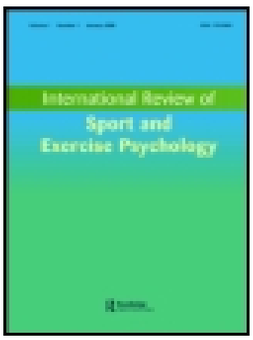

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The effect of sport-based interventions on positive youth development: a systematic review and meta-analysis

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ABSTRACT

Organized sport is a context in which to promote positive youth development (PYD). Interventions with a PYD lens are often implemented to promote a wide range of physical or psychosocial benefits through sport participation. To date, no meta-analytic review of the effect of these interventions has been conducted. This is important because such interventions are held in high regard when it comes to policy development. In the present study, we conducted seven meta-analyses to evaluate the overall effect of sport-based interventions on PYD outcomes. Aspects of the study design and sample also were tested as moderators. In total, 35 studies (from 29 published articles) reporting on 74 effect sizes highlighted small to medium effects of PYD interventions on competence, confidence, and life skills outcomes. No significant overall effects were found for outcomes related to character, connection, PYD climate, and health. Further, moderation analyses showed that: (a) character was moderated by study design, sport type, and study duration; (b) competence was moderated by design and participant sex; and, (c) life skills were moderated by design, sport type, duration, and participant age. Implications for theory and practice concerning the use of sport-based interventions to influence PYD are discussed.

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Organized sport; positive youth development; meta-analysis; review; youth sport interventions; life skills

Organized sport has been identified globally as a context with the capacity to promote positive youth development (PYD; Holt, 2016). Although PYD has been conceptualized and operationalized in a number of different ways (e.g. King et al., 2005), there is consensus within the youth sport literature that PYD can be defined as a strength-based conception of development in which children and adolescents are viewed as having 'resources to be developed' rather than 'problems to be solved' (Lerner et al., 2005). The past 15 years has seen a considerable body of empirical evidence emerge which describes the relations between sport participation and a number of positive, developmental outcomes in youth including psychosocial and mental health benefits (Eime et al., 2013; Holt et al., 2017; Whitley et al., 2019). Given the potential for sport to influence individual growth across physical, cognitive, and social domains and the high sport participation rates

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among youth, government bodies and researchers have invested substantial time and resources into developing PYD-related interventions in order to promote youth development. In spite of this trend, there has been no meta-analytic review of these studies to date that documents the degree to which these programs are effective. The present review provides a systematic and meta-analytic account of the quantitative literature regarding the effects of sport-based interventions on PYD outcomes.

Previous reviews and gaps in the literature

Several systematic reviews have evaluated the relationship between sport participation and outcomes associated with PYD (Eime et al., 2013; Holt et al., 2017; Whitley et al., 2019). Eime et al. (2013) conducted a systematic review of the literature examining psychological and social health benefits of participation in sport by children and adolescents (30 published articles). The majority of identified studies at the time were quantitative and cross-sectional with most studies showing that positive psychosocial outcomes were associated with sport participation. As an outcome of their review, the authors put forward the Health through Sport Conceptual Model. The model depicts the relationship between physical, psychological, and social domains and their positive associations with sport participation. An important acknowledgement of the review was the predominance of observational research. More specifically, all 30 studies included in the review were observational (i.e. 21 cross-sectional and nine longitudinal designs) with no intervention studies. Two key recommendations put forth were the need to examine the causal link between participation in sport and psychosocial health and utilize established protocols (e.g. CONSORT) to assess the methodological rigor of studies (Eime et al., 2013). At the current time (May, 2020), this systematic review has played a primary role in shaping sport-based PYD research (approximately 1,000 citations as per Google Scholar metrics).

Holt et al. (2017) took an alternative approach with examining the PYD literature by conducting a qualitative meta-synthesis to review, evaluate, and summarize the qualitative studies of PYD in sport. The search returned 63 articles as of October 2015. Similar to Eime et al. (2013), an overall purpose and outcome of the review was the creation of a model of PYD through sport – this time grounded exclusively in the extant qualitative literature. Drawing from the inductive meta-data analysis, three categories were identified in the model: (1) PYD climate – focusing on positive and supportive adult (leaders/coaches) relationships, peer relationships, and parental involvement; (2) life skills program – focus on life skill building activities and transfer activities; and (3) PYD outcomes – in personal, social, and physical domains. Based on the results and the model, a distinction is made between implicit and explicit learning as pathways to facilitate positive developmental outcomes in sport (Holt et al., 2017). An implicit approach focuses on fostering sport-specific PYD outcomes but does not deliberately identify and teach these PYD outcomes as transferable life skills (Turnnidge et al., 2014). In comparison, an explicit approach focuses on developing a sport environment in which the transferability of life skills to non-sport settings is deliberately taught by the program leaders (Turnnidge et al., 2014). Despite the valuable contribution of the integrated PYD model to the sport psychology literature, it is important to acknowledge the lone source of qualitative data for the metasynthesis review.

Citing the growing number of sport-based youth development interventions, Whitley et al. (2019) recently conducted a systematic review evaluating the efficacy and quality of

sport-based youth development interventions in the United States. The authors organized the identified sport-based PYD interventions into ten different category types (e.g. Summer Sports and Life Skills Camps, Coach Across America, Girls on the Run). Results showed limited efficacy data, classifying the quality of the methods and evidence of the studies as largely weak and incoherent (Whitley et al., 2019). This included concerns over the transparency of researchers with respect to the intervention protocol, absence of control conditions necessary to make causal claims, and a lack of null/non-significant findings indicative of publication bias. Conclusions mirrored the earlier reviews calling for more rigorous research, and the greater inclusion and evaluation of physical health outcomes; however, the scope of the systematic review was limited to the United States and there was no meta-analytic review of the intervention effects.

Taken together, the conclusions offered by these systematic reviews are consistent with the notion that participation in youth sport is associated with positive developmental outcomes. However, as brought to light by Whitley et al. (2019), we know little about the overall impact of sport-based interventions on important PYD-related outcomes. In fact, it was suggested that policy-makers defer wide-spread implementation of sport interventions to positively influence PYD as the evidence is inconclusive and lacks rigor.

To date, no systematic review of the effect of sport-based programs on PYD has been conducted. This is surprising, given that governments and institutions world-wide have implemented sports programs to promote youth development (e.g. United Nations General Assembly, 2018; see also Beutler, 2008). Collectively, these three reviews offer some limited support for the possible effect of sport-based PYD programs on developmental outcomes. However, it is imperative from a scientific perspective to gain greater understanding of the effect of sport-based interventions on youth development to provide evidence on which to base decisions regarding the widespread use of sport-based interventions to enhance PYD. In the current study, we aimed to fill the gaps in the existing literature by conducting a systematic review and meta-analysis of the effects of organized sport-based PYD programming on a wide range of positive developmental outcomes. Specifically, we examined the effectiveness of sport-based PYD programs on positive developmental outcomes. Second, we undertook a quality assessment of the included articles to assess the quality of research in the field. Third, we examined possible moderators of intervention effects related to the study design, sample, and intervention characteristics to better understand the factors that might influence the strength of the effects of youth sport interventions on PYD, and for whom the interventions may be particularly beneficial. These moderators were exploratory in nature given an absence of literature outlining specific factors that would qualify sport-based PYD interventions. Instead, we used a similar approach of including categorical moderators that focused on aspects of the study design and characteristics of the intervention itself, similar to recent meta-analyses in the field of sport and exercise psychology (e.g. Bailey et al., 2018; Marker et al., 2018; Spruit et al., 2016).

Methods

Procedure

In this meta-analysis we appraised original peer-reviewed journal articles with the objective of synthesizing previously published PYD through organized youth sport

interventions. The search process aligned with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines (PRISMA; Moher et al., 2009). An overview of the process can be found in Figure 1. Details of the protocol for this systematic review were registered on PROSPERO and can be accessed at www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42018085586.

Search process

The primary searches were conducted by three of the authors following the search strategy used in a recent qualitative meta-synthesis on PYD (Holt et al., 2017). A unique search strategy was conducted over eleven academic databases, including: SPORTDiscus, Child Development & Adolescent Studies, CINAHL, Physical Education Index, Australian Education Index, Sociological Abstracts, Scopus, PsycINFO, MEDLINE, Web of Science, and ERIC. Databases were first searched in the first week of February of 2017, which were then repeated in the first week of June 2018 and again in the third week of December 2019 to assure no relevant articles were omitted. The results of each search were saved and were entered into an Endnote X8 database (Thompson Reuters, California).

Gray literature search and expert review

First, additional articles known to the authors were assessed for possible inclusion. Second, similar search terms used in the original database search were applied to the google scholar database in an effort to identify any studies that may have been missed

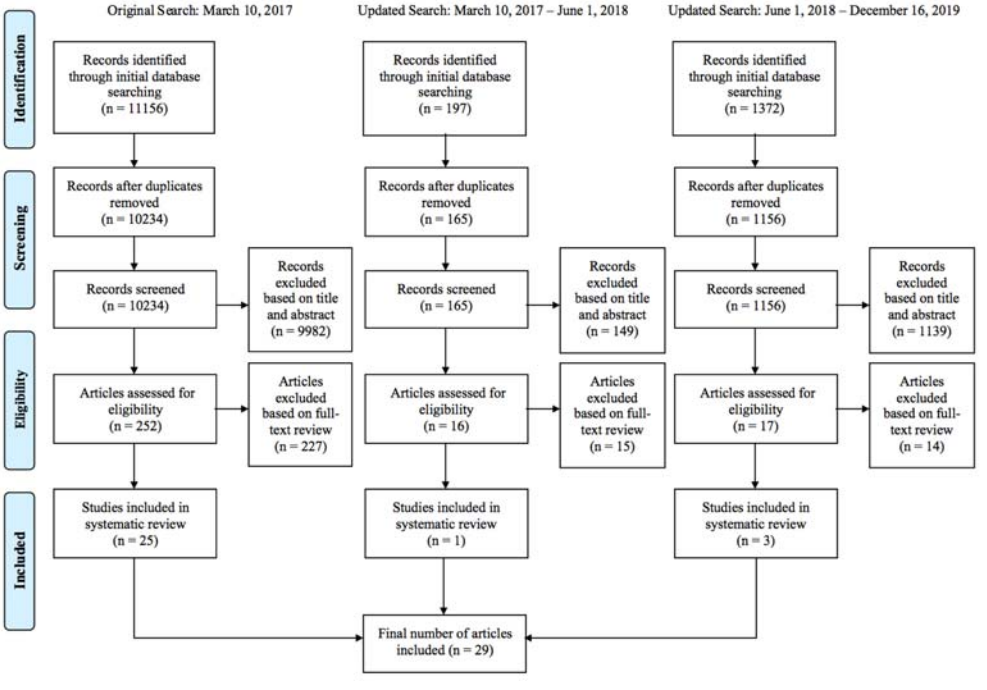

Figure 1. PRISMA flow diagram for article screening.

via database searches. Finally, two experts in the field of sport-based PYD were identified and sent the final list of included articles via email. Both experts found the list to be comprehensive, and an accurate representation of currently available PYD interventions.

Inclusion and exclusion criteria

First, studies were included if they reported data obtained using at least one quantitative outcome measure within a PYD through sport experimental intervention. To test the efficacy of the PYD interventions, outcome(s) had to be measured (at minimum) pre – and post-intervention. Mixed methods studies were included if quantitative data could be separated and examined independently from qualitative data. Second, the research must have been conducted with participants in organized and adult-supervised competitive sport, recreational sport, or other settings that included sport activities (e.g. summer camps, school/after-school programs). Third, articles must have (i) made a direct reference to PYD in the title or abstract; or (ii), used PYD research in the literature review, in establishing the conceptual context for the study, in the analysis, in the study results, or in the discussion. Studies of life skills were included, as this research fits the overall umbrella of PYD (Lerner, 2004). Literature reviews, methodological papers, conceptual/theoretical papers, conference abstracts, theses/dissertations, government/nongovernmental organization, and non-profit organization reports were excluded from the analysis, because they either did not contain original data or had not been subjected to robust peer review. Articles that examined health or positive outcomes in the absence of a PYD perspective were also excluded.

For the purpose of article selection, we operationalized sport as activities that include: physical exertion and/or a physical skill; a structured or organized setting for training and/or competition; and, competition against others. This definition was taken from previous research and nationally sanctioned organizations (Australian Bureau of Statistics, 2008; Khan et al., 2012). With regard to our targeted demographic, we used the same criteria as outlined by Evans et al. (2017) whereby studies were included if the sample was primarily between 7 and 17 years of age (i.e. at least 90% of the sample was within this range) and there were no participants older than 20 years of age. In this review, all participants within the included studies were between the ages of 7 and 18 years.

Article screening and data extraction

The original search returned 10,234 articles following the removal of duplicates. Screening was conducted by the same authors whom conducted the search (i.e. CM, LG, & JS). As a first step, all articles were screened at the title and abstract level, which resulted in the retention of 252 articles for full-text review. Each of the 252 articles were reviewed independently and disagreements were discussed among the entire research team. This stage yielded a total of 99 relevant, quantitative articles that measured PYD outcomes in sport participants. However, provided that the purpose of the current study was to meta-analyse articles that leveraged a sport intervention on PYD outcomes, an additional 74 articles were removed, leaving 25 articles for analysis. This process was mirrored in June 2018 and December 2019, resulting in an additional four articles for inclusion in the review. A total sample of 29 articles was subjected to meta-analyses (see Figure 1).

A coding spreadsheet guided data extraction for each study. The spreadsheet included: citation information, country and language, details of the study sample, contextual elements of youth sport (e.g. sport type, duration of intervention), PYD outcomes measured, the effect of intervention on participants, and study quality. CM and JS were responsible for coding each article. At the onset of coding, approximately 10% of articles (i.e. 3) were double – coded and any inconsistencies were discussed alongside the first and seventh authors. Upon consensus between all authors, the remaining articles were single-coded by the third author and the second author double-checked an additional seven articles at random for accuracy (i.e. approximately 25%). Throughout the process, MB and SV were consulted for any minor coding issues or ambiguities that could not be immediately resolved by the primary coders.

Outcomes from the included studies were categorized into seven broad PYD domains: (i) character, (ii) competence, (iii) confidence, (iv) connection, (v) health, (vi) life skills, (vii) PYD climate. The outcome categories of character, competence, confidence, and connection followed the definitions outlined in the 4 C's framework of Côté et al. (2010), and the life skills category aligned with the definition of Danish et al. (2004) (see Table 1). The remaining outcomes were divided into two general categories: health and PYD climate. Health was inclusive of both physical and mental health (e.g. physical health, mental well-being, resilience, hope, psychological difficulties), and PYD climate captured perceptions of the motivational climate (task and ego), and leader behaviors such as autonomy and emotional support. PYD climate also aligned with the qualitative meta-synthesis of Holt et al. (2017) (see Table 1). The categorization of these outcomes into different categories followed a similar process to the primary extraction. Specifically, CM and JS performed the preliminary categorization of all outcomes guided by the category definitions, operational definitions from the original study, and conceptual considerations based on existing literature (e.g. current paradigms in sport psychological research). Following this process,

Table 1. Category definitions for the placement of study constructs.

Category	Definition	Source
Competence	A positive view of one's actions in domain-specific areas including social, cognitive, academic and vocational. Social competence pertains to interpersonal skills (e.g. conflict resolution). Cognitive competence pertains to cognitive abilities (e.g. decision making). Academic competence includes school grades, attendance, and test scores. Vocational competence involves work habits and career choice explorations	Côté et al. (2010)
Confidence	An internal sense of overall positive self-worth and self-efficacy; one's global self-regard, as opposed to domain-specific beliefs	Côté et al. (2010)
Character	Respect for societal and cultural rules, possession of standards for correct behaviors, a sense of right and wrong (morality), and integrity	Côté et al. (2010)
Connection	Positive bonds with people and institutions that are reflected in bidirectional exchanges between the individual and peers, family, school, and community, in which both parties contribute to the relationship	Côté et al. (2010)
Life Skills	This theme included many and varied outcomes that were seen by sport coaches to be useful tools that can be applied to benefit sports performance in addition to contributing to positive human functioning	Vella et al. (2011)
PYD Climate	Climate is defined here as the accumulated atmosphere that results from interpersonal interactions and relationships between team members. As opposed to the connection theme that conceptualizes positive individual outcomes, the theme of climate refers specifically to outcomes at a group level	Vella et al. (2011)
Health	A state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.	WHO (1946)

placing the study outcomes into categories was finalized after a thorough review and discussion with MB and SV until a consensus was reached.

Assigning study quality

Study quality was assessed based on the guidelines and checklist provided by Downs and Black (1998), and recent adaptations for youth development research (e.g. Eime et al., 2013; Evans et al., 2017). The original checklist is comprised of 27 items, which are divided into: reporting (10 items), external validity (3 items), internal validity-bias (7 items), internal validity-confounding (6 items), and study power (1 item). However, certain items within the checklist were deemed irrelevant due to the experimental nature of the current study and thus subsequently removed. The resulting checklist included 12 items (Downs & Black, 1998; items 1, 2, 3, 6, 7, 10, 16, 18, 20, 21, 25, 27). For instance, a reporting item asked 'did the study provide estimates of random variability within psychosocial constructs?' and an internal validity-bias item asked 'was the main psychosocial construct (i) reliable and/or (ii) valid?' One additional item assessed whether authors conceptualized PYD in their respective articles given the noted variability in the literature of PYD conceptualizations and definitions (King et al., 2005). Items were coded dichotomously (i.e. 1/0) to calculate a summary score for each study, which was then categorized based on high (11-13), moderate (6-10), or low (1-5) for ease of interpretation (see Turnidge & Côté, 2018 for an example of this categorization approach). A summary of each study included in the review can be found in Table 2.

Strategy for data synthesis

To assess the effect of sport-based PYD programming on different PYD outcomes, seven separate meta-analyses were conducted. Meta-analyses were conducted to determine the effect of sport programs on positive youth development (PYD) using Comprehensive Meta-Analysis CMA software (Version 3 for Windows, Biostat company, Englewood NJ, USA). CMA enables the harmonization of data presented in different formats (i.e. standardized mean differences, change scores and standard deviations, posttest means and standard deviations) and from different study designs [i.e. single group pretest-posttest, quasi experimental, randomized controlled trial (RCT)]. In cases where studies reported multiple outcomes corresponding to a single domain, data were converted to standardized mean differences (SMD) and the average of values for each domain was calculated and used in the meta-analyses. This approach accounts for the non-independence of outcomes from single studies, which might otherwise result in inflated effect size estimates.

Random effects meta-analyses were conducted and pooled SMD (Cohen's *d*) were calculated for each PYD domain. The magnitude of effect sizes was interpreted as small (SMD = .2), medium (SMD = .4) and large (SMD = .6) (Hattie, 2009). Heterogeneity was determined by Cochrane's Q statistic and I^2 values, whereby values of less than 25, 50, and 75 are considered to indicate low, moderate and high levels of heterogeneity, respectively (Higgins et al., 2003). Publication bias was assessed using Rosenthal's classic fail-safe N, which provides an indication of the number of studies needed with a mean effect of zero before the overall effect would no longer be statistically significant (Rosenthal, 1979). Publication bias was also assessed using the trim-and-fill method to adjust the pooled effect (Duval & Tweedie, 2000).

Table 2. Study summary and quality assessment.

Author(s) & year	PYD intervention	Participants	Study characteristics	Outcomes assessed	Outcome category	Effect of intervention	Quality index
Anderson-Butcher et al. (2013)	National Youth Sport Program (NYSP). Sport instruction (2 sports/day for 2 h) and enrichment activities (e.g. social competence training) for 1 h per day.	$N_{INT} = 193$ $N_{CTL} = 0$ $M_{age} = 11.93$ (range 9 – 16) 43.5% female	Design: Pre/Post Dose: 5 hr/day, 5days/wk, 4 weeks Sport type(s): Team & Individual	Social competence Athletic competence Belongingness	Competence Competence Connection	NYSP participants reported no difference in social competence or belonging; pre-post improvements were reported in athletic competence ($p < .01$)	Moderate 6/13
Anderson-Butcher et al. (2014)	LiFE Sports Camp. 1 h of play-based social skills instruction and 3 one-hour sessions of sport-related instruction that incorporates social skill practice each day.	$N_{INT} = 287$ $N_{CTL} = 0$ $M_{age} = 11.85$ (range 9 – 16) 65.2% female	Design: Pre/Post Dose: 4hr/day, 19 total days, 4 weeks Sport type(s): Team & Individual	Social competence Sport competence Self-control Effort Teamwork Social responsibility	Competence Competence Life skill Life skill Connection Character	LiFE Sports camp participants reported an increase in social responsibility from pre-to posttest ($p < .05$). No other outcomes significantly improved, and values returned to baseline between camps. Moderator analysis showed that those with lowest pre-test scores benefitted most from the program.	Moderate 7/13
Anderson-Butcher et al. (2018)	LiFE Sports Camp. See Anderson-Butcher et al. (2014)	$N_{INT} = 231$ $N_{CTL} = 0$ $M_{age} = 10.71$ (range 9 – 14) 38.1% female	Design: Pre/Post Dose and Sport type (s): See Anderson-Butcher et al. (2014)	Self-control Effort Transfer Teamwork	Life skill Life skill Life skill Connection	Following a cluster analysis, LiFE Sports camp participants labeled at-risk (lowest pre-test scores) reported significant growth for self-control, effort, and teamwork across time. Maintenance or decreases for those with higher pre-test scores (i.e. high achievers). No change in transfer.	Moderate 7/13
Bean and Forneris (2015)	Girls Just Wanna Have Fun. A youth-driven physical activity-based life skills program for at-risk female youth (Teaching Personal and Social Responsibility focus). One life skills activity and some form of sport or physical activity to reinforce the life skill per weekly session.	$N_{INT} = 12$ $N_{CTL} = 0$ $M_{age} = 11.75$ (range 11–14) 100% female	Design: Pre/Post Dose: 1 d/wk, 30 weeks Sport type(s): Team & Individual	Social responsibility Personal responsibility	Character Character	Participants reported no significant increases in personal or social responsibility over the course of the Girls Just Wanna Have Fun intervention.	Moderate 9/13
Bohnert and Ward (2013)	Girls in the Game. Includes 10 three-week modules that cover a different sport, health, and leadership topic. Each 90-minute session has 50% sport, 50% education on health, nutrition, leadership, and life skills topics. Control group received no exposure.	$N_{INT} = 52$ $N_{CTL} = 24$ $M_{age} = 9.13$ (range 8 – 12) 100% female	Design: RCT Dose: 1.5hr/wk, 30 weeks Sport type(s): Team & Individual	Social-emotional development Self-esteem	Life skill Confidence	Compared with the control group, There were no significant effects for girls' social-emotional development or self-esteem as a result of participating in the Girls in the Game intervention.	High 10/13
Brunelle et al. (2007)	Sports United to Promote Education and Recreation (SUPER). As part of the first tee golf academy, five 45-minute life skills (SUPER) sessions were taught by Life Skills Center Staff working at the academy. Objective to transfer skills outside of golf	$N_{INT} = 100$ $N_{CTL} = 0$ $M_{age} = 14.92$ (range 13 – 17) 23% female	Design: Pre-Post Dose: 45min/day for 5 days Sport type(s): Individual	Social responsibility Empathetic concern Social interest Perspective taking Goal knowledge Goal self-efficacy	Character Character Character Life skill Competence Confidence	Participants who completed the SUPER protocol reported a significant increase in social responsibility, social interest, and goal knowledge. No differences were found for empathetic concern, perspective taking, or goal self-efficacy. Of those who participated in the follow-up volunteering ($n = 42$),	Moderate 9/13

						significantly higher social responsibility and empathetic concern were observed compared to a subgroup of participants that did not volunteer ($n = 23$).	
Coatsworth and Conroy (2006)	Coach Effectiveness Training (CET). Two-hour cognitive-behavioural training program with an educational, role-playing, and self-monitoring component. Control coaches received a two-hour session on injury prevention and emergency first aid.	$N_{INT} = 66$ $N_{CTL} = 69$ $M_{age} = 11.4$ (range 7 – 18) 61.5% female	Design: Quasi-Experimental Dose: 2hr Sport type(s): Team	Self-efficacy	Confidence	There was no significant difference in self-esteem across time for athletes swimming for a CET versus a control coach. Moderation analyses revealed the CET was most effective for younger participants, and girls with lower baseline self-esteem.	Moderate 9/13
Cryan and Martinek (2017)	Soccer Coaching Club. 6-week after-school program that used TPSR to teach concepts through soccer participation.	$N_{INT} = 14$ $N_{CTL} = 0$ $M_{age} = N/A$ (range 11 – 12) 0% female	Design: Pre-Post Dose: 2 hr/day, 2 days/week, 6 weeks Sport type(s): Team	Personal responsibility Social responsibility	Character Character	Program participants reported a significant increase in social responsibility ($p < .05$), but no differences in personal responsibility.	Moderate 7/13
DeBate and Bleck (2016)	Girls on the Run (GOTR). Structured 12-week, 24-lesson curriculum (90 min each) addressing developmental assets (5C's). Builds towards a 5K run and celebration.	$N_{INT} = 384$ $N_{CTL} = 0$ $M_{age} = N/A$ (range 3rd to 5th grade students-USA) 100% female	Design: Pre/Post Dose: 1.5hr/day, 2 days/week, 12 weeks Sport type(s): Individual	Prosocial behavior Bullying behavior Social competence Cognitive competence Physical activity competence Physical activity self-efficacy General self-regard Perceived physical appearance Connectedness Sympathy	Character Character Competence Competence Competence Confidence Confidence Confidence Connection Life skill	GOTR participants reported significant increases from baseline to post-intervention for social, cognitive, and physical activity competence, general self-regard, perceived physical appearance, and connectedness ($p < .05$). No mean score changes were observed for prosocial and bullying behavior, physical activity self-efficacy, or sympathy.	Moderate 8/13
DeBate et al. (2009)	GOTR and Girls on the Track. (GOTT) GOTR is described in DeBate and Bleck (2016). GOTT uses the same curriculum structure, but adapts activities and lessons to be age-appropriate (6th to 8th Grade).	$N_{INT} = 1034$ $N_{CTL} = 0$ $M_{age} = N/A$ (range 8 – 15) 100% female	Design: Pre/Post Dose & Sport type(s): see DeBate and Bleck (2016)	Self-esteem	Confidence	Participants from GOTR and GOTT reported significant increases in self-esteem from baseline to post-intervention measures. Exploratory analyses suggested the effect was significant for girls entering the program for the first or second time (not third or more). Age did not impact the changes.	Moderate 10/13
Gabriel et al. (2011)	GOTR. See DeBate and Bleck (2016)	$N_{INT} = 877$ $N_{CTL} = 0$ $M_{age} = N/A$ (range 3rd to 5th grade students-USA) 100% female	Design: Pre/Post Dose & Sport type(s): see DeBate and Bleck (2016)	Self-esteem	Confidence	GOTR participants reported no significant change in self-esteem from baseline to post-intervention, regardless of analysis group (never exposed, newly exposed, or previously exposed)	High 12/13
Harwood et al. (2015)	5C's Coach Education Program. Coach introduced to each 'C' in separate 90-min workshop, spaced three weeks apart. Practiced lessons with soccer team between workshop sessions	$N_{INT} = 5$ $N_{CTL} = 0$ $M_{age} = 12.58$ (range N/A) 0% female	Design: Pre/Post Single Case Dose: 50–75min/session, every 3 weeks for 15 weeks Sport type(s): Team	Commitment Communication Concentration Control Confidence	Life skill Life skill Life skill Confidence Confidence	Visual comparison of the mean levels from baseline to post-intervention for the dependent variables indicated players' perceptions of their 5C psychosocial responses and behaviors increased following the 5C intervention	Moderate 6/13

(*Continued*)

Table 2. Continued.

Author(s) & year	PYD intervention	Participants	Study characteristics	Outcomes assessed	Outcome category	Effect of intervention	Quality index
Ho et al. (2017)	PYD Sport Mentorship Program. Semi-structured curriculum where participants were guided through deliberate sport and PA instruction (basketball, volleyball, or kickboxing) and formal discussions with the instructor (e.g. goal setting). The control condition received access to a web-based health education program only.	$N_{INT} = 333$ $N_{CTL} = 331$ $M_{age} = 12.30$ (range N/A) 55.8% female	Design: RCT Dose: 90min/day, 1 d/ week, 18 weeks Sport type(s): Individual and Team	Mental well-being Physical well-being Resilience Self-efficacy Family connectedness School connectedness	Health Health Health Confidence Connection Connection	Participants who completed the PYD intervention reported significant improvements in mental well-being, self-efficacy, and resilience compared with the control condition. There were no differences in physical well-being, family connectedness, and school connectedness.	High 13/13
Iachini et al. (2017)	GOTR. See DeBate and Bleck (2016)	$N_{INT} = 247$ $N_{CTL} = 0$ $M_{age} = 9.21$ (range 8 – 11) 100% female	Design: Pre/Post Dose & Sport type(s): See DeBate and Bleck (2016)	Self-esteem	Confidence	Participants who completed GOTR in this sample reported significant increases in self-esteem from baseline to post-intervention ($p < .001$)	High 11/13
McDavid et al. (2017)	Physical activity-based PYD program. Staff attended three 90 min training sessions to understand staff-youth relationships and the character building curriculum. Control staff received standard care (i.e. a handbook). Participants completed six 40-minute sport stations per day	$N_{INT} = 171$ $N_{CTL} = 208$ $M_{age} = 10.0$ (range 7–15) 49% female	Design: Quasi Experimental Dose: 7hr/day, 5 d/ week, 4 weeks Sport type(s): Individual and Team	Autonomy Competence Relatedness Hope Self-worth	Motivation Competence Connection Health Confidence	Changes in psychological need satisfaction predicted changes in hope and self worth. Intervention did not affect leader behavior as intended, and there were no significant improvements as a result of the SDT-based staff training.	Moderate 10/13
McDavid et al. (2019)	Physical activity-based PYD program. See McDavid et al. (2017)	$N_{INT} = 149$ $N_{CTL} = 149$ $M_{age} = N/A$ (range 7–12) 53.7% female	Design: Quasi Experimental Dose & Sport type(s): see McDavid et al. (2017)	Academic performance School attendance Behavioural issues	Competence Life skill Character	Participants in the PYD intervention had a 55% greater chance of being in the top 25% of math scores ($p = .04$), but not language scores. There were no differences for remaining outcome variables between PYD participants and matched controls.	Moderate 8/13
McDonough et al. (2013)	PYD Summer Camp (NYSP) See Anderson-Butcher et al. (2013)	Sample A $N_{INT} = 198$ $N_{CTL} = 0$ $M_{age} = 11.58$ (range 9–16) Sex N/A Sample B $N_{INT} = 287$ $N_{CTL} = 0$ $M_{age} = 12.33$ (range 9–16) Sex N/A	Design: Pre/Post Dose: 5 hr/day, 5days/ wk, 4 weeks Sport type(s): Team & Individual	Sample A Belonging Leader emotional support Autonomy support Social responsibility Sample B Belonging Leader emotional support Autonomy support Social responsibility	 Connection PYD climate PYD climate Character Connection PYD climate PYD climate Character	In both samples, PYD Summer Camp participants reported no significant positive changes in belonging, leader emotional support, autonomy support, or social responsibility.	Moderate 10/13

Papacharisis et al. (2005)	Abbreviated SUPER. See Brunelle et al. (2007). Shorter sessions (15min) during practice time, program beginning with a sport skill test.	Sample A N_{INT} = 19 N_{CTL} = 21 M_{age} = 11.47 (range 10–12) 100% female Sample B N_{INT} = 15 N_{CTL} = 17 M_{age} = 11.7 (range 10–12) 0% female	Design: Quasi Experimental Dose: 15min/day, 1 d/wk, 8 weeks Sport type(s): Team	Sample A and B: Knowledge test Goal setting ability Problem solving Positive thinking	Competence Life skill Life skill Life skill	In both samples, participants in the experimental condition differed significantly from those in the control condition for knowledge test scores, and self-beliefs for goal setting ability, problem solving, and positive thinking.	High 11/13
Parise et al. (2015)	Rugby Project for School. Three month introductory rugby training course, with one weekly lesson taken outside school hours	N_{INT} = 63 N_{CTL} = 40 M_{age} = 13.50 (range 11–15) 27.2% female	Design: Quasi Experimental Dose: 1 d/wk, 3 months Sport type(s): Team	Global self-esteem Self-efficacy – expressing positive emotions Self-efficacy – managing negative emotion Social self-efficacy Empathic self-efficacy Prosocial behavior	Confidence Confidence Confidence Confidence Confidence Character	Controlling for baseline scores, rugby group participants reported significantly higher scores for all variables with the exception of global self-esteem	Moderate 10/13
Peralta et al. (2014)	Indigenous School Community Program (SCP). A 10-week program that met once per week for 2 h. Lessons were practical (e.g. skill development) or theoretical (e.g. culture) in nature, and were taught by an Indigenous teacher and subject-matter expert.	N_{INT} = 34 N_{CTL} = 0 M_{age} = 13.70 (range 7th to 10th grade-Australia) 58% female	Design: Pre/Post Dose: 2 hr/day, 1 d/wk, 10 weeks Sport type(s): Team	Life skill development	Life skill	There were no significant improvements in life skill development as a result of the SCP	High 11/13
Riley et al. (2017)	LiFE Sports Camp. See Anderson-Butcher et al. (2014).	N_{INT} = 329 N_{CTL} = 0 M_{age} = 11.52 (range 9-15) 36.5% female	Design: Pre/Post Dose & Sport type(s): see Anderson-Butcher et al. (2014)	Self-control Externalizing behaviors	Life skill Character	LiFE Sport camp participants reported a significant increase in self-control ($p < .01$), but no change in externalizing behaviors.	High 11/13
Terry et al. (2014)	Box Tag. Exercises and activities designed to prepare participants for subsequent competition. Emphasis on building fitness, technical skills, and positive social attitudes with end goal of competition in mind. Two to three sessions per week with 35 min of instruction.	N_{INT} = 26 N_{CTL} = 25 M_{age} = N/A (range 11–12) 45.1% female	Design: RCT Dose: 2–3 days/week, 50 min/day, 8 weeks Sport type(s): Individual	Total mood disturbance Total difficulties score	Health Health	There were no significant effects of the Box Tag intervention on mood disturbance or total difficulties when compared with the control condition	High 11/13
Ullrich-French and Cole (2018)	GOTR. See DeBate and Bleck (2016)	Study 1: N_{INT} = 140 N_{CTL} = 0	Design: Pre/Post Dose & Sport type(s):	Study 1 and 2: Emotional self-efficacy Physical self-worth	Confidence Confidence	GOTR participants reported a significant increase in physical competence and physical self-worth in Study 1, with no differences for emotional	High 10/13

(*Continued*)

Table 2. Continued.

Author(s) & year	PYD intervention	Participants	Study characteristics	Outcomes assessed	Outcome category	Effect of intervention	Quality index
		M_{age} = 8.76 (range 7–11) 100% female Study 2: N_{INT} = 249 N_{CTL} = 0 M_{age} = 9.07 (range 7–11) 100% female	see DeBate and Bleck (2016)	Physical competence Autonomy support	Competence PYD climate	self-efficacy or autonomy support. In Study 2, the only significant increase was for physical competence.	
Ullrich-French and McDonough (2013)	Purdue Athletes Life Success (PALS) program. Addresses environmental barriers to healthy living and builds personal and social assets. In age-specific teams, participants rotate through four sport/physical activity stations and classroom-type instruction. Emphasis on PYD with weekly 'themes'.	N_{INT} = 215 N_{CTL} = 0 M_{age} = 11.16 (range 8–13 at basline) 48.4% female	Design: Pre/Post Dose: 5 days/week, 6 hr/day, 4 weeks. Sport type(s): Individual & Team	Global self-worth Physical self-worth Physical competence Social competence Attraction to physical activity Hope Leader support	Confidence Confidence Competence Competence Health Health PYD climate	Across the first year of the study, participants in the PALS program reported significant increases in global self-worth, ($p < .001$) physical self-worth ($p = .011$), physical competence ($p = .05$), and social competence ($p = .015$). There were no differences for attraction to physical activity, hope, or leader support ($ps > .395$).	Moderate 10/13
Ullrich-French et al. (2012)	NYSP. See Anderson-Butcher et al. (2013)	N_{INT} = 197 N_{CTL} = 0 M_{age} = 11.8 (range 9–16) 51.8% female	Design: Pre/Post Dose & Sport type(s): See Anderson-Butcher et al. (2013)	Global self-worth Physical self-worth Physical competence Social competence Attraction to physical activity Hope Leader support	Confidence Confidence Competence Competence Health Health PYD climate	NYSP participants reported significant increases in global self-worth, ($p < .001$) physical self-worth ($p = .001$), physical competence ($p < .001$), and social competence ($p < .001$). There were no differences for attraction to physical activity, hope, or leader support ($ps > .171$).	Moderate 10/13
Vella et al. (2013)	Coach Transformational Leadership Training Program. One group session based on Coach effectiveness training/mastery approach to coaching. Monthly follow-up via telephone.	N_{INT} = 116 N_{CTL} = 127 M_{age} = 15.0 (range 12–18) 48.2% female	Design: Quasi Experimental Dose: two-hour session with monthly follow-up Sport type(s): Team	Personal and social skills Goal setting Initiative Cognitive skills Negative experiences	Life skill Life skill Life skill Competence Health	Athletes of trained coaches reported greater cognitive skills ($p = .019$) and goal setting ($p = .009$) between baseline and follow-up. At follow-up, athlete experiences with personal and social skills, goal setting and initiative were significantly higher in the intervention than the control condition. There were no differences observed for negative experiences.	High 12/13
Waldron (2007)	GOTT. See DeBate et al. (2009).	N_{INT} = 34 N_{CTL} = 0 M_{age} = 11.51 (range 6th to 8th grade students-USA) 100% female	Design: Pre/Post Dose & Sport type(s): see DeBate et al. (2009)	Social competence Physical competence Physical appearance competence Close friend competence Global self-worth	Competence Competence Competence Connection Confidence	Female GOTT participants reported greater social competence, physical competence, and perceived physical appearance competence following the program. No changes reported for close friendship competence or global self-worth	Moderate 9/13
Weiss et al. (2019)	GOTR. See DeBate and Bleck (2016)	N_{INT} = 203 N_{CTL} = 0 M_{age} = 9.8 (range	Design: Pre/Post Dose & Sport type(s): see DeBate and Bleck (2016)	Physical and social competence Perceived physical appearance	Competence Confidence	GOTR participants reported increased perceived physical appearance between baseline and follow-up, global self-esteem post-intervention to follow-up, and perceived classmate support	Moderate 9/13

		8 – 11) 100% female		Global self-esteem Perceived classmate support Social responsibility Perceived empathy/ sympathy	Confidence Connection Character Character	post-intervention to follow-up. No differences were found for competence or character outcomes.	
Weiss et al. (2016)	First Tee Program. A PYD-based programme that provides the opportunity to determine the synergy among context (golf), external assets (coaches) and internal assets (life skills) in contributing to developmental outcomes (Nine Core Values).	Study 1: $N_{INT} = 405$ $N_{CTL} = 159$ $M_{age} = 12.6$ (range 10–17) 26% female Study 2: $N_{INT} = 192$ $N_{CTL} = 0$ $M_{age} = 12.5$ at baseline (range 10–17) 27.6% female	Study 1: Design: Quasi Experimental Dose: Not offered Sport type(s): Individual Study 2: Design: Pre/Post Dose & Sport Type(s): see above	Meeting and greeting Managing emotions Goal setting Resolving conflicts Making healthy choices Appreciating diversity Getting help Helping others Academic competence Social competence Behavioural conduct Respect Responsibility Honesty Preference for challenging skills Self-regulated learning	Life skill Life skill Life skill Life skill Life skill Life skill Life skill Life skill Competence Competence Character Character Character Character Life skill Life skill	In Study 1, First Tee participants reported significant increases in all variables except goal setting, making healthy choices, helping others, social acceptance, and respect compared with a control group of youth in other structured programming. In Study 2, First Tee participants reported increased meeting and greeting, appreciating diversity, and getting help. Stable scores emerged for the other five life skills outcomes, however they did not increase over time.	High 11/13

Note: Study outcomes and outcome categories are side-by-side to demonstrate the categorization processes. Quality index scores are assigned a level corresponding to low (0-5), moderate, (6-10), and high (11-13). A total of 29 published articles are listed with 35 unique studies from which effect sizes could be extracted.

Table 3. Primary meta-analysis of the effect of sport programs on positive youth development domains.

	Effect size and precision					Heterogeneity				
Outcomes	Studies	N	Estimate	95% CI	*p*-value	Q-value	*df* (Q)	*p*-value	I^2	*Fail safe N*
Character	11	2,765	0.038	−0.066–0.142	0.475	49.95	10	<0.001	79.98	-
Competence	16	3,448	0.209	0.106–0.312	<0.001	102.39	15	<0.001	85.35	386
Confidence	16	4,778	0.219	0.126–0.312	<0.001	117.53	15	<0.001	87.24	610
Connection	9	2,602	0.023	−0.068–0.113	0.624	39.97	8	<0.001	79.99	-
Health	5	1,534	0.049	−0.019–0.117	0.160	3.39	4	0.496	0.00	-
Life skills	14	2,701	0.570	0.329–0.812	<0.001	489.24	13	<0.001	97.34	497
PYD climate	3	610	−0.054	−0.123–0.015	0.126	1.68	2	0.431	0.00	-

Subgroup moderator analyses were conducted for PYD domains if I^2 values demonstrated at least moderate heterogeneity. The following categorical moderators were determined *a priori*: (i) study design (pretest-posttest, quasi-experimental, RCT), (ii) sex (male, female, mixed), (iii) mean age (children [<12 years], adolescents [>12 years]), (iv) sport type (team, individual, both), and (v) study duration (<10 weeks, > 10 weeks; specified to differentiate between programs that lasted approximately one school term or longer). Sub-group results are reported for moderator analyses that were statistically significant ($p < .10$).

Results

The results of each meta-analysis are described below. Table 3 shows the overall effect of PYD programs on outcomes across: (i) character; (ii) competence; (iii) confidence; (iv) connection; (v) health; (vi) life skills; and, (vii) PYD climate. Also, moderator analyses further probe the boundary conditions of this effect within each PYD domain (see Table 4), and we comment briefly on the PYD interventions associated with significant positive changes in the PYD-related outcomes.

Character

The SMD for character was not statistically significant and high levels of heterogeneity were observed. Study design, sport type and study duration were found to moderate the effects of sport programs on character. Stronger effects were observed in quasi-experimental studies, for individual sports, and in studies >10 weeks in duration. Following the trim and fill procedure, four studies were trimmed and the adjusted effect size was slightly weaker (SMD = −0.034, 95% CI −0.071–0.003). PYD interventions associated with positive character changes included the National Youth Sport Program (NYSP) camp (McDonough et al., 2013), Girls on the Run (Weiss et al., 2019), and the First Tee Program (Weiss et al., 2016) (Figure 2).

Competence

The SMD for competence was 0.209 (95% CI [0.106, 0.312]) demonstrating a small but statistically significant effect. Heterogeneity was high and subgroup analyses showed that

Table 4. Summary of statistically significant moderators of treatment effects across PYD outcomes.

		Effect size and precision				Heterogeneity	
Moderators	Sub group	Studies (N)	Estimate	95% CI	*p*-value	Q-value	***p*-value**
Study design							
Character	Pre/post	8	−0.016	−0.123–0.092	0.772	3.67	0.057
	Quasi-experimental	3	0.198	0.006–0.390	0.043		
Competence	Pre/post	10	0.156	0.074–0.239	<0.001	4.67	0.031
	Quasi-experimental	6	0.641	0.209–1.073	0.004		
Sex							
Competence	Male	1	2.094	1.231–2.958	<0.001	19.16	<0.001
	Female	6	0.258	0.040–0.475	0.020		
	Mixed	9	0.171	0.079–0.262	<0.001		
Life skills	Male	2	3.680	0.966–6.394	0.008	6.58	0.037
	Female	3	0.225	−0.089–0.539	0.161		
	Mixed	9	0.153	0.000–0.305	0.049		
Sport type							
Character	Individual	4	0.150	0.049–0.251	0.004	10.61	0.005
	Team	2	0.134	−0.086–0.355	0.233		
	Both	5	−0.081	−0.184–0.0121	0.120		
Life skills	Individual	4	0.032	−0.147–0.211	0.725	5.23	0.073
	Team	5	1.838	0.281–3.396	0.021		
	Both	5	0.097	−0.037–0.230	0.156		
Study duration							
Character	≤ 10 weeks	6	−0.022	−0.130–0.085	0.684	9.36	0.002
	> 10 weeks	5	0.256	0.114–0.399	<0.001		
Life skills	≤ 10 weeks	10	0.877	0.500–1.255	<0.001	16.48	<0.001
	> 10 weeks	4	0.001	−0.190–0.192	0.992		
Age							
Life skills	< 12 years	8	0.220	0.070–0.371	0.004	4.70	0.030
	≥ 12 years	6	0.953	0.308–1.598	0.004		

study design and sex were significant effect modifiers. Specifically, substantially larger effects were observed in quasi-experimental studies, and in the one study with males only. However, as this was just one study, this finding should be interpreted with caution. Inspection of Rosenthal's classic fail-safe N showed that 386 unpublished studies with an effect size of zero would be required to make the observed effect no longer statistically significant. The trim and fill procedure resulted in no change to the

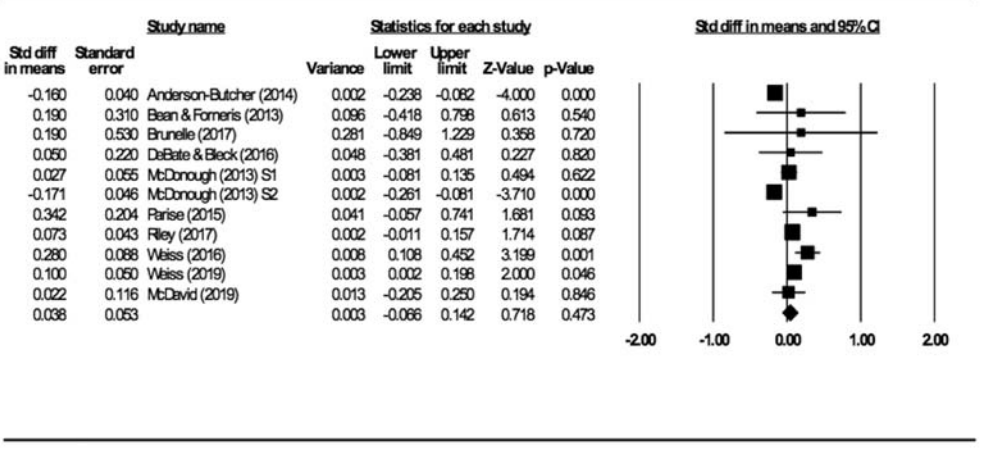

Figure 2. Character effect summary and forest plot.

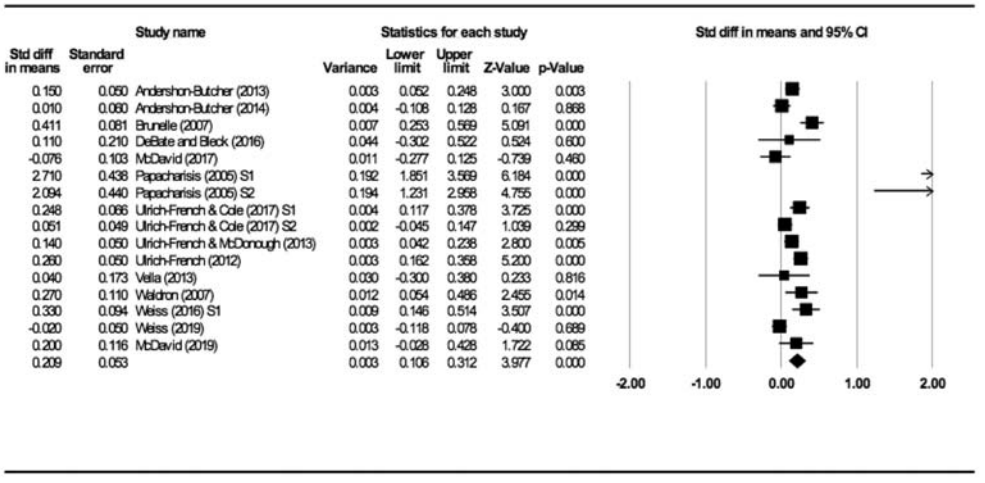

Figure 3. Competence effect summary and forest plot.

estimated effect size. PYD interventions associated with positive competence changes included NYSP (Anderson-Butcher et al., 2013; Ullrich-French et al., 2012), Sports United to Promote Education and Recreation (SUPER; Brunelle et al., 2007; Papacharisis et al., 2005), Girls on the Run (Ullrich-French & Cole, 2018), Girls on the Track (Waldron, 2007), First Tee (Weiss et al., 2016), and two customized PYD programs (McDavid et al., 2019; Ullrich-French & McDonough, 2013) (Figure 3).

Confidence

The SMD for confidence was 0.219 (95% CI [0.126, 0.312]) indicating a small but statistically significant effect. Heterogeneity was high but none of the hypothesized moderators were statistically significant, suggesting there may be other unmeasured factors responsible for the heterogeneity of effects. Inspection of Rosenthal's classic fail-safe N showed that 610 unpublished studies with an effect size of zero would be required to make the observed effect no longer significant. The trim and fill procedure resulted in no change to the estimated effect size. PYD interventions associated with positive confidence changes included SUPER (Brunelle et al., 2007), Girls on the Run (DeBate et al., 2009; Gabriel et al., 2011; Iachini et al., 2017; Ullrich-French & Cole, 2018), NYSP (Ullrich-French et al., 2012), and one customized PYD intervention (Ho et al., 2017) (Figure 4).

Connection

The SMD for connection was not statistically significant and moderate-to-high levels of heterogeneity were observed. No moderators of effects were observed. The trim and fill procedure resulted in no change to the estimated effect size. PYD interventions associated with positive connection changes included Girls on the Run (DeBate & Bleck, 2016; Weiss et al., 2019), NYSP (McDonough et al., 2013), and LiFE Sports Summer Camp (Anderson-Butcher et al., 2018) (Figure 5).

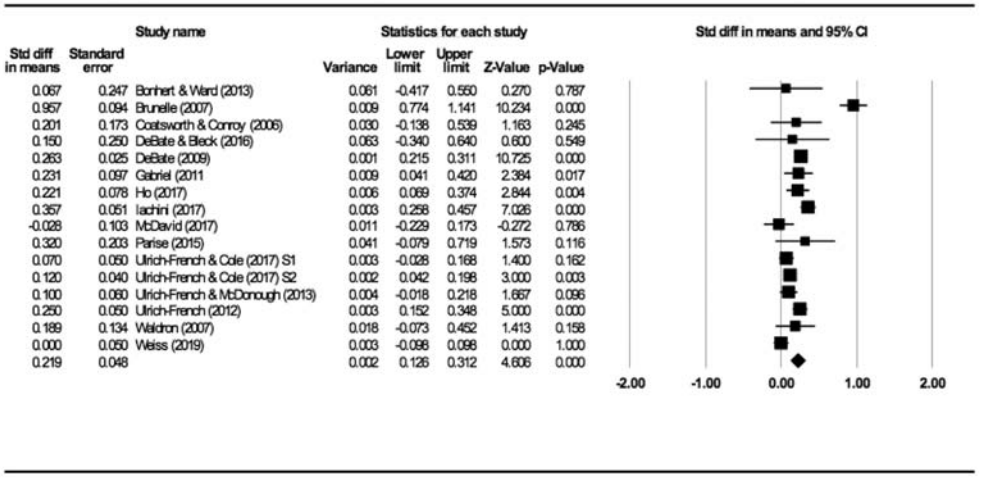

Figure 4. Confidence effect summary and forest plot.

Health

The SMD for health was not statistically significant and there was no heterogeneity. As such, subgroup analyses were not performed. Following the trim and fill procedure, two studies were trimmed and the adjusted effect size was slightly weaker (SMD = 0.023, 95% CI = −0.038–0.085). No PYD interventions were associated with positive changes in health outcomes (Figure 6).

Life skills

The SMD for life skills was 0.570 (95% CI [0.329, 0.812]) demonstrating a moderate statistically significant effect. Heterogeneity was very high and subgroup analyses showed that sex, sport type, study duration and age moderated the effects of sport on life skills. Specifically, male-only studies showed a stronger effect, but this finding should be interpreted

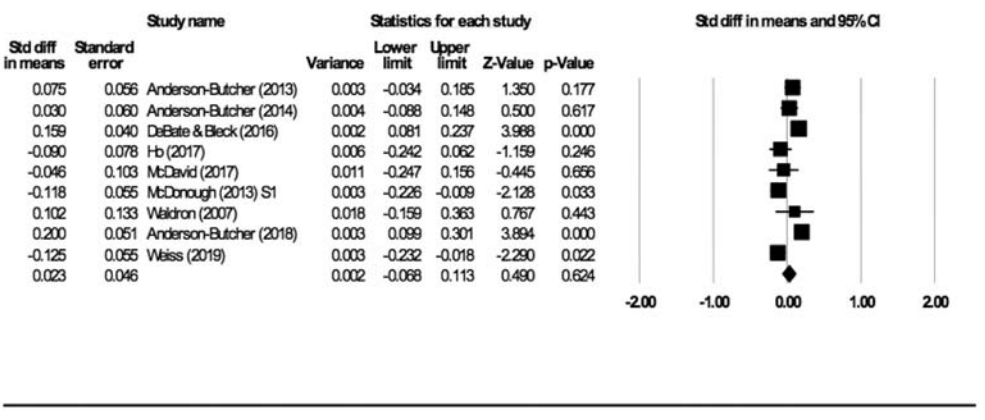

Figure 5. Connection effect summary and forest plot.

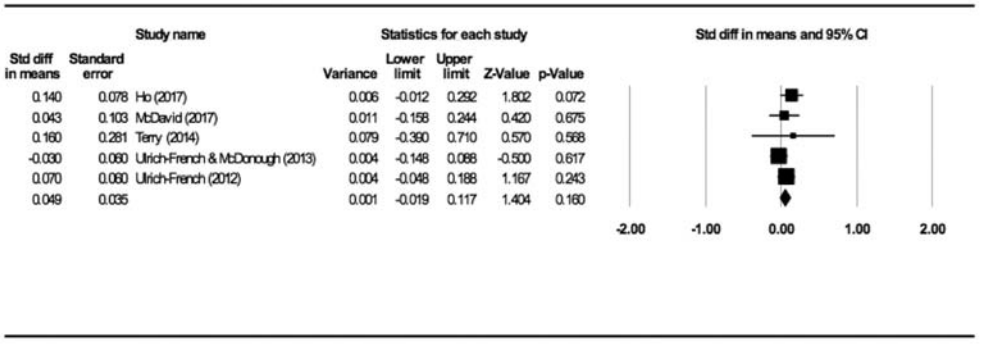

Figure 6. Health effect summary and forest plot.

with caution as there were only two studies included. Also, larger effects were seen for team sports, for studies ≤10 weeks in duration, and for studies with youth >12 years of age. Inspection of Rosenthal's classic fail-safe N showed that 497 unpublished studies with an effect size of zero would be required to make the observed effect no longer significant. The trim and fill procedure resulted in no change to the estimated effect size. PYD interventions associated with positive life skill changes included SUPER (Brunelle et al., 2007; Papacharisis et al., 2005), Girls on the Run (DeBate & Bleck, 2016), LiFE Sports Summer Camp (Anderson-Butcher et al., 2018; Riley et al., 2017), First Tee (Weiss et al., 2016), and three customized PYD interventions (Harwood et al., 2015; McDavid et al., 2019; Vella et al., 2013) (Figure 7).

PYD climate

The SMD for PYD climate was not statistically significant and there was no heterogeneity. As such, subgroup analyses were not performed. The trim and fill procedure resulted in no

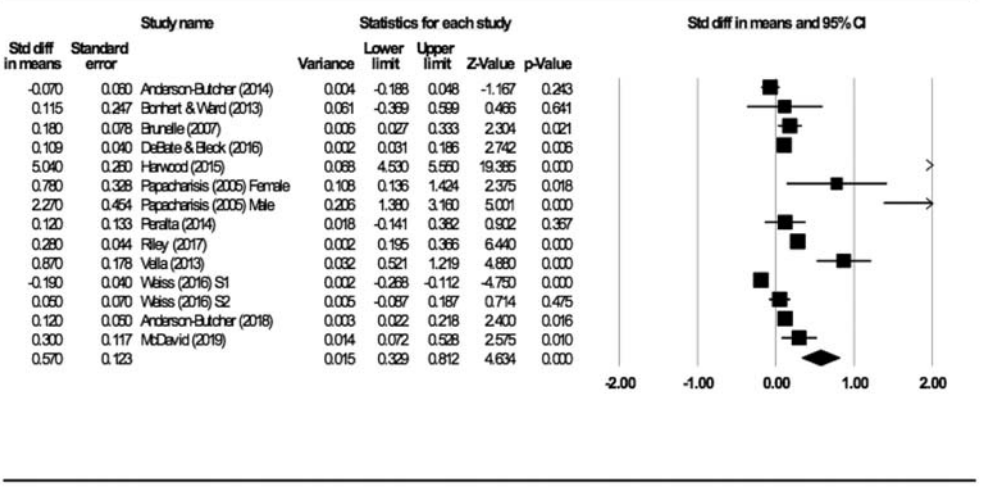

Figure 7. Life skills effect summary and forest plot.

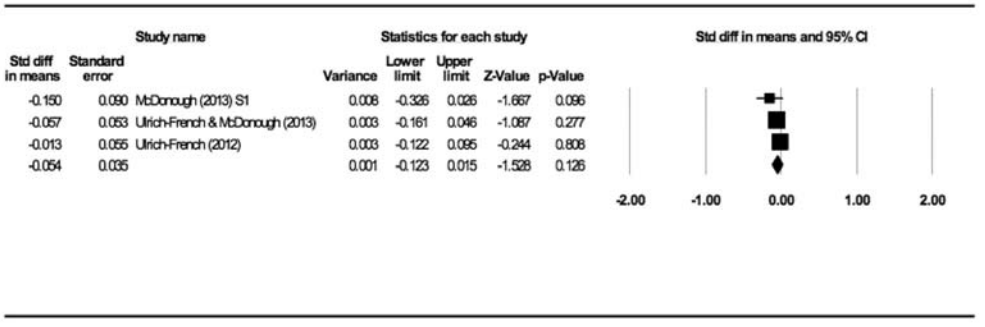

Figure 8. PYD climate effect summary and forest plot.

change to the estimated effect size. No PYD interventions were associated with positive changes in PYD climate outcomes (Figure 8).

Discussion

In the current review we assessed the effects of organized sport-based PYD interventions on adolescent PYD-related outcomes through seven separate meta-analyses. We also investigated the possible moderating effects of study design and sample characteristics on the strength of the effect on different categories of developmental outcomes. Overall, we found significant small to moderate effect sizes for the influence of sport-based PYD interventions on competence (SMD = .209), confidence (SMD = .219), and life skills outcomes (SMD = .570), indicating generally that sport-based interventions had a positive effect on some psychosocial outcome categories. These results are consistent with findings of previous systematic reviews (Eime et al., 2013; Holt et al., 2017; Whitley et al., 2019).

With respect to the overall pattern of results, there were no significant overall effects of PYD interventions on outcomes within the categories of character, connection, health, and PYD climate. While two of the outcome categories leveraged past reviews (e.g. Holt et al., 2017) to understand generally the sample of tested variables (i.e. health and PYD climate), the remaining two make up one-half of the widely used 4 C's conceptualization – character and connection (Côté et al., 2010). Given the importance and prominence of the 4C's conceptualization in sport-based PYD literature, this is problematic. Drawing upon the PYD literature (e.g. Catalano et al., 2004), a possible explanation may be the wide range of operationalizations and measurement approaches for the constructs. For instance, some of the variables captured under the character category include prosocial behavior (e.g. Bohnert & Ward, 2013), social and personal responsibility (e.g. Brunelle et al., 2007), and respect (Weiss et al., 2016). The heterogeneity in measurement of outcome variables is also detrimental because it does not allow a direct comparison of the efficacy or cost-effectiveness of various interventions, thereby disarming policy makers from important decision-making tools. Further, the heterogeneity in outcome measures reflects a distinct lack of consensus around those variables that could, or should, be targeted as core outcomes of sport-based PYD. We urge researchers to agree on the conceptualization, operationalization, and measurement of a core set of outcome measures.

An equally plausible explanation for the lack of effect is that the PYD interventions did not change the PYD outcomes due to inadequate intervention designs that did not appropriately target the constructs, or inadequate implementation of the interventions. In regards to the latter, it has been reported that poor implementation is a major challenge in other physical activity interventions (e.g. McCrabb et al., 2019), leading to phenomena like program drift (i.e. a decrease in intervention effectiveness due to a deviation from manualized protocols; Chambers et al., 2013). Though not the purpose of the current review, the lack of evaluation data supports this possibility in the sport-based PYD intervention literature. A productive investigative approach may be to examine why PYD interventions were effective in changing competence, confidence, and life skills. What about these interventions lent themselves to these changes? How can these elements be applied in the design of future PYD interventions—including much needed Randomized Controlled Trials (RCT)—to yield more consistent positive changes? It is important to note, there are individual studies within the PYD outcome categories of character, connection, health, and PYD climate that reported a positive effect of PYD interventions on PYD outcomes (e.g. character and connection; Weiss et al., 2019; physical and mental health, Ho et al., 2017). This would suggest that it is merely the overall effect for sport-based PYD programs on these four PYD outcomes to date is nonsignificant, but that potential exists to meaningfully impact these important PYD outcomes through well designed (e.g. only two studies for each of character and connection included a control group), *and* well implemented interventions (e.g. no studies in this review evaluated implementation quality). With respect to the latter point, we urge researchers to pay attention to the implementation of interventions because implementation of youth sport interventions can be difficult (Vella et al., 2019). Furthermore, we call for transparency in reporting of important variables that indicate the quality of implementation efforts, including the reach of the intervention, the dose delivered, fidelity of delivery, training of intervention staff, and any relevant implementation models used.

In terms of study quality, no indications of publication bias were found. Using the Downs and Black (1998) assessment, studies in the meta-analysis typically fell within the moderate range of study quality (i.e. composite index scores between 6 and 10 out of 13 possible points awarded). The assessment indicators least likely to be satisfied included an indication of study power calculations (only one study design completed an a priori power calculation), reporting actual significance values rather than simply reporting if a difference met a threshold for significance (e.g. $p = .035$ versus $p < .05$), and failing to control for relevant confounding variables within the sample. Additionally, our item created specifically for this review revealed that a number of studies did not conceptualize PYD despite positioning the study as a PYD intervention. One of the problems driving these design weaknesses is likely a pre-existing program where the role of the research team is more to measure outcome variables of interest at the beginning and end of the exposure period. As such, researchers have little to no control over sample sizes (limited to program enrollment) or the presence of a control group who are exposed to a different (or no) study protocol. However, strengthening reporting standards, considering participant demographics as control variables or moderators of intervention effectiveness, and grounding the PYD intervention in a conceptual framework (e.g. Relational Developmental Systems Theory; Lerner, 2004) are well within the control of the research team, and will improve future PYD intervention research. This

call for more rigorous designs align directly with those made in other recent PYD reviews (e.g. Whitley et al., 2019).

In the seven meta-analyses, there was evidence of heterogeneity based on the Cochrane's Q statistic and I^2 values in five outcome categories. In these cases (i.e. competence, character, connection, life skills, and confidence), moderating variables were tested to aid in explaining the differences in the strength of the effect sizes. For the meta-analysis regarding the effect of organized sport-based PYD interventions on developmental outcomes, moderating effects related to study design (i.e. intervention design type, sport type, and study duration) and participant characteristics (i.e. sex and age) emerged. Stronger effects were found in character and competence for quasi-experimental studies. Thus, intervention studies with greater internal validity yielded stronger effects for some psychosocial outcomes compared with, for example, a pre/post design which lacks a comparison group. In the sport type moderation analysis, larger effects were reported for character when the intervention program involved exposure to individual sports, and for team sport-based programs for the life skills category. Taken together, these findings highlight the importance of considering contextual considerations of sport programming. Sport-based interventions don't occur in a social vacuum. Considerations of the group dynamics at play in any youth sport intervention are necessary, and should inform a tailored approach to the application of theory, as well as intervention design and implementation (Vella et al., 2020).

As a final study design variable, stronger effects were reported in PYD interventions less than 10 weeks for life skills and greater than 10 weeks for character. The findings highlight the possibility for changes in adolescent PYD outcomes in shorter and longer term PYD interventions. Reflecting on the findings, life skills may be easier to teach than a 4 C's outcome like character. As an example, adolescents may be able to learn and apply goal setting in a one-hour session, however, changing a youth's antisocial teammate behavior may take more time. It is possible that behavioral and attitudinal changes take more effort and time than micro-skill development. One intervention that was consistently associated with positive changes in the 4 C's outcome categories was the Girls on the Run program. Girls on the Run involved 24 structured lessons based around 5 C's (Lerner, 2004) across 12 weeks, each 90 min in duration. Further investigation reveals that each lesson addresses both competence and confidence, with a select number addressing connection, character, and caring (merged into character in the 4 C's). As a result, the positive changes found in each of these categories (especially for confidence) may be related to this increased dose through structured learning opportunities. Catalano et al. (2004) provide guidance on the length of effective PYD programs to take longer than 10 weeks. Taken together, the intervention duration moderation findings also cast some light on the need to consider the intervention duration with the desired PYD outcomes to see if they align to monitor change during the intervention and at follow-up.

The study sample was found to moderate the effect of sport-based PYD interventions on PYD outcomes. Specifically, the moderating result of sex on competence and life skills may indicate that interventions may have larger effects on males. However, given that there were only three studies total (one – competence, two – life skills) caution should be used. A larger sample of interventions may be necessary before sound conclusions can be made regarding variations in effectiveness by sex. The examination of age was found to moderate the effect PYD-based sport interventions on developing life skills

for youth older than 12 years of age. This moderator, however, did not appear to have any effect on the remaining outcome categories.

Collectively, there is an inconsistent pattern of moderation effects of study design and participant characteristics on different outcome categories. There appears to be a range of qualifiers depending on the category, with no one variable having the same amplifying effect on each type of outcome. As such, future researchers will need to take caution depending on the outcome variable of choice to indicate positive youth development. Although there were a range of PYD interventions that were associated with positive change in different PYD outcomes, a common trend was protocols involving structured time dedicated to building knowledge or skills associated with the main outcomes of interest as well as the opportunity to explore this learning through the medium of sport participation. At this time, it is difficult to expand beyond this general observation to recommend a gold-standard PYD intervention protocol given the variability in findings with different categories of PYD outcomes.

Limitations and future directions

There are limitations related to this systematic review and the broader sport-based PYD intervention literature that are important to acknowledge. Relevant to this review, the range of conceptualizations and definitions of the PYD outcomes may attenuate the overall effects. One of the primary conclusions not captured in the quality assessment was the wide range of constructs through which researchers determine the effectiveness of their sport-based PYD intervention. In pooling studies to come up with an overall effect, it is possible that this lack of coherence dilutes (or even amplifies) the true effects. From a measurement perspective, constructs in this study were, in general, measured via self-report. Although ease of assessment is an advantage, response biases are a limitation. As such, there is an opportunity for greater use of objective measures for constructs such as those captured in competence, life skills, or health (e.g. fundamental and specialized movement skill competence, game play/decision making; Lubans et al., 2010; Miller et al., 2016). The PYD literature base would benefit from an overview of this conceptual-operational congruence in the form of a scoping or systematic review.

Second, and relevant to the PYD literature more generally, there were few studies in this review that included control groups (i.e. 19 of 29 published articles used pre-experimental designs), which limited our ability to comment on the underlying causal attributions. As a result, we are limited in our ability to report that participation in a sport-based PYD program positively influences a range of PYD outcomes. Broadly, the findings implicate that those who take part in a sport-based PYD intervention also report higher PYD outcome scores at follow-up (i.e. competence, confidence, and life skills). Without a greater prevalence of experimental designs containing a control condition (e.g. RCT, quasi-experimental), the results remain open to other possible alternative explanations (e.g. Hawthorne effects). As highlighted in this review, it is critical for sport-based PYD interventions to strengthen study designs (e.g. cluster randomized control trial, propensity score matching). Finally, and related to the previous limitation, there was a general lack of testing of the mechanisms to explain how the sport-based PYD programs are associated with the PYD-related outcomes. Therefore, the underlying pathways through which participation come to alter PYD outcomes are largely unknown.

The current review yields other important implications for future research. Building upon the first identified limitation of the wide range of PYD constructs, greater conceptual clarity and stronger psychometric measurement are warranted. Specifically, further theoretical and empirical research is needed to more succinctly operationalize and evaluate the 4Cs in youth sport. In addition, there is an opportunity within the sport-based PYD literature to incorporate mental health outcomes (Vella et al., 2020). To date, outcomes relevant to one's mental health have not been examined through the lens of PYD in sport despite the conceptual congruence between PYD and mental health as strength-based approaches to development (Barry & Jenkins, 2007; Lerner et al., 2005). For example, mental health literacy may be an important developmental asset (Vella et al., 2020).

Given the inconsistent moderation patterns, additional research on the potential mechanisms influencing the PYD intervention – PYD outcome effects is needed. As an example of *why* this effect exists, it may be fruitful to examine the efficacy of the delivery format for the interventions (implicit vs explicit). Of note, the majority of the studies were athlete-focused, explicit interventions. Here, the PYD outcomes of interest are taught directly to sport participants in an effort to develop and refine these skills through sport. Further research is needed to explore the efficacy of both implicit and explicit approaches (Turnnidge et al., 2014). This is important because with an implicit approach, the conditions could be created to foster these same outcomes, but the emergence is more natural.

As another example of the moderation analyses, sport-based PYD interventions had a small yet statistically significant effect on confidence. Despite finding high heterogeneity of effect sizes, none of the hypothesized moderators were statistically significant. This suggests that some other unmeasured factors responsible for the heterogeneity of effects. As such, we may need to look towards other qualifiers of this effect not captured in the study design or participant sample demographics. One instance of *when* this effect occurs may relate to past experience in sport. Is the effect the same for a participant who is newer to sport activities (e.g. Girls on the Run; Ullrich-French & Cole, 2018), versus a sample with more experienced athletes (e.g. Harwood et al., 2015)?

Conclusion

In sum, the current study showed that sport-based PYD interventions can be effective in improving PYD-related outcomes. However, study designs are weak and generally have not included control groups, so causal attributions may not be possible. Given the range of PYD outcome variables being examined within the academic literature, further high quality studies are necessary to gain greater understanding of how, when, and why sport yields positive psychosocial outcomes for youth participants. This includes more consistent operationalizations and assessments of PYD constructs and tests of the mechanisms that underpin the relations between intervention involvement and development outcomes. There is a clear need to better understand and enhance the quality of youth sport-based PYD intervention research, including stronger research designs and better implementation protocols. Despite this, the findings of this meta-analytic review provide some support for the view that sport participation positively impacts youth developmental outcomes.

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