teams and studies need to be encouraged.

In addition to research that span disciplines, projects that cross geographic boundaries could be important for sport specialization literature. A majority of articles in the review originated from authors in the U.S. which may be a byproduct of the terminology used to describe athletes selecting a single sport early in their career. Nonetheless, perspectives from varied sport systems are important. Currently, the U.S. is characterized by a youth sport system that is commercialized and privatized while the Norwegian sport system has few entry barriers to sport participation in early adolescence. Travel teams that stratify promising athletic talent are not formed until athletes reach their teenage years (Farrey, 2019). While this system may appear counterintuitive to becoming an athletic superpower, Norway won 39 medals at the 2018 Winter Olympics while the U.S. won 23. Research that can engage with multiple sport structures could test the efficacy of implementing recommendations and interventions that are informed by different sport philosophies.

In terms of article types, narrative reviews were most common. This is not surprising since the purpose of review articles is to synthesize research knowledge as opposed to create knowledge. Research synthesis is more conducive to developing recommendations since it is drawing on data from several sources. The presence of knowledge synthesis studies across three different fields of study supports the notion that sport specialization is a rapidly growing and evolving body of literature that has reached a point where results can be synthesized and distilled for dissemination to practitioners.

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i-PARIHS Constructs

Evidence and Innovation

Findings from this review were overwhelmingly supportive of avoiding specialization in early adolescence and provided training recommendations to guide athletes, parents, and coaches toward achieving the sampling approach. Practical recommendations originated from research activities (e.g., Bell et al., 2020; Post et al., 2020), expert opinion or clinical experience (e.g., Bergeson, 2019; Carson et al., 2010), and a combination of these two evidence types in the form of position statement and clinical reviews (e.g., Coakley et al., 2010; LaPrade et al., 2016; Myer et al., 2016). These sources align with the types of available evidence often consulted for EBP. However, far less evidence was generated from stakeholder experience and the local context or environment, both of which are also considered important sources of information for EBP (Rycroft-Malone, 2004).

Furthermore, stakeholders are instrumental to innovating evidence. Harvey and Kitson (2016) proposed that people rarely take evidence in its original form as a systematic review or clinical guideline and apply it directly to a practical context. Therefore, one of the refinements to the framework was that evidence is adapted to a specific situation – sometimes called *tinkering* – and this process of aligning evidence to make it compatible with a specific context or need is considered innovating the literature (Harvey & Kitson, 2016). Thus, there is an important distinction between evidence and innovation that centers around incorporating stakeholder perspectives and priorities to tailor evidence. For example, an implementation team leading a project to improve the

management of chronic kidney disease first produced national clinical guidelines and then gathered a group of patient representatives, clinicians, researchers, and mangers to determine priorities and expectations at a local level (Harvey et al., 2015).

For early specialization, mechanisms to integrate stakeholder opinions and priorities related to sport participation and associated recommendations were not apparent in this review. This is not to suggest that stakeholder perspectives are not explored, in fact, a group of articles among those excluded from the review because they lacked recommendations was labeled *stakeholder perspectives*. Instead, more efforts to integrate stakeholder priorities, particularly from athletes, and local experience into the tinkering process could positively influence the uptake of sport specialization recommendations.

In general, studies that provide guidance for adapting recommendations into a local context were absent in this review, suggesting that blending evidence-based knowledge with practical experiences needs to be an area of focus. Position statements have directly acknowledged the concerns of sport specialization since 2000 when the AAP released a statement (i.e., Anderson et al., 2000). Since then, other professional organizations and governing bodies, such as the IOC, the NATA, and Major League Baseball (MLB), have spoken against athletes specializing at a young age, but growing expert consensus has not curbed the prevalence of specialization.

Several barriers exist that could prevent guidelines from going through a tinkering process. First, these statements are often written with technical medical terminology or academic jargon that could make reading them less appealing to individuals that are not medical practitioners or academics (Kliethermes et al., 2020). Inconsistencies in the

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definition and measurement of specialization may be as challenging to implementation as they are to developing knowledge. Second, some position statements address topics that are related to sport specialization but are not specific to sport specialization itself. Several statements were excluded from this review (e.g., Herring et al., 2008) because they evaluated musculoskeletal issues and treatments and only briefly discussed overtraining and sport specialization at the end of the document. Sport practitioners may overlook such resources because they do appear to pertain to the topic of interest. Furthermore, the team physician was identified as one of targets for this particular statement which may preclude teams and organizations that do not have team physicians from recognizing the importance and applicability of the recommendations. Third, youth sport coaches are often parents or volunteers that might not have the resources or time to explore and adapt guidelines. Finally, innovation research recognizes that variations in an innovation's attributes will impact the adoption of that innovation (Greenhalgh et al., 2004).

This last point is supported by diffusion of innovation (Rogers, 2003) – one of most influential theories related to knowledge utilization and most frequently used to understand what influences implementation outcomes (Nilsen, 2015). Five characteristics of the innovation impact its adoption: relative advantage, compatibility, complexity, triability, and observability (Rogers, 2003). Within youth sport, participation recommendations, such as delaying specialization, are considered the innovation. Arguably, the relative advantage, compatibility, and observability are currently low for this innovation. Athletes, parents, and coaches may not perceive that diversification is unambiguously advantageous to developing skill and obtaining elite status comparatively

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to specialization (relatively advantage). Adhering to the recommendations may not align with their personal values and social norms (compatibility), and the benefits of diversification to athlete health and well-being are not readily observable over the short-term (observability).

Ultimately, the infrastructure is in place to develop more research-based evidence. Scholars have outlined research gaps and questions that create a clear research agenda (Bell & Straciollini, 2019; Kliethermes et al., 2020) and are working toward establishing an agreed upon definition (Jayanathi et al., 2020) and refining specialization measures (Downing et al., 2020). The barriers to implementation that need more attention are those related to tinkering with evidence so it can be distilled for a given specific set of conditions and subsequently applied with greater success. In short, early sport specialization literature needs to be innovated, otherwise attempts to translate this research into practice may be negated.

In addition to the challenge of adapting evidence to a specific context, effective dissemination may rely upon how messages are communicated. One of five major questions posited by Bell & Straccolini (2019) to continue moving the field of specialization research forward was, "what is the best way to make decisions about specialization?" (p. 1009). This question was viewed as one that would seek to inform athletes and families about specialization and promote shared decision-making about sport pursuits. However, the authors also noted that the best approach to communicating this information is still elusive.

Early sport specialization is engulfed by passionate opinions and support on both sides of the debate. This is not uncommon or novel as public opinion tends to be divided for a variety of social and scientific topics, such as climate change and more recently vaccination safety and efficacy. Scientific communication is a technique that has been leveraged to enhance individuals' awareness, enjoyment, interest, opinion, and understanding of academic and scientific literature among science practitioners, involved stakeholders, and members of the general public (Burns et al., 2003).

However, scientific communication is often predicated upon the notion that lack of support for an approach is simply a matter of a knowledge deficit that must be fulfilled – termed the knowledge deficit model. As such, communicating scientific information is often approached by repeatedly presenting rigorously developed evidence to a target audience with the intention that the information will eventually become "legitimate and memorable" (Jones & Crow, 2017, p. 2). In many cases, this is unsuccessful because it oversimplifies the uptake of scientific and academic knowledge by assuming that decision-making is a rational enterprise that is unaffected by social and contextual factors (Simis et al., 2016). This can be explained, in part, by the concept of biased assimilation wherein people tend to engage with new information in a way that extends their preexisting assumptions and expectations (Lord & Taylor, 2009). Similarly, George Marshall (2015), author of a book on climate change communication described a term coined *narrative fidelity* by a professor of communications (Walter Fisher). Essentially, when non-experts are making sense of complex technical issues, they make decisions based on the quality of the story instead of the quality of information within the story.

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Therefore, repetitive exposure to scientific evidence alone is often not persuasive enough to shift perspectives (Jones & Crow, 2017), making the important takeaway that is not simply what is recommended, but how that information is being communicated.

Some articles in the search referenced resources that are more readily available to practitioners than those contained in research articles and consensus statements. Matzkin and Garvey (2019) pointed to The OneSport Injury, a public service campaign that raises awareness of the potential risks of youth sports specialization and offers recommendations to protect young athletes' bones, joints, and muscles. Andrews (2013) STOP Initiative offers a series of sport, injury, and role specific tip sheets, one of which addresses sport specialization in youth athletes. These resources have been distilled down to knowledge products and tools (e.g., infographics) that are aimed at youth sport stakeholders, but they lacked the detail necessary to drive appropriate actions. For example, OneSport Injury produces accessible resources but there was no indication of who should be responsible for making parents and coaches aware of the campaign or how these resources could be disseminated for greater uptake (Matzkin and Garvey, 2019).

Recipients

Parents and coaches were most frequently identified as the recipients of recommendations related to sport specialization. This is unsurprising given that these two stakeholders are integral components of an athlete's initial exposure to sport and subsequent athletic experiences. Baxter-Jones and Maffulli (2003) purported that the belief systems of parents will significantly contribute to children's physical activity participation and found athletes who display high levels of sport have parents with a sport

background as well, showing the strength of socialization in sport participation. Socialization is essentially the process of developing awareness of social norms and expectations by observing and interacting with each other and the environment (Coakley, 2015). This is derived from a variety of models, such as social learning theory (Bandura, 1977, 1986), and explains that these interactions influence the decisions individuals make and who they become. For children, the preferences and expectations of sport held by primary actors in their social worlds will be highly influential (Brustad et al., 2011).

Parents also have been viewed as providers, interpreters, and role models when it comes to youth athletes (Harwood & Knight, 2015). Meanwhile, coaches may be discussed as secondary factors, however, this may be a function of coaches having more impact during later stages of athlete development. Knight (2017) explained that parents are critical to starting athletes in sport as they choose which sports children are exposed to and are responsible for selecting how many athletic endeavors to support. Coaches become more critical in phases where athletes excel in sport because they drive athlete development and become prominent sources of leadership (Knight, 2017).

Such insight adds further depth to the finding that parents and coaches are viable recipients for specialization recommendations. Parents' and coaches' knowledge of injury prevention recommendations is quite low (Bell et al., 2020; Fazarale et al., 2012; Post et al., 2020), and directing similar recommendations at both groups might be contributing to the lack of awareness about early specialization recommendations. Since these two stakeholder groups exert their influence at different times in athlete development, it might be important to test the efficacy of tailoring certain information to each stakeholder at a

specific time in athlete development. Using the age ranges presented in the DMSP (Côté et al., 2007), parents could be the recipients of information related to single sport participation outcomes when athletes are entering a sport pathway around age 6 since parents are more influential to starting sport. Meanwhile coaches could be targeted with information that is directly aimed at general and sport-specific training volumes when practice expectations become more intensive which might be a few years later.

Another concern is that parents and coaches hold contrasting views about optimal youth development activities (Kearney et al., 2020). Specifically, parents tend to overestimate the amount of successful adult athletes that also achieved success as adolescents, and they are more likely to encourage year-round training at an earlier age comparatively to coaches. While it is important for the coach-parent dyad to communicate effectively and work harmoniously together with shared goals (Blom et al., 2013; Horne et al., 2020), differences in their perceptions and the temporality of their influence might require treating these two stakeholders as independent recipient groups during early developmental years. Doing so could increase the uptake of information for both parents and coaches.

Athletes were also identified as recipients of information, but they were rarely the sole target of specific information. Instead, they were most often considered in conjunction with parents and coaches likely because youth sport endeavors are increasingly dependent upon adults to provide the resources necessary for participation and to structure practice and competition activities. Considering control over the youth sport experiences has shifted away from young athletes (Coakley, 2015; Popkin et al.,

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2019), it is imperative to concentrate on the motivations and desires of athletes. Athlete autonomy has been identified as an important factor to sport participation in several facets. First, Coakley (1992) suggested that athletes who begin to feel tightly controlled by parents, coaches, or other influential adults may resist support from these individuals and seek out a sense of autonomy. The feelings of being controlled or powerless may originate from an awareness of how much time, money, and effort parents are spending on sport engagement, ultimately leading to symptoms of burnout (Coakley, 1992).

Autonomy-supportive environments in organized sports have been linked to basic psychological need satisfaction, self-determined motivation, and persistence (Conroy & Coatsworth, 2007) which can lead to positive experiences with sport and act as a protective factor against attrition. The Aspen Institute and Project Play have identified sport attrition as a concern since youth sport participation rates have dropped in recent years. This could have further implications for health and wellness into adulthood as physically active children are more likely to be active adults (Brenner, 2016). Coaches have been encouraged to develop autonomy-supportive environments to promote these benefits by creating structures for shared decision-making, recognizing athletes' feelings and perspectives, and avoiding overt control or criticism (Mageau & Vallerand, 2003).

The relationship between athlete autonomy and burnout as well as the advantages of autonomy-supportive environment demonstrate the importance of ensuring the athlete voice is heard, particularly as it pertains to their own sport decisions. Athletes should not only be targeted as their own recipient group, separate from parents and coaches, but recommendations should continue to be directed at parents and coaches about supporting

athlete autonomy and understanding individual-level antecedents that are related to the decision to specialize, including mental toughness (Buhrow et al., 2017) and motivational orientations (Chamberlin, 2020).

Context

Context accounts for how aspects of the environment, such as culture and past experience with change or innovation, enable or constrain implementation efforts. Given that studies evaluating the application of sport specialization recommendations are lacking, this review was limited in the amount of information that was ascertained about different contexts and their impact on implementation efforts. Nevertheless, curriculum changes in the interscholastic environment and physical education classes were repeatedly discussed as viable contexts to curb specialization trends.

However, there are challenges with placing this responsibility on elementary, middle, or high schools because a curriculum change for physical education does not necessarily draw athletes away from their competitive endeavors. While it might promote more general engagement in physical activity, these actions are not guaranteed to preclude young athletes from fulfilling their physical education requirements while still competing in organized athletics. Furthermore, different school districts could operationalize these requirements differently. Bell et al. (2019) noted that an "option would be for all states to adopt resolutions to improve physical education and activity levels in schools" which would ensure that schools would operate similarly state-wide. However, it would not account for how different states might approach this issue as some

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states are strongly rooted in culture of high school athletics, such as Texas football (Toler, 2017).

In terms of the overall sport environment – the external context – this review found that scholars view the current structure and culture as problematic to the uptake of sport specialization recommendations. While college and professional teams might encourage sampling sports in adolescents, high-level sport organizations often take actions that inherently promote sport specialization. These actions are so engrained in our sport society that they are viewed as the norm – like collegiate recruitment practices. Recruitment rules are in place to prevent college coaches from contacting or verbally offering an athlete a scholarship until after their sophomore year, but there are still loopholes that provide coaches with the leeway to scout and contact young talent before this cutoff. At the same time, organizations such as the Naismith National Youth All American (NYAA) Report are designed to rank youth athletes to "springboard" an athlete's career using ranking camps that are designed for players as young as third grade (NYAA Report, 2021).

Facilitation and Barriers to Implementation

The facilitation construct of the framework was the least represented in the data. While several stakeholders were identified as potential facilitators for sport participation recommendations, the i-PARIHS framework indicates that facilitators must understand their role as well as be supported by clear facilitation processes (Harvey & Kitson, 2016). However, there was limited guidance about how these stakeholders should conduct their roles as facilitators. Facilitation is purported to be the active ingredient of successful

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implementation, and a lack of proper guidance for the facilitator contributes to unsuccessful implementation of recommendations.

A variety of facilitators were suggested across different socioecological levels of the sport environment (Bronfenbrenner, 1994). More specifically, parents and coaches were identified as facilitators that are and closely and continually interacting with athletes in their immediate, interpersonal environment. Athletic directors and medical professionals (e.g., pediatricians, athletic trainers) are more removed from the athlete and might have less contact. Finally, there are entities at the community and society level that were identified, such as youth sport organizations and national governing bodies (NGBs).

Despite the lack of guidance for facilitators, the variety of potential to fill this role could inspire a top-down approach to implementation. The messaging that comes from highly visible sport organizations can flow down to athletes, parents, and coaches where it is internalized and contributes to the youth sport environment, whether positively or negatively. An example of this influence is the MLB acknowledging the potential for overuse throwing injuries by developing and promoting pitch count guidelines that can be instituted in the youth baseball environment. Similarly, Matzkin and Garvey (2019) highlighted that the IOC is urging "youth sport governing bodies to bring awareness, education, and implementation of the evidence-backed recommendations aimed at promoting the health and well-being of young athletes" (p. 101-102). Perhaps efforts need to focus on developing and testing intervention strategies that take advantage of these diverse facilitators.

There are several potential barriers to implementing recommendations, but the

Health Belief Model (HBM) may provide insight as to why the value placed on athletic excellence and early talent identification and development may be a primary barrier. Tenets of the HBM model state that an individual is more likely to take action that they believe will reduce their risks. However, individuals must also:

> Regard themselves as susceptible to a condition, believe that condition would have potentially serious consequences, believe that a course of action available to them would be beneficial in reducing either their susceptibility to or severity of the condition, and believe the anticipated benefits of taking action outweigh the barriers to (or costs of) action. (Champion & Skinner, 2008, p. 47)

The HMB was originally developed to understand why people often fail to participate in programs that are designed to prevent and detect disease, thus a *condition* related to a specific illness. In applying the HBM to early specialization, the condition is operationalized as adverse health outcomes that can results from intensive sport participation.

Often, individuals do not perceive themselves (or their children) to be susceptible to the adverse effects of ESS (the condition). LaPrade and colleagues (2016) noted the biggest roadblock to making a culture shift in youth sport rests on an acknowledgement from coaches and parents that children are participating too early in sports. However, there is a mentality that adverse effects of specialization ''doesn't apply to 'my' sport or 'my' child.'' (LaPrade et al., 2016, p. 5). Furthermore, individuals do not perceive the consequences of specializing to be severe. A study by Ahmad et al. (2012) developed a questionnaire to measure coach, parent, and athlete perception of Tommy John surgery.

Thirty-one percent of coaches, 28% of players, and 25% of parents did not believe that the number of pitches thrown to be a risk factor for injury. More surprising is that many players (28%) and coaches (20%) believed that the surgery would enhance performance beyond that of preinjury levels. These beliefs indicate that youth sport stakeholders likely underestimate the severity of adverse effects, and as such, do not believe that an alternate course of action (early diversification) is beneficial to them. Finally, individuals do not believe the benefits of changing their view of specialization will outweigh the cost of taking this action. In other words, even though = scholars and medical practitioners largely agree that diversifying later is often a protective factor against overuse injuries, burnout, and sport attrition, these benefits do not outweigh the risk of diversification which is, arguably, falling behind and not reaching elite status.

Since there is general alignment with the HBM tenets, the theoretical constructs of the model could be a framework for assessing stakeholder perspectives and developing educational objectives that would inform what information is disseminated.

<center>**Implications and Future Research**</center>

This scoping review identified numerous key characteristics that relate to how conducive the youth sport environment is for implementing recommendations related to sport specialization and diversification. From this information, several implications and suggestions for future research were developed for improving implementation efforts.

Messaging and Communication

Findings from the scoping review indicated that effective communication and messaging are integral to the implementation of recommendations. While there is still a

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need for more empirical studies across several areas of sport specialization, this study highlighted that the way information is communicated is just as important as the recommendation itself. The framing of messages, whether positive or negative, is known to affect individual judgements and decisions (Levin et al., 1998) and framing typologies have been established to understand decision-making tendencies. These typologies – one being risky choice framing wherein negative framing causes decision-makers to seek out risk – could be applied to early specialization and diversification information and tested to ascertain the most effective framing for message uptake.

Strategic narratives are another tool that could be helpful in determining the most effective communication mechanisms for sport specialization evidence to mitigate the research-practice gap, overcome biased assimilation, and encourage evidence-based practices. Literature about strategic narratives suggests that a compelling story will be more effective at persuading people than abstract statistics because humans experience the world through narratives and stories (Bushell et al., 2017; Hinyard et al., 2007). At present, a pervasive storyline in youth sport culture is that it is necessary to initiate sport early, narrow the focus to a single sport to accumulate hours of deliberate practice, and obtain scholarships or professional status by doing so. Recommendations that are presented to the contrary may be discarded due to the assumptions and expectations that youth sport stakeholders, specifically parents and athletes, have already developed about athletic development and prowess. Narrative communication is theoretically grounded in concepts from behavior change models such as social cognitive theory (Bandura, 1977) and theory of reasoned action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) which

could make it a promising avenue for influencing characteristic behaviors within the early sport specialization environment.

Facilitators and Stakeholder Perspectives

Facilitation is thought of as the active ingredient to successful implementation within the i-PARIHS framework. The facilitation construct is not well-developed in early specialization literature, but there were enough stakeholders identified as potential facilitators that research could be conducted with these different groups to gain an understanding of how practitioners and those directly involved with specialization might view the facilitator role, what it should involve, and who could most effectively fill the role. Since the sixth consultation step of scoping review protocols was not initiated for this study, this would be an area for possible expansion. Stakeholders that have been identified as either recipients or facilitators could be consulted, and there would be a clear purpose for integrating their perspectives into the study.

Since early specialization recommendations are being presented as evidence without undergoing the tinkering process, there is no adaptation of the evidence to a specific context or situation which may be negating attempts to translate research into practice. Research needs to be initiated that involves stakeholders' opinions which could shed light on how best to innovate these recommendations. Specifically, since Project Play reports suggest one of the major strategies for youth sports is to "ask kids what they want" (The Aspen Institute, 2019, p. 7), it is advised that athletes be a primary point for consultation.

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Systematic Mapping of Literature

The article selection process for this review also provided valuable insight regarding the general early sport specialization and diversification literature base. In order to effectively identify sources of evidence that contained recommendations, a broad set of inclusion and exclusion criteria for the title and abstract screening was necessary, which resulted in a substantial pool of full text articles to review. Accounting for articles that were removed because they were unrelated to specialization, there were still nearly 200 articles to screen. While this is not representative of the entire scope of early specialization literature, there is a rapidly growing number of articles produced from several fields, evidenced by eight fields of study being represented in this sample.

With the amount of research attention given to early specialization, the field would benefit from a synthesis with the intent of broadly mapping these areas. There have been several systematic reviews conducted on specialization research, but the nature of systematic reviews calls for a very narrowed topic and set of inclusion criteria. Even the scoping reviews that have been conducted, this one included, had a smaller number of articles that were ultimately extracted. Research activity that is designed to visualize and summarize the content, history, and connections within a heterogenous topic, such as systematic mapping or research weaving, would provide a comprehensive and broader synthesis of the volume and characteristics of the evidence base (Collins et al., 2020; Nakagawa et al., 2019). Such mapping studies are designed to handle large numbers of studies to fully grasp the extent of a knowledge base. As specialization research continues to experience an uptick in production, a broader systematic map would highlight higher-

level trends in the literature and analyze more overarching literature gaps related to the research focus.

Overall, this project was focused on developing a foundation for dissemination and implementation science efforts in the realm of early sport specialization research. The i-PARIHS framework guided the analysis of a scoping review on early sport specialization and diversification recommendations. Findings from the review identified critical actors and contexts necessary for successful implementation of innovations within the youth sport environment. As primary research continues to be rapidly produced, it will become more important to established how to innovate the literature and overcome barriers to implementation.

Limitations

In addition to limitations identified at the beginning of the study, some of the inclusion and exclusion criteria were developed based on subjectively determining how to effectively extract information that would be relevant to recommendations and their implementation. The decisions to extract articles with separate recommendations or practical recommendations helped to increase reproducibility if another research were to replicate the study, however, this criterion was still subjective. Articles might have included pertinent recommendations that could be coded but were not preceded by the language necessary to extract them (e.g., Beese et al., 2015). Therefore, some relevant content could have been excluded based on how the authors of those articles labeled their recommendations.

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Appendix A. Search Term Adjustments

	Search Terms[a]	Retained Terms	Adjusted Terms[b]	Removed Terms
Sport	Sport, training, practice, elite sport, competitive sport, competitive youth sport, competition, recreation, recreational, recreational sport, performance, skill, skills	elite sport; competitive sport; competitive youth sport; recreational sport	**sports**; **year-round** training; **high** performance **athlete/sportsman**	practice; competition; recreation; recreational; skill(s)
Youth	Youth, youth sport, development, developing, adolescent(s), kids, child, children, school, elementary school, middle school, high school, interscholastic, positive youth development	youth; youth sport; adolescent(s); kids; child/children; elementary school; middle school; high school; interscholastic	–	development; developing; school; positive youth development
Specialization	Specialization, specialize, specializers, specializing, samplers, sampling, multisport, expert, expertise, development, novice, diversification, diverse	specialization; multisport; diversification	specialize**d**; **sport** sampling	specializers; specializing; samplers; expert; expertise; development; novice; diverse

Note. [a]broad groups and search terms adapted from DiSanti and Erickson (2019) protocol; [b]text in bold are adjustments made to the original term (e.g., sport became sports)

Appendix B. Database Search Strategies

Databases	Search Strategy	Additional Restrictions
SPORTDiscus **PsycINFO** **SocINDEX**	(athletics OR sports OR sport OR "elite sport" OR "competitive sport" OR "competitive youth sport" OR "recreational sport" OR "youth sport" OR "youth sports") AND ("Athletes"[Mesh] OR "elite athletes" OR "professional athletes" OR adolescent[mesh] OR teens OR adolescent OR adolescents OR adolescence OR youth OR child[mesh] OR children OR kids OR "elementary school" OR "middle school" OR "high school" OR interscholastic) AND (specialization OR specialization[mesh] OR diversification OR "multiple sport" OR "multiple sports" OR "single sport" OR "year round training" OR specialized OR "sport sampling" OR multisport)	None
PubMed	(athletics[tw] OR sports[tw] OR sports[mesh] OR sport[tw] OR "elite sport"[tw] OR "competitive sport"[tw] OR "competitive youth sport"[tw] OR "recreational sport"[tw] OR "youth sport"[tw] OR "youth sports"[tw] OR youth sports[mesh]) AND ("Athletes"[Mesh] OR "elite athletes"[tw] OR "professional athletes"[tw] OR adolescent[mesh] OR teens[tw] OR adolescent[tw] OR adolescents[tw] OR adolescence[tw] OR youth[tw] OR child[mesh] OR children[tw] OR kids[tw] OR "elementary school"[tw] OR "middle school"[tw] OR "high school"[tw] OR interscholastic[tw]) AND (specialization[tw] OR specialization[mesh] OR diversification[tw] OR "multiple sport"[tw] OR "multiple sports"[tw] OR "single sport"[tw] OR "year round training"[tw] OR specialized[tw] OR "sport sampling"[tw] OR multisport[tw])	None

Continued

Embase	('athlete'/exp OR 'athlete' OR 'athletes' OR 'sportman' OR 'sportmen' OR 'sports player' OR 'sports players' OR 'sportsman' OR 'sportsmen' OR 'sportspeople' OR 'sportsperson' OR 'sportspersons' OR 'sportsplayers' OR 'sportswoman' OR 'sportswomen' OR 'sportwomen' OR 'adolescent'/exp OR 'adolescent' OR 'teenager' OR 'child'/exp OR 'child' OR 'children' OR 'school child'/exp OR 'child, school' OR 'school boy' OR 'school child' OR 'school children' OR 'school girl' OR 'school-going (boy)' OR 'school-going (boys)' OR 'school-going (child)' OR 'school-going (children)' OR 'school-going (girl)' OR 'school-going (girls)' OR 'schoolboy' OR 'schoolboys' OR 'schoolchild' OR 'schoolchildren' OR 'schoolgirl' OR 'schoolgirls' OR 'schoolgoing (child)' OR 'schoolgoing (children)' OR 'primary school'/exp OR 'elementary school' OR 'primary school' OR 'middle school'/exp OR 'middle school' OR 'high school'/exp OR 'high school' OR 'secondary school' OR interscholastic OR 'juvenile'/exp OR 'juvenile' OR 'youth' OR 'elite athlete'/exp OR 'elite athlete' OR 'elite athletes' OR 'elite sport players' OR 'elite sports players' OR 'elite sportsman' OR 'elite sportsmen' OR 'elite sportspeople' OR 'elite sportsperson' OR 'elite sportspersons' OR 'elite sportswoman' OR 'elite sportswomen' OR 'high-performance athlete' OR 'high-performance athletes' OR 'high-performance sportsman' OR 'high-performance sportsmen' OR 'professional athlete'/exp OR 'professional athlete' OR 'professional athletes' OR 'professional sport players' OR 'professional sports player' OR 'professional sports players' OR 'professional sportsman' OR 'professional sportsmen' OR 'professional sportsperson' OR 'professional sportspersons' OR 'professional sportsplayers' OR 'professional sportswoman' OR 'professional sportswomen') AND ('specialization'/exp OR 'specialism' OR 'specialization' OR 'diversification'/exp OR diversification OR specialized OR multisport OR 'single sport' OR 'sport sampling' OR 'multiple sports' OR 'year round training') AND ('youth sport'/exp OR 'adolescent sport' OR 'adolescents sports' OR 'children`s sport' OR 'juvenile sport' OR 'paediatric sport' OR 'pediatric sport' OR 'youth sport' OR 'youth sports' OR 'athletics'/exp OR 'athletics' OR 'sport'/exp OR 'competitive gymnastics' OR 'competitive sport' OR 'sport' OR 'sports') NOT 'conference abstract'/it	No conference abstracts

ProQuest Dissertations and Theses	(athletics OR sports OR sport OR "elite sport" OR "competitive sport" OR "competitive youth sport" OR "recreational sport" OR "youth sport" OR "youth sports") AND ("Athletes"[Mesh] OR "elite athletes" OR "professional athletes" OR adolescent[mesh] OR teens OR adolescent OR adolescents OR adolescence OR youth OR child[mesh] OR children OR kids OR "elementary school" OR "middle school" OR "high school" OR interscholastic) AND (specialization OR specialization[mesh] OR diversification OR "multiple sport" OR "multiple sports" OR "single sport" OR "year round training" OR specialized OR "sport sampling" OR multisport)	Search field restricted to "anywhere except full text"

Appendix C. Inclusion and Exclusion Criteria

Initial Draft (from research questions)	Inclusion	• Articles related to early sport specialization and/or diversification (athlete sport participation from the ages of 6-18), discussed from any stakeholder perspective
	Exclusion	• Articles that are not written in English • Conference abstracts • Opinion or commentary articles

Second Draft (from reviewing PubMed and SPORTDiscus)	Inclusion	• Articles related to early sport specialization and/or diversification (athlete sport participation from the ages of 6-18), discussed from any stakeholder perspective
		• Discusses outcomes and/or recommendations related to early sport specialization/diversification
		    o Prevention or treatment strategies related to youth sport training
		    o Guidelines or suggestions for parents, coaches, medical practitioners, etc. related to youth sport training
		    o Health promotion and behavioral change programming
		• Identifies a facilitator to provide education and/or increase awareness of information and recommendations regarding early sport specialization/diversification
		• Study design captures specialization level or participation activities from age 6-18 years

	Exclusion	• Articles that are not written in English • Conference abstracts
Third Draft (from piloting in Embase)	Inclusion	• Articles related to early sport specialization and/or diversification (athlete sport participation from the ages of 6-18), discussed from any stakeholder perspective • Articles identify outcomes, recommendations, and/or educational strategies related to early sport specialization and/or diversification
	Exclusion	• Articles that are not written in English • Conference abstracts

Appendix D. Charting Table of Extracted Variables and Analysis Approach

Content Extracted	Analysis Approach	Data Management Strategy
Author(s)	Content Analysis	Charted in Excel
Year of Publication	Content Analysis	Charted in Excel
Title	Content Analysis	Charted in Excel
Journal	Content Analysis	Charted in Excel
Volume (Issue) pp-pp	Content Analysis	Charted in Excel
Country of Origin	Content Analysis	Charted in Excel
Empirical Study (Y/N)	Content Analysis	Charted in Excel
Article Type	Content Analysis	Charted in Excel
Purpose	Content Analysis	Charted in Excel
Sports Included	Content Analysis	Charted in Excel
Specialization Definition	Content Analysis	Coded in Nvivo
Reasons for Specializing	Content Analysis	Coded in Nvivo
Innovation (e.g., recommendations and educational strategies)	Framework Analysis	Coded in Nvivo
Recipients (e.g., athletes, parents, coaches, medical professionals, athletic administrators)	Framework Analysis	Coded in Nvivo
Context (Type of context – local or external)	Framework Analysis	Coded in Nvivo
Facilitators (e.g., athletes, parents, coaches, medical professionals, athletic administrators)	Framework Analysis	Coded in Nvivo

Appendix E: Extracted Article Information

Article Identifier	Authors (Date)	Article Type	Sports Reviewed	Cited Position Statements	Recipient	Context	Facilitator	Barriers
A1	Anderson et al. (2000)	Position Statement	Unspecified	None	Yes	No	Yes	Yes
A2	Bell et al. (2019)	Narrative Review	Unspecified	AAP	Yes	Yes	Yes	Yes
A3	Bell et al. (2020)	Empirical Research	Soccer, volleyball, basketball	NATA	Yes	No	Yes	Yes
A4	Bergeson (2019)	Commentary/Opinion	Unspecified	None	Yes	Yes	Yes	No
A5	Berstein et al. (2020)	Narrative Review	Unspecified	AMSSM, AOSSM, IOC, NBA	Yes	No	No	No
A6	Blagrove et al. (2017)	Narrative Review	Female athletes	AAP, IOC, NCSA	Yes	No	Yes	No
A7	Bodey et al. (2013)	Narrative Review	Unspecified	None	Yes	No	Yes	No

Continued

Appendix E Continued

A8	Brenner (2016)	Clinical Report or Review	Unspecified	None	Yes	Yes	Yes	No
A9	Brenner et al. (2019)	Narrative Review	Unspecified	AAP, AMSSM	No	No	No	No
A10	Carson et al. (2010)	Commentary /Opinion	Unspecified	NASPE	Yes	Yes	No	No
A11	Chase & DiSanti (2017)	Narrative Review	Unspecified	None	Yes	Yes	Yes	No
A12	Coakley et al. (2010)	Position Statement	Unspecified	None	Yes	Yes	Yes	No
A13	Côté et al. (2009)	Narrative Review	Unspecified	None	Yes	Yes	Yes	No
A14	DiFiori et al. (2017)	Editorial	Basketball	None	Yes	No	Yes	No
A15	Ford & Williams (2017)	Book Chapter	Unspecified	None	Yes	No	Yes	No
A16	Goodway & Robinson (2015)	Narrative Review	Unspecified	None	No	Yes	No	No
A17	Gould (2010)	Narrative Review	Unspecified	ISSP	Yes	No	No	No
A18	Hill & Hansen (1988)	Narrative Review	Unspecified	None	Yes	No	Yes	No

A19	Hill (1990)	Commentary /Opinion	Unspecified	None	Yes	No	Yes	No
A20	Jayanthi & Dugas (2017)	Narrative Review	Female athletes	AMSSM, AAP, NATA	Yes	No	Yes	Yes
A21	Jayanthi et al. (2013)	Narrative Review	Unspecified	None	No	No	No	No
A22	Jayanthi et al. (2019)	Knowledge Synthesis	Unspecified	AAP, AMSSM, AOSSM, FIMS, IOC, NATA, NSCA	Yes	No	No	No
A23	Judge & Gilreath (2009)	Narrative Review	Unspecified	None	Yes	Yes	Yes	No
A24	Kliethermes et al. (2020)	Knowledge Synthesis	Unspecified	None	No	No	No	No
A25	LaPrade et al. (2016)	Position Statement	Unspecified	AMSSM, IOC	No	Yes	No	Yes
A26	Lord (2000)	Commentary /Opinion	Unspecified	AAP	Yes	No	No	No
A27	Matzkin & Garvey (2019)	Narrative Review	Unspecified	AAOS, IOC, AOSSM	Yes	Yes	Yes	No
A28	Myer et al. (2015)	Clinical Report or Review	Unspecified	None	Yes	No	No	No

A29	Myer et al. (2016)	Clinical Report or Review	Unspecified	None	Yes	No	No	No
A30	Post et al. (2020)	Empirical Research	Unspecified	NSCA, NATA, AAP, AOSSM	Yes	No	Yes	Yes
A31	Read et al. (2016)	Narrative Review	Soccer	AMSSM	Yes	No	No	No
A32	Santa (2010)	Commentary /Opinion	Unspecified	None	Yes	Yes	No	Yes
A33	Sleiman (2019)	Knowledge Synthesis	Unspecified	None	Yes	No	No	No
A34	Sluder et al. (2017)	Narrative Review	Unspecified	None	Yes	No	No	Yes
A35	Whitehead (1991)	Commentary /Opinion	Unspecified	None	Yes	Yes	Yes	No
A36	Wiersma (2000)	Narrative Review	Unspecified	None	Yes	No	No	No
A37	Zaremski et al. (2019)	Narrative Review	Throwing-dominated sports	AAP, MLB PitchSmart	Yes	No	Yes	Yes

Note. Abbreviations are as follows: AAP, American Academy of Pediatrics; AMSSM, American Medical Society for Sport Medicine; AOSSM, American Orthopaedic Society for Sport Medicine; FIMS, International Federation of Sport Medicine; IOC, International Olympics Committee; MLB, Major League Baseball NATA, National Athletic Trainers Association; NSCA, National Strength and Conditioning Association

Appendix F: Expanded Full Text Reasons for Exclusion

Reason	Description
Logistic Criteria	
Not in English	Article title and abstract were in English and passed onto the full text screening, but the article text is in another language
Conference Abstract	Abstract for an oral or poster presentation at any conference proceedings
Duplicate Article	Manually identified duplicate article that was not screened out by Covidence after originally importing the search results
Full Text Unavailable	Interlibrary loan requests for the material could not be fulfilled. (e.g., This book, volume, and/or issue is currently not available. We have exhausted all available lenders of this item.)
Content Criteria	
Irrelevant	Articles that are entirely outside the scope of early sport specialization. Examples are: • General muscular growth and development / pediatric injury classification and/or epidemiology • Broad sport issues • Athlete identity • Positive youth development experiences
Specialization not Primary Focus	Articles with topics that are similar to early sport specialization but had a general focus on sport development and participation. Examples are: • Talent development and identification • General sport participation biography

Appendix F Continued

Articles without Recommendations	
Review of Specialization	Articles that synthesize the results of individual quantitative studies with no reference to the statistical significance of the findings (Siddaway et al., 2019, p. 755). This category of articles reflect content, not a methodology. Therefore, it contains reviews that are methodologically rigorous, such as narrative reviews, as well as articles published in newspapers that were intentionally brief and focused on reaching a broader audience.
Antecedents of Specialization	Research that discusses factors that might predict whether an athlete chooses to specialize.
Prevalence	Research that discusses the occurrence of specialization generally or within a specific sport population.
Stakeholder Beliefs	Research that discusses any youth sport stakeholder (e.g., athlete, coach, athlete director) beliefs on early specialization. This can include primary studies investigating stakeholder perceptions or opinion pieces from a specific stakeholder.
Specialization Profiles	Research that discusses when athletes specialize, their sport participation profiles, and/or specialization patterns/characteristics
Measurement of Specialization	Research that discusses how specialization is currently measured. This can include proposing new measures for determining degrees of specialization
Outcomes of Specialization	Research that discusses outcomes related to early specialization and captured comparisons between degrees of specialization (e.g., Jayanthi and colleagues' (2015) sport specialization scale) or single versus multi-sport athletes.
Commentary on Other Articles	Articles that provide a brief commentary on other research articles or preface a journal issue

Appendix G. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: Extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	Title page
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Abstract included (p. ii-iii), but no structured summary
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Pgs. 14-17
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Pgs. 17-18
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	No registered review protocol
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Pgs. 84-87 Appendix C

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Pgs. 76-80; Pg. 84 (search initiation date)
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Pgs. 81-83 Appendix B
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Pgs. 83-84 Figure 2
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Pgs. 87-88 Appendix D
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	Appendix D
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Pgs. 87-88
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Pgs. 88-90
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Pgs. 92-96 Table 1 Figure 1
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Pgs. 98-104 Appendix E

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	Critical appraisal not conducted (see item 12)
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Appendix E
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Pgs. 104-123 Tables 4 and 5
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Pgs. 124-141
Limitations	20	Discuss the limitations of the scoping review process.	Pgs. 19; 145
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Pgs. 141-145
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	No funding was obtained to conduct this scoping review

Note. Adapted from Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., …Tuncalp, Ö. (2018). PRISMA extension for scoping reviews (PRISMAScR): Checklist and explanation. *Annals of Internal Medicine, 169*, 467–473. https://doi.org/10.7326/M18-0850