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A SYSTEMATIC REVIEW OF TALENT IDENTIFICATION PRACTICES IN TABLE TENNIS

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ABSTRACT

Talent identification (TID) within sport provides extensive development opportunities to enhance the potential for senior success. However, little is known about the effectiveness of TID in table tennis. Therefore, the objective of this systematic review is to examine current research and practice in TID in table tennis, identify commonalities, disparities, and gaps in the literature, and provide directions for future research on TID in table tennis. A search of the electronic databases (EBSCOhost, Scopus, Web of Science, PubMed, and SPORTDiscus) was conducted from September 2023 to March 2025. The search terms utilized represented table tennis, talent, performance, giftedness, and athlete selection. In accordance with the PRISMA guidelines, 31 articles were thoroughly reviewed. The results established three common themes: morphological qualities, performance profiles, and player characteristics. A key finding established maturation bias as a limitation in talent identification within table tennis, highlighting the importance of maturational assessments in future initiatives. Furthermore, given that most studies used a cross-sectional design, future research should consider longitudinal designs to provide a more accurate assessment of talent and development.

Keywords: *perceptual-motor skills, physical, maturation, racquet sports, performance testing, giftedness.*

INTRODUCTION

Identifying and developing the best athletes is the overall pursuit of elite sport organizations. Given the extensive time requirements for the development of expertise (Baker & Young, 2014; Vaeyens et al., 2009) young athletes are often prioritized, given that they have the greatest opportunity to undertake longer-term systematic development (Vaeyens et al., 2009). In searching for young prospective athletes, talent identification (TID) protocols are commonly used to recognize and subsequently develop individuals perceived as having the highest potential for senior success (Johnston et al., 2018; Vaeyens et al., 2008). Whilst the effectiveness of TID protocols remains relatively unknown, such practice will likely remain a cornerstone of sporting recruitment. Therefore, TID protocols and assessments warrant extensive investigation to ensure accurate understanding and interpretation of performance, whilst mitigating against potential bias or error.

Table tennis is an open-skilled sport characterized by unpredictable and dynamic actions, demanding reactions within limited time frames (Doherty et al., 2018). Specifically, research in table tennis has identified high demands for perceptual-cognitive and perceptual-motor abilities (Faber et al., 2015), emphasizing the importance of game understanding, decision-making, and anticipation skills, as well as a mastery of associated movement patterns (e.g., footwork, technical ability, bal-

ance, etc.) (Faber, Bustin, et al., 2016; Faber et al., 2015). Thus, TID protocols in table tennis are inherently complex due to the need for diverse skill sets and advanced perceptual-cognitive abilities. Additionally, table tennis is considered an early specialization sport, whereby engagement within the sport from an early age is thought to be necessary to attain subsequent senior success (Faber et al., 2017a; Koopmann et al., 2023). Previous research has reported that athletes as young as 8-12 years are considered a special interest for TID purposes (Koopmann et al., 2023). However, this age range aligns with key developmental stages in youths (e.g., the growth spurt), whereby significant physical advancement occurs (Myburgh et al., 2019). Therefore, in the absence of such an acknowledgment, TID in table tennis is likely to be influenced by physical maturation.

With the above-mentioned in mind, this review seeks to synthesize current research and practice of TID in table tennis. More precisely, the research seeks to investigate: i) the variations of methodological design (e.g., cross-sectional, retrospective, or longitudinal) and the focus of assessment (i.e., singular domain or multifaceted) used in literature to distinguish key performance attributes of table tennis; ii) the range of assessment instruments used to measure and assess performance (i.e., physical, cognitive and anthropometric profile); and iii) characteristic differentiation in identifying talent (e.g., age, sex, nationality). By highlighting the commonalities, disparities, and gaps in current knowledge, this review aims to offer future directions for refining and advancing TID offerings within table tennis, benefiting practitioners and organizations in identifying talent effectively and improving their talent identification processes.

METHODOLOGY

Search Strategy: Databases & Eligibility Criteria

A systematic review was conducted to examine the current practice of talent identification in table tennis. The procedures were established prior to conducting the review, whereby relevant literature was determined following the *Preferred Reporting of Items for Systematic Reviews and Meta-Analysis* (PRISMA) guidelines (Page et al., 2021). Preliminary searches were conducted in August 2023 to identify standard search terms for distinguishing talented table tennis players. The electronic databases EBSCO Host, Scopus, Web of Science, PubMed, and SPORTDiscuss were searched from September 2023 until March 2025, using the following search terms: '*Table Tennis AND Talent**', '*Table Tennis AND Gift**', *'Table Tennis AND Select**',* and *'Table Tennis AND Performance**'*. Boolean operators ("AND") and wildcards ("*") were used to enhance the breadth of the search.

To ascertain the appropriateness of the literature, an inclusion criterion was established: i) research must be relevant to talent identification in table tennis. Comparison of purely technical or tactical superiority was excluded as these were deemed irrelevant to identifying talent (typically focused on game strategy); ii) studies must be related to table tennis (i.e., not other racket sports); iii) studies must be available as full text; iv) studies must be written in English; and, v) studies must have been published within the last 10 years, for contemporary relevance.

Study Selection

Two reviewers (RK and HOB) assessed the articles following the PRISMA process. The literature was imported into an online systematic review management tool (Covidence,

Australia), and duplicates were removed prior to screening. For the screening process, each reviewer worked independently. Using the inclusion criteria throughout, titles and abstracts were first assessed, and studies that met the criteria underwent full-text screening. At both screening stages, any conflicts regarding the eligibility of the research articles were resolved through discussion between the reviewers (RK and HOB). Lastly, data were extracted independently by both authors (RK and HOB).

Quality of Literature

To assess the methodological quality of the extracted literature, the McMaster critical review form was used (Law et al., 1998). The form assesses against 16 items, although the present study removed the application of point 9 (intervention applied) as deemed irrelevant to the reviewed literature, which aligns with previous studies (Faber, Bustin, et al., 2016; Sarmento et al., 2018). Articles were assessed on: 1) study objective; 2) a review of relevant literature; 3) appropriate research design; 4) sample description; 5) sample size justification; 6) informed consent procedure; 7) reliability assessment of outcome measures, 8) validity assessment of outcome measures; 10) statistical reporting; 11) analysis approach; 12) practical importance; 13) drop-out reporting; 14) appropriate conclusions; 15) practical implications; and 16) research limitations. Each item was scored with either a 1 (meets criteria), a 0 (does not meet criteria), "*NA"* (not applicable), or "*?"* (undetermined rating). Overall scores were presented as a percentage and were derived by summing the scores of all items and dividing them by the number of relevant scored items for each research article. This study adopted cut-off points set as ≤ 50% = low methodological quality, 51% to 75% = good methodological quality, and >75% = excellent methodological quality, in line with similar studies (Faber, Bustin, et al., 2016; Sarmento et al., 2018). Throughout the process, one reviewer conducted the methodological quality screening (HOB), and another reviewer verified the outcomes (RK). Disagreements between reviewers were resolved through discussion.

The quality assessment established a mean value for all the studies of 73%, where 17 studies were considered excellent quality (> 75%), 12 studies considered good quality (51 to 75%), and two studies considered low quality (< 50%), with quality percentages summarised in Table 1. On further observation, low-quality studies were typically characterized by methodological issues (i.e., failure to report consent and/or the use of unreliable or invalid measures) and by outcome commentary (i.e., lacking statistical reporting and not highlighting study limitations).

RESULTS

Systematic Search

The initial search identified 1822 manuscripts within the aforementioned databases. Following the removal of duplicates (n = 575), 1246 studies were eligible for review. Initial screening consisted of evaluating the relevance and eligibility of literature titles and abstracts, after which 1185 studies were removed. The remaining 61 manuscripts underwent full-text review, during which each study was assessed against the eligibility criteria, resulting in 30 additional exclusions. The systematic review identified 31 studies eligible for in-depth review (Figure 1). Exclusion of literature consisted of studies lacking full-text availability (n = 10), wrong study design (n = 12), wrong outcomes (n = 5), manuscript retraction (n = 1), methodological concerns (n = 1), or not being written in English (n = 1).

Synthesis of Literature

Upon reviewing the literature, three themes emerged (with additional sub-themes) outlining the variables reported to distinguish talent in table tennis: *Morphological Qualities* (anthropometrics and maturation); *Performance Profile* (components of fitness, perceptual-motor skills, and psychometric evaluation); and *Player Characteristics* (training history, handedness, and birth date distribution). A summary of the instruments used in the literature reporting significant results related to TID is presented in Figure 2.

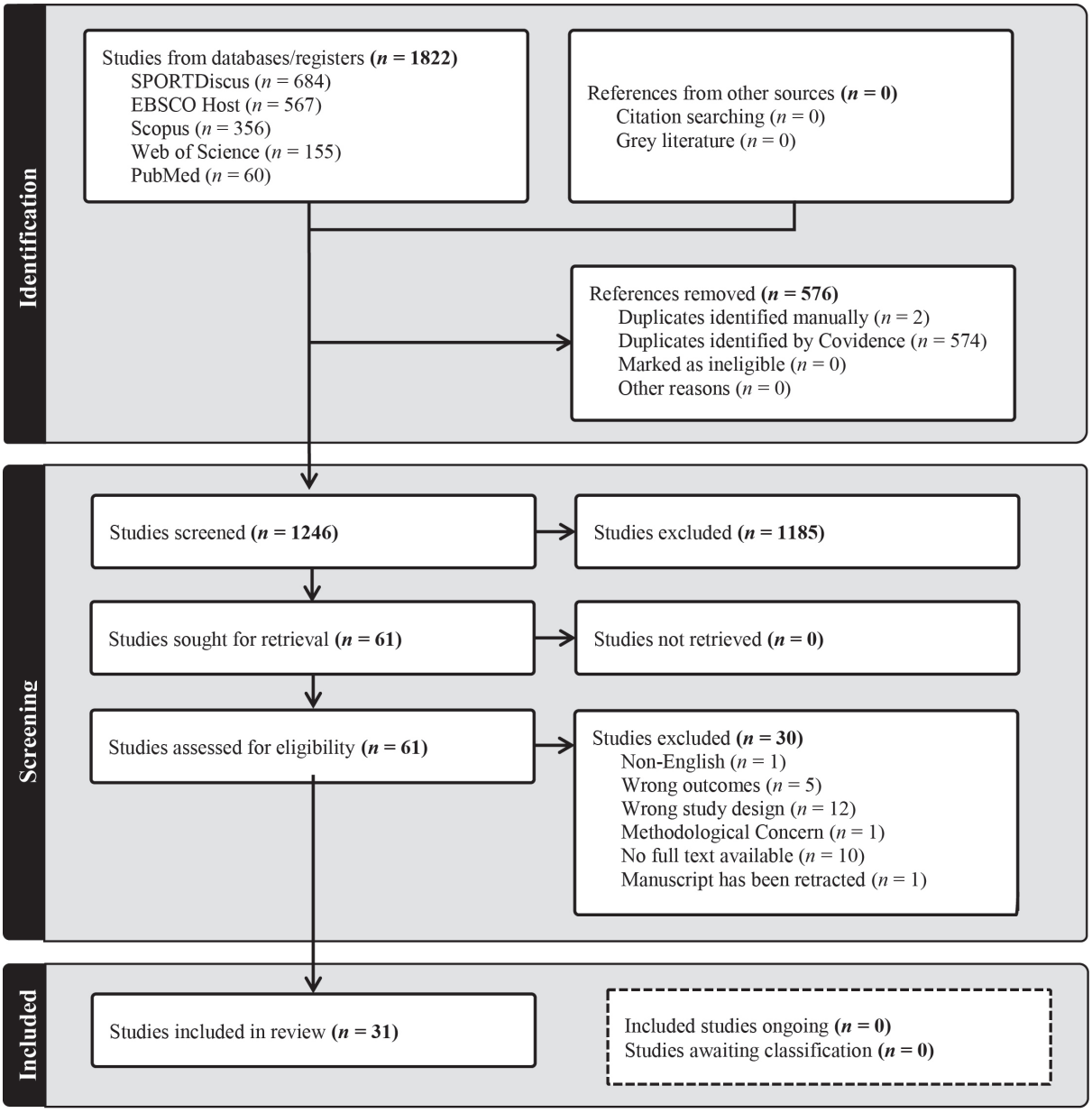


Figure 1. *PRISMA flowchart outlining the review process*

Table 1. *An overview of the reviewed literature*

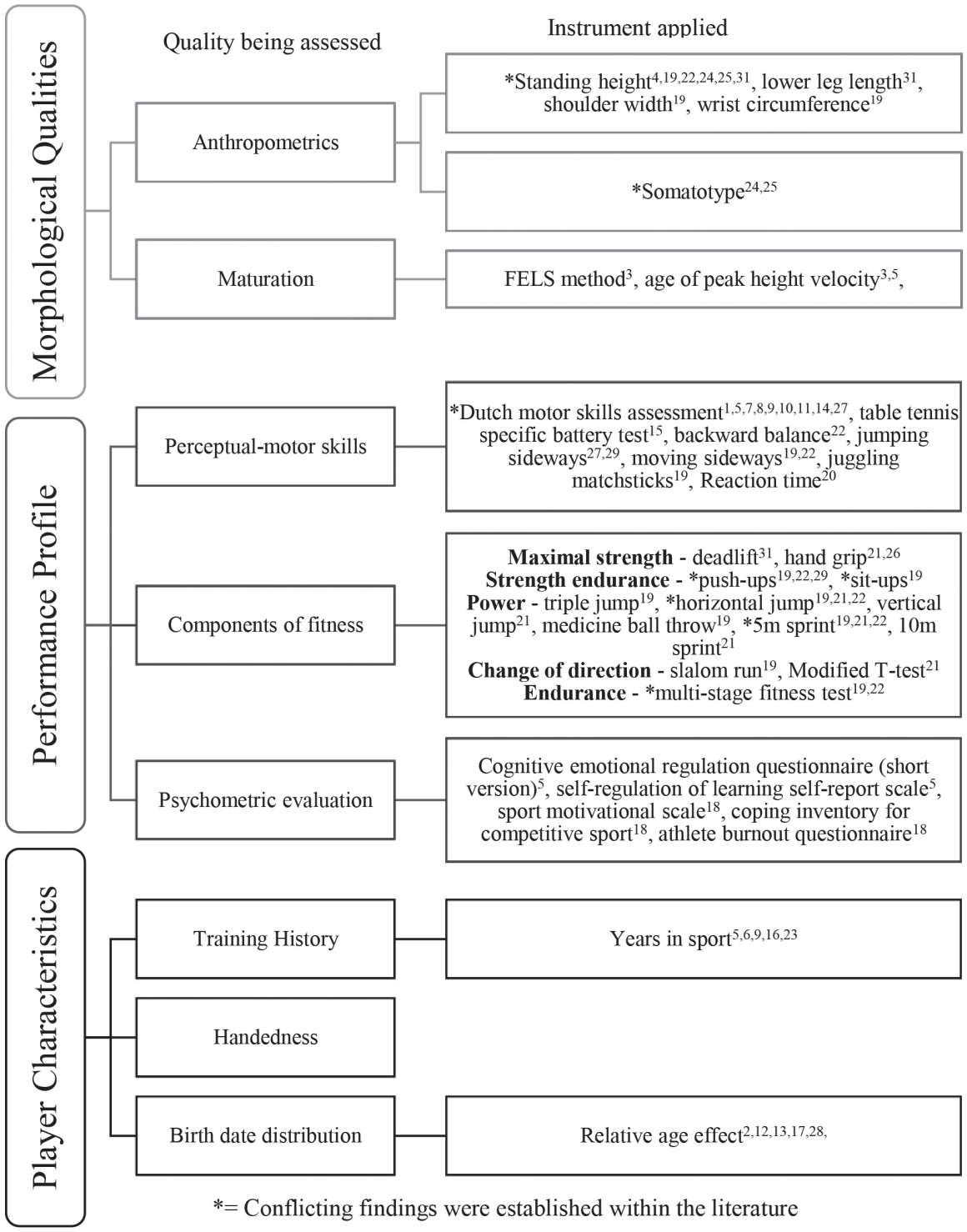
Authors	Title	Population	Sample Size	Research Design (t_1-t_2)	Overview of Research and Findings	Quality Score
Abazi et al. (2023)	A cross-country validation between Kosovo and the Netherlands of the Dutch perceptual-motor skills assessment for talent detection in table tennis.	7-9-year recreational players from Kosovo and the Netherlands	391	MD + CSD	The research aimed to compare performance on the Dutch perceptual-motor skills assessment across countries (the Netherlands and Kosovo) and identify significant differences. Moreover, country-specific normative values are required to enhance talent identification	80%
Bilgiç & Güvenç (2024)	The prevalence of relative age effects in a nationwide analysis of racket sports: Happy birthday?	5-85-year-old Turkish racket sport players	57476	UD + CSD	Investigating the relative-age effect among racquet-sport players, significant biases were observed in table tennis, suggesting that selection processes may inadvertently favor relatively older players within the same age group.	92%
Coelho-e-silva et al. (2022)	Growth and maturity status of young male table tennis players.	8-15-year Portuguese and Polish competitive players	99	UD + CSD	The research sought to identify the trend in maturity status among competitive table tennis players, noting that biological ages typically exceed chronological ages at landmark ages (i.e., the onset of PHV).	92%
Djokić et al. (2017)	Anthropometric characteristics of top-class world and European male table tennis players.	World's top 100 ITTF senior male players	75	UD + CSD	The analysis of anthropometric profiles of the top 100-ranked male ITTF players found no differences between profiles and performance.	33%
Doherty et al. (2018)	Determinants for table tennis performance in elite Scottish youth players using a multidimensional approach: A pilot study.	Scottish top 25-ranked Junior players	14	MD + LD (2016 - 2017)	A multidimensional assessment model was developed and compared over a 1-year period. Maturation status was a confounding factor of performance, as was sprint ability and self-regulation capacity.	79%
Elferink-Gemser et al. (2018)	Higher-level cognitive functions in Dutch elite and sub-elite table tennis players	Elite and sub-elite Dutch competitive players (NTTA)	60	UD + CSD	Comparing cognitive functions in elite and sub-elite players, both groups outperformed average norms. When comparing the two groups, no significant differences emerged after controlling for training hours, suggesting that sport exposure may play a key role in cognitive development.	80%
Faber et al. (2014)	Does an eye-hand coordination test have added value as part of talent identification in table tennis? A validity and reproducibility study.	6-12-year Dutch (NTTA) recreational, regional, and national players	43	UD + CSD	A hand-eye coordination test distinguished local training centers from players at regional and national standards.	80%

Faber et al. (2015)	The Dutch motor skills assessment as a tool for talent development in table tennis: a reproducibility and validity study.	6-10-year Dutch (NTTA) talent pathway players	113	MD + CSD	The Netherlands table tennis motor skills assessment was measured for reliability and consistency, establishing acceptable reliability and good reproducibility.	73%
Faber et al. (2016)	Can perceptuo-motor skills assessment outcomes in young table tennis players (7-11 years) predict future competition participation and performance? an observational prospective study.	7-11-year-old Dutch (NTTA) talent pathway players	48	MD + LD (2011 – 2014)	A motor skills assessment was compared with five sporting performance markers (competition outcomes) every 6 months (totaling 2.5 years). The assessment demonstrated 51-53% of performance outcomes, indicating it is a suitable instrument for assessing talent in table tennis.	71%
Faber et al. (2017)	Can an early perceptuo-motor skills assessment predict future performance in youth table tennis players? An observational study (1998-2013).	7-10yrs Dutch (NTTA) talent pathway players	1191	MD + CSD	Of the four tests assessed (sprint, agility, speed while dribbling, and throwing a ball), all but agility were related to performance in girls, and all but agility and speed while dribbling in boys. However, the model's accuracy was low, casting doubt on the use of the tests in isolation.	77%
Faber et al. (2018)	Does a perceptuomotor skills assessment add value in detecting table tennis talent in primary school children?	8-10-year Dutch talent pathway (NTTA) and recreational players	267	MD + CSD	The assessment of 8 perceptuomotor skills (sprint, agility, vertical jump, speed while dribbling, aiming at a target, ball skills, throwing a ball, eye-hand co-ordination) identified primary-age children who possess the necessary skills to become gifted table tennis players.	71%
Faber et al. (2020)	Are performance trajectories associated with relative age among French top-100 youth table tennis players? – A longitudinal approach	13-18-year French Top 100 national players (FFTT)	1000	UD + LD (2013 – 2017)	A longitudinal retrospective study design sought to acknowledge the influence of the relative age effect on performance. Only the U18 demonstrated a relative age bias. However, the small sample size and lack of Q4 participants challenge the findings.	79%
Faber et al. (2020)	The interaction between within-year and between-year effects across ages in elite table tennis in international and national contexts – A further exploration of relative age effects in sports.	U15-Senior top 100 world, European, and national (France and the Netherlands) ranked players	1509	UD + CSD	A retrospective cross-sectional design investigating relative age effects (RAE). The study found both within-year and between-year effects, identifying greater prominence of RAE in males than in females.	75%
Faber et al. (2023)	Can perceptuo-motor skills outcomes predict future participation in, drop-out from, and competition performance in youth table tennis players? A 9-year follow-up study.	7-10-year Dutch talent pathway (NTTA) players	57	MD + LD (2011 – 2020)	Using a 9-year follow-up, the research found that perceptuo-motor skill assessments identified potential for drop-off whilst aligning with performance outcomes. The assessments 'aiming at targets' and 'eye-hand coordination' (when controlled for age and sex) were found to be the best predictors of performance, with an R2 of 36.4.	79%

Katsikadelis et al. (2014)	Test-retest reliability of the “table tennis specific battery test” in competitive-level young players.	Greek adolescent ranked players (HTTF)	30	MD + CSD	In assessing the “table tennis specific battery test”, the findings suggest that this tool is reliable for assessing technical skills and tracking performance progress.	53%
Koopman et al. (2023)	Exploring the subjective beliefs of expert coaches on ‘talent’ and player selection in German table tennis	German national and international coaches	15	MD + CSD	Following in-depth interviews, coaches demonstrated a view of talent as dependent on multiple factors (profile, practice and experience, individual skills, and environmental factors).	83%
Loffing & Schorer (2021)	Handedness and Relative Age in International Elite Interactive Individual Sports Revisited.	Top 200 senior international players between 2007 and 2016	942	MD + LD (2007 – 2016)	Using a retrospective design, handedness and relative age bias were assessed in senior and youth athletes across a range of sports, spanning 10 years. Table tennis athletes had a higher proportion of left-handed players than the population estimate. A small relative age bias was also identified, but only in women.	64%
Martinent et al. (2018)	The prognostic relevance of psychological factors for participation and success in table tennis.	11-19yrs French competitive players (FFTT)	159	UD + LD (2009 – 2016)	Analyzing psychological factors, the study found that sporting retention and performance were aligned with lower amotivation, disengagement-oriented coping, sport devaluation, and lower accomplishment scores.	86%
Nikolić et al. (2019)	Anthropometric characteristics and motor abilities of young female players in relation to competitive success.	U11 Croatian female competitive players (CTTA)	40	MD + LD (Nd)	Over a 2-year span, athletes were assessed using a wide battery of anthropometric and motor competency measures. Physical profile and agility tests distinguished relationships with performance.	58%
Padula et al. (2016)	Task complexity reveals the expertise of table tennis players	High-level Italian-ranked players to non-table tennis players	28	UD + CSD	In testing reaction speed and perceptual-cognitive reactions, reaction time differentiated only between table tennis players and non-players, whereas ball speed identified the standard of players.	67%
Picabea et al. (2021)	Physical fitness profiling of national category table tennis players: implications for health and performance	U12-senior Spanish mixed gender players	71	UD + CSD	Components of fitness (strength, power, speed, flexibility) are influenced by age, with improvements observed from U12 to U20, whereas beyond this, performance declined.	80%
Pion et al. (2014)	Generic anthropometric and performance characteristics among elite adolescent boys in nine different sports.	U18 Belgium national male players	141	MD + CSD	Using the Flemish Sports Compass, a non-sport-specific assessment battery, the research sought to allocate participants to various sports (n=9) correctly. Table tennis showed no discrimination by anthropometric or physical fitness tests. Motor coordination tests discriminated between sporting allocation.	79%
Pluta et al. (2020)	The motor and leisure time conditioning of young table tennis players’ physical fitness.	9-17-year-old Polish regional and talent pathway players	87	UD + CSD	The research primarily looks at associations between physical fitness tests and lifestyle determinants. Only the bent-arm hang test and the standing long jump distinguished performance standards.	79%

Pluta et al. (2021)	Somatic characteristics and special motor fitness of young top-level Polish table tennis players	9-17-year-old Polish regional talent pathway players	87	MD + CSD	Anthropometry was determined to influence table tennis performance across a range of movements. Likewise, a dominant morphological structure was established, characterized by a mesomorphic physique.	87%
Pradas et al. (2021)	Anthropometric profiles in table tennis players: analysis of sex, age, and ranking.	7yrs - senior Spanish top-50 nationally ranked players (RSTTF)	495	UD + CSD	Assessing eight skinfold measurements, the results indicated that healthy body composition was associated with table tennis involvement. Additionally, higher upper-body lean mass was associated with player rank, establishing morphological influence on performance	80%
Pradas et al. (2022)	Analysis of specific physical fitness in high-level table tennis players – sex differences	Elite senior Spanish players	48	MD + CSD	Assessing components of fitness in both men and women, the research found that men outperformed women across most assessments, except reaction time. A range of similar racket sports is discussed, considering normative values and the various differences with table tennis performance.	73%
Robertson et al. (2018)	A coach's perspective on the contribution of anthropometry, physical performance, and motor coordination in racquet sports.	Licensed table tennis coaches worldwide	177	MD + CSD	Coach perceptions of racquet sports established table tennis as requiring the lowest demands in anthropometry, physical performance, and motor coordination. Although hand-eye coordination was the highest in table tennis.	73%
Romann & Fuchslocher (2014)	The need to consider relative age effects in women's talent development.	10-20-year Swiss recreational and talent pathway	3675	UD + CSD	The relative age effect was assessed in table tennis, revealing a reverse effect: an overrepresentation of Q4 athletes.	46%
Siener & Hohmann (2019)	Talent orientation: the impact of motor abilities on future success in table tennis	U13-U17 German club to national standard players	225	MD+ LD (2010 – 2014)	In assessing motor skills, the study identified key performance indicators of later success in table tennis, with push-ups and sideward jumping as strong predictors of performance.	57%
Widodo (2024)	Developing reaction time measurement tool norms for table tennis athletes	17-18-year-old table tennis players	90	UD + CSD	The study focused on developing a reaction time assessment instrument. The instrument demonstrated strong validity and reliability. Therefore, reaction times can be assessed and tracked.	54%
Zhao et al. (2019)	Physiological, anthropometric, and motor characteristics of elite Chinese youth athletes from six different sports.	U15 & U16-aged Chinese national and international players	15	MD + CSD	In reviewing a range of different sports, attempting to detect qualities aligned to each, table tennis was distinguished by lower leg length as the only anthropometric variable, dynamic back strength in motor qualities, and vital capacity as a physiological determinant.	86%

Notes: Quality of studies was scored as >75% = excellent quality, 50-75% = good quality, and <50% = low quality.
UD = Unidimensional, MD = Multidimensional, CSD = Cross-sectional design, LD = Longitudinal design, t_1 - t_2 = time point 1 to time point 2, Nd = No date stated.



***Study key**: 1) Abazi et al. (2023); 2) Bilgic et al. (2024); 3) Coelho-e-silva et al. (2022); 4) Djokić et al. (2017); 5) Doherty et al. (2018); 6) Elferink-Gemser et al. (2018); 7) Faber et al. (2014); 8) Faber et al. (2015); 9) Faber et al. (2016); 10) Faber et al. (2017); 11) Faber et al. (2018); 12) Faber et al. (2020); 13) Faber et al. (2020); 14) Faber et al. (2023); 15) Katsikadelis et al. (2014); 16) Koopman et al. (2023); 17) Loffing et al. (2021); 18) Martinent et al. (2018); 19) Nikolic et al. (2019); 20) Padulo et al. (2016); 21) Picabea et al. (2021); 22) Pion et al. (2014); 23) Pluta et al. (2020); 24) Pluta et al. (2021); 25) Pradas et al. (2021); 26) Pradas et al. (2022); 27) Robertson et al. (2018); 28) Romann et al. (2014); 29) Siener et al. (2019); 30) Widodo (2024); 31) Zhao et al. (2019)*

Figure 2. *A summary of the instruments used within the literature. The number corresponds to each article that applied such an instrument (please see 'study key' for article numbers).*

Morphological Qualities

Anthropometrics. Anthropometric measures featured in a vast majority of the reviewed studies, including skinfold assessments and subsequent body fat percentage calculations, limb circumference and length measures, body mass, BMI calculations, and somatotype considerations. However, no consensus was reached in anthropometric assessment in distinguishing talent or performance abilities. For example, whilst standing height was reported as related to performance in two studies (Nikolic et al., 2019; Pradas et al., 2021), it was unrelated in others (Djokic et al., 2017; Pion et al., 2015; Zhao et al., 2019). Likewise, somatotype was inconsistent, whereby Pluta et al. (2021) established mesomorphic somatotype of boys as better related to performance, contrary to Pradas et al. (2021) who found that the ectomorphic somatotype in boys was better related to performance. Although consistency was observed in endomorphic traits among the worst performers. Additionally, measures of the lower leg length (Zhao et al., 2019), shoulder width, and wrist circumference (Nikolic et al., 2019) were suggested as capable of distinguishing performance ability.

Maturation. Maturity status was determined to be an influential factor for success within the talent selection process, hindering the later maturing player (Coelho-e-Silva et al., 2022; Doherty et al., 2018). Coelho-e-Silva et al. (2022) identified a selection bias towards early-maturing players. Similarly, Doherty et al. (2018) acknowledged a performance dominance by average and early maturing players, over their lesser mature peers, yet acknowledged a greater development opportunity for later maturing players.

Performance Profiles

Components of Fitness. Whilst commonly investigated, only a few studies have established that components of fitness are capable of determining talent (Nikolic et al., 2019; Picabea et al., 2021; Zhao et al., 2019). Strength appears to be an influential factor, as Zhao et al. (2019) found that maximal deadlift performance is an area of sporting requirement among under-15 and under-16 athletes, and Siener & Hohmann (2019) found the push-up to be a highly significant test-related measure of performance. However, conflicting findings were noted, with Nikolic et al. (2019) reporting significant findings in jumping activities (triple and horizontal jumps), strength endurance tests (sit-ups and push-ups), the 5m sprint test, medicine ball throw, slalom run, and the multi-stage fitness test in young females. Whereas wider research found non-significant findings in push-ups (Pion et al., 2015), sit-up (Siener & Hohmann, 2019), horizontal jump (Pion et al., 2015; Siener & Hohmann, 2019), 5m sprint (Pion et al., 2015), and the multi-stage fitness test in elite youth males (Pion et al., 2015). Likewise, Faber, Pion, Munivrana, Faber, & Nijhuis-Van der Sanden (2018) found that physical ability was inversely related to distinguishing primary-age talented players.

Perceptual-Motor Skills. The requirement to read the environment and respond with appropriate fine motor skills has been consistently reported as a key quality of table tennis in the literature. The Dutch Motor Skills Assessment, comprised of eight motor skill assessments (sprint, change of direction[1], vertical jump, speed whilst dribbling,

[1] The original authors term this as an assessment of 'agility'. However, given that this is a predetermined task lacking a reactive component, its classification would fall within a 'change of direction' task.

aiming at a target, ball skills, throwing a ball, and eye-hand coordination) has been heavily implemented using either part (Doherty et al., 2018; Faber et al., 2014), or the whole of the assessment battery (Abazi et al., 2023; Faber, Elferink-Gemser, et al., 2016; Faber et al., 2015, 2017b, 2018). The synthesis of findings generally established that the 'ball-oriented' tasks (speed whilst dribbling, aiming at a target, ball skills, throwing a ball, and eye-hand coordination) are consistent in distinguishing talent across a range of populations. Whereas conflicting findings have been reported in the 'physical assessments' (vertical jump, sprint, and change of direction tests), with primary-aged children outscoring national talent pathway players (low potential) in the sprint and change of direction tests (Faber et al., 2018).

In addition to the Dutch Motor Skills Assessment, perceptual-motor skills were established in tasks assessing backward balance (Pion et al., 2015), jumping sideways (Robertson et al., 2018; Siener & Hohmann, 2019), jumping backward (Nikolic et al., 2019), moving sideways (Nikolic et al., 2019; Pion et al., 2015) and juggling matchsticks (Nikolic et al., 2019). However, the validity of such assessments remains unknown, which challenges their use. Reaction tests have shown promise in distinguishing the performance of athletes (Katsikadelis et al., 2014; Padulo et al., 2015; Pluta et al., 2020), with methods developed to assess athletes with high reliability further (Widodo, 2024).

Psychometric Evaluation. Only two of the 31 included studies directly investigated psychological qualities (Doherty et al., 2018; Martinent et al., 2018). Psychometric evaluation was used to assess performance ability and identify potential dropouts (while not directly associated with talent identification, understanding barriers to participation/performance is a relevant topic for enhancing talent development). Research by Doherty et al. (2018) noted that positive refocusing, evaluation, and self-monitoring (two components of self-regulation) were performance characteristics. The authors noted that the outcomes were contradictory: evaluation (positively associated) and self-monitoring (negatively associated) showed different associations with performance. Additionally, motivation was established as a further quality related to performance by Martinent et al. (2018). Interestingly, this contradicts the findings of Doherty et al. (2018), who found no associations between motivation (or amotivation) and performance. Dropout was also investigated, revealing that sport devaluation and disengagement-oriented coping were influential factors (Martinent et al., 2018).

Player Characteristics

Training History. Training history was found to be a determinant of performance in four studies. Whilst of little surprise, the accumulation of time involved in the sport was linked to an expected higher performance and competition participation (Doherty et al., 2018; Elferink-Gemser et al., 2018; Faber, Elferink-Gemser, et al., 2016; Koopmann et al., 2023). In particular, Elferink-Gemser et al., (2018) linked enhanced cognitive function (which was associated with performance) as a byproduct of greater exposure to table tennis. Likewise, coaches' perceptions of talent consider training age as a confounding factor within their selection criteria (Koopmann et al., 2023).

Handedness. Several studies investigated handedness, with only one study highlighting

an over-representation of left-handed players within table tennis, due to a perceived performance advantage (Loffing & Schorer, 2021). However, Djokic et al. (2017) challenged such findings, highlighting performance dominance among right-handed players and overall questioning the use and reliability of assessing handedness within the talent identification protocol for table tennis.

Birth Date Distribution. Five studies explored the effect of birth distribution and reported a relative age effect (RAE) (Bilgiç & Güvenç, 2024; Faber, Liu, et al., 2020; Faber, Martinent, et al., 2020; Loffing & Schorer, 2021; Romann & Fuchslocher, 2014). However, the findings were conflicting, given that both a traditional RAE was reported in senior females (Loffing & Schorer, 2021) senior males (Faber, Martinent, et al., 2020), and combined (Bilgiç & Güvenç, 2024), whereas a reverse RAE (Romann & Fuchslocher, 2014) was reported in recreational and talent pathway females.

DISCUSSION

This study set out to determine the current assessments and processes utilized to identify talent in table tennis. A synthesis of the literature established three focal areas in table tennis TID initiatives: *Morphological Qualities*, *Performance Profiles*, and *Player Characteristics*. A key finding highlighted inconsistencies and inconclusive findings, alongside a lack of longitudinal design and the emphasis on cross-sectional design. Whilst a positive observation noted a broad multidimensional assessment (as opposed to unidimensional), the overall findings challenge the use of current applications in talent identification, underscoring the need for longitudinal research designs. Additionally, it was evident that maturational assessment (and subsequent corrections for athlete comparison) is an important consideration, given both its probable and established high influence within many of the protocols currently used.

When considering the morphological qualities of table tennis, no consensus emerged regarding specific anthropometric advantages. Therefore, it is apparent that height, weight, and somatotype currently offer inconsistent reporting towards sporting transfer. Whilst various limb length measures (wrist circumference and shoulder width) were suggested to determine performance ability by Nikolic et al. (2019), the low-quality score of the study (58%) challenges the reliability of these findings. Likewise, lower limb length was also noted as a discriminative variable of performance by Zhao et al. (2019). Conversely, it may be speculated that these findings are directly related to maturational status, given that wrist bone formation (Flores-Mir et al., 2006; Freitas et al., 2024; Poortmans et al., 2005) and lower leg bone length (Hattori et al., 2011; Zhang & Li, 2015) are associated with bone age measurements. Lower leg bone length, in particular, has been established as peaking in growth just prior to the growth spurt, represented as peak height velocity (PHV) (Hattori et al., 2011; Zhang & Li, 2015), eluding individuals with larger relative growth will likely be more advanced in maturation. Therefore, it is logical to assume that such distinguishable landmarks may serve as proxies for maturation status.

Further to the above, it was recognized that young players exhibiting advanced physical development (i.e., early maturation) are likely to be selected over their less developed peers due to their athletic prowess

(Coelho-e-Silva et al., 2022; Doherty et al., 2018). Athletes approaching critical stages of maturation, namely the timing of PHV, will exhibit substantial increases in muscular size and force production, which are inherent to physiological development (Cumming et al., 2017). However, the onset of maturation is unique to individuals, with some entering puberty earlier than average and others later (Bradley et al., 2019; Malina et al., 2005). This highlights why biological age (typically modeling growth curves to account for somatic characteristics) is critical to attain within youth athletes, as players of a similar chronological age (age from birth) may have dramatic differences in biological age, with reports of as much as 5 years in difference (Bradley et al., 2019). In contrast, when comparing athletes' performance pre- and post-PHV, or directly associated with biological age, large variance in physical performance has been reported across maturational status, favoring the early maturers (Johnson et al., 2017; Kite et al., 2023; Patel et al., 2020). Moreover, whilst early-maturing athletes may initially thrive on athletic prowess, these advantages are neutralized once their average- and later-maturing peers 'catch up' (Cumming et al., 2017). Therefore, caution must be applied when comparing components of fitness test outcomes, as well as anthropometry, without controlling for maturational influences.

It has also been suggested that later-maturing players may need to adopt additional strategies to 'survive' training and selection processes. Due to such heightened coping demands, a common trait enhanced in later maturing players is mental resilience (Cumming et al., 2018). Previous reports have highlighted such psychological qualities as essential to subsequent success (Collins, MacNamara, et al., 2016; Collins, Macnamara, et al., 2016), which perhaps emphasizes how later maturing peers may flourish beyond the maturation process. This longitudinal advantage was acknowledged by Doherty et al., (2018), demonstrating positive recognition of maturational impact within table tennis talent development, further supporting why maturation assessment (and allometric scaling) is important within TID processes.

Regarding *Performance Profiles*, three areas emerged considering physical assessment, perceptual-motor abilities, and psychological qualities. Limited and conflicting findings were observed regarding the use of physical assessments, which may be partly explained by variations in the recruited sample groups across studies. Nikolic et al., (2019) used under-11-aged female players, whilst Pion et al. (2015) used under-18-aged male players. The differing sexes and wide age ranges may suggest different assessment needs, dependent on sex, age, and time spent in the sport. Furthermore, it is key to highlight that the sample size used by Pion et al. (2015) was arguably insufficient to distinguish variations (n = 6), further questioning the reliability of these findings. Likewise, the utility of under-11-year-old players introduces the high probability of maturation influencing performance (e.g., failing to distinguish performances biased by advanced maturational status).

Further research investigating physical performance testing was undertaken by Zhao et al. (2019), who assessed maximal strength via a deadlift assessment to determine performance abilities in 15 to 16-year-olds. The findings reported that the lower back strength of table tennis players was greater than that of other assessed sports (fencing, basketball,

volleyball, judo, and swimming). However, it is unclear how this conclusion was established, given that the study presented average loads that were lower than those of all the other sports (bar one). Without further clarity of such results, back strength remains inconclusive as a determinant of table tennis ability. Regardless, future TID protocols may consider using strength testing, although such assessments may have a low probability of predicting talent potential, they have uses beyond identification and extend into long-term talent development. For example, Isometric hand grip tests have been associated with technical and sporting ability (Picabea et al., 2021; Pradas et al., 2022; Sari et al., 2020), potentially further explaining why wrist circumference was found as a distinguishing factor in this study (Nikolic et al., 2019) (i.e., greater wrist strength is synonymous with greater muscle cross-sectional area). Other strength tests are beneficial for long-term development, which may further increase the likelihood of identifying and mitigating injury. Therefore, given the broader benefits of strength assessments and the current lack of their application in the table tennis literature, further research and TID initiatives should include relevant strength assessments.

A notable observation in the physical assessment is the choice of assessments used. For example, a 5m sprint assessment likely demonstrates good ecological validity with table tennis performance, yet is problematic as an assessment. Starting distance has been demonstrated to influence 5m sprint times significantly (Altmann et al., 2015), because of the measuring device (Bezodis et al., 2012). Therefore, greater attention should be paid to the reliability and validity of the selected assessments. Conversely, it was apparent that change-of-direction assessments were lacking (or yielded less informative outcomes), which may warrant further research. Therefore, it may be of interest to further investigate the use of 10m linear sprints (in place of 5m) to enhance validity, and the use of assessments such as the 505 change of direction assessment (or modified variants), whereby both components can be used to calculate 505 deficit, a measure of turning time (Nimphius et al., 2016). This metric offers training direction, performance information, and potential TID-related inputs.

Whilst the above-mentioned findings are largely inconclusive, the inclusion of physical assessments should arguably remain within TID protocols. The clear quantification of abilities typically provides useful information on thresholds of physical ability in table tennis, further informing practitioners of each athlete's unique areas for development and enabling long-term tracking of physical performance trajectories. However, the influence of maturation on physical abilities is well reported, and practitioners should be cognisant of controlling for this where possible (e.g., allometric scaling). Overall, given the limited literature found in this search, more work is needed better to understand physical assessment in table tennis and TID.

A more promising area of research was noted in perceptual-motor assessments. Perceptual-motor skills differ from perceptual-cognitive skills, whereby the former focuses more on motor pattern learning and skill acquisition, contrary to the latter, which examines areas such as anticipation and decision-making abilities (Williams & Ericsson, 2005). In the instance of table tennis, the Dutch motor skills assessment was a prominent instrument applied in several

studies (Abazi et al., 2023; Doherty et al., 2018; Faber et al., 2015; Robertson et al., 2018). A criticism of the Dutch motor skills assessment is that only a few items were found to identify talent, suggesting that the assessment as a whole may be helpful but not necessary. One issue with the assessment of perceptual-motor and perceptual-cognitive skills is the basis upon which they are built, namely, an athlete's familiarity with the decisions based upon previous experiences (Williams et al., 2011; Williams & Ericsson, 2005). For instance, it has been reported in the literature (Elferink-Gemser et al., 2018), that athletes with greater exposure to table tennis environments and the demands of the sport will develop and exhibit higher levels of perceptual-cognitive abilities. Therefore, whilst the assessment of perceptual-cognitive abilities may be capable of distinguishing performance standards, it may not be a tool that can adequately distinguish talent potential (i.e., those likely to possess expert skills in the future).

Minimal findings were established with regard to psychometric evaluation, with contradicting findings observed by both Doherty et al. (2018) and Martinent et al. (2018). Doherty et al. (2018) acknowledged contradictory findings between 'evaluation' and 'self-monitoring' within their study, whereas Martinent et al. (2018) deemed 'motivation' as both unrelated and related to performance. Again, such findings may be due to the age disparities between studies, with the use of junior-aged players (Doherty et al., 2018), and 11 to 19-year-old players (Martinent et al., 2018). Moreover, whilst psychological qualities are likely an important aspect of performance (especially given the relation to cognitive tasks as discussed above), further research is required to establish associations within TID. Given the breadth of research that highlights the need for holistic assessment (Baker et al., 2018; Johnston et al., 2018; Lloyd et al., 2016; Vaeyens et al., 2008), such pursuits would appear worthwhile.

When reviewing *Player Characteristics,* few meaningful results were established. Handedness appeared as a potential factor in performance, whereby left-handed players have been perceived to exhibit an advantage. Yet, these beliefs were unsubstantiated within the literature findings (Loffing & Schorer, 2021). Therefore, it is apparent that handedness does not confer any advantage in performance. Additionally, it was determined that accumulated time spent within the sport was directly related to performance, as expected. Athletes who have been afforded systematic development would be expected to exhibit a progression in abilities. This brings about its own issues when considering the use of TID, specifically the new recruitment of athletes (i.e., talent detection). The use of assessments with high sport specificity will therefore be biased towards athletes with previous sporting exposure, and needs to ensure that assessments are not biased in favor of those with sporting experience (as highlighted in perceptual-motor and cognitive skill assessments).

In this study, the birth distribution bias, otherwise known as the relative age effect (RAE), was inconclusive, as both a reverse and a traditional direction of RAE were observed. RAE observes the timing of birth in a calendar year and the consideration of cut-off dates within the sporting calendar. In the U.K. academic calendar, individuals born in September would be almost a year older than those born in August, yet competing within

the same age category. Beliefs of relative age advantages include the benefit of greater physical and cognitive development (Hill et al., 2020; Towlson et al., 2021). However, the constructs of somatic maturation and RAE should be viewed separately (Hill et al., 2020; Malina et al., 2019; Towlson et al., 2021). Given that maturational timing can significantly vary (as discussed above) (Malina et al., 2019), assumptions about maturation based on birth timing are flawed. Moreover, maturation should be assessed independently and used in conjunction with talent identification assessment and talent development tracking. In contrast, RAE may be worthwhile to track to determine whether this is a constructed bias on the part of selectors.

Moreover, at present, the investigation into Player Characteristics has utilized limited inputs. Learning from other research in TID, it may be of interest to further explore an athlete's wider sporting history (MacNamara & Collins, 2015), or even extend explorations to acknowledge parent and sibling sporting endeavors (Koch & Krenn, 2021; Tranckle & Cushion, 2006). It may be of further interest to understand the effectiveness of talent transfer, such as in other racquet sports, and how this may aid player history information.

Limitations of the Literature

A contentious issue highlighted throughout the reviewed literature is the sheer lack of longitudinal assessment. Reports have highlighted how utilizing cross-sectional designs to measure and compare talented players with less talented players is problematic, and instead, change over time (e.g., monitoring performance trajectory) is likely more informative to identify talent (Baker et al., 2018; Till & Baker, 2020; Vaeyens et al., 2008; Williams et al., 2020). Of the 31 studies reviewed, 8 used a longitudinal approach. Future research should be mindful of the issues raised, and whilst longitudinal research designs are inherently challenging to complete (with considerations for drop-out, ongoing participant access, etc.), the outcomes provided are potentially more informative for accurate talent assessment.

Sample size and characteristics are further areas of challenge throughout the literature. Studies have reported small sample sizes (e.g., one study with 6 participants), casting doubt on the statistical findings. Likewise, when considering the sample characteristics, there has been a disparity in methods accounting for sex differences, with current results typically exhibiting either singular sex or mixed-sex outcomes. Understanding sex-specific criteria is highly informative, given the probable variations in abilities. Likewise, ages have ranged from youth to senior age. However, without further research to investigate these potential variations, development plans and performance assessments will likely remain generic across age and sex, potentially increasing the risk of misidentification. Therefore, caution must be taken when comparing non-homogeneous groups, whereby research has reported participants by a variation of different standards (e.g., school students, recreational, national, talent pathway athletes, regional, etc.) and nations (China, Poland, France, Scotland, etc.), which must account for the differing player demands and needs.

Practical Applications

In light of this study's findings, several recommendations can be made to support TID initiatives in table tennis. Given that ta-

ble tennis has highlighted a focus on young players near the average age of PHV (boys = 13.8 yrs; girls = 11.9 yrs) (Cumming et al., 2017), and an acknowledgement of a potential maturational bias, a direction for talent identification initiatives in table tennis would be for the inclusion of maturation assessment and the use of allometric scaling (accounting for maturation) where appropriate. Whilst a range of non-invasive, simple-to-administer somatic maturation prediction equations exist, practitioners should be both cautious and diligent when choosing the methods used to assess maturity status. Whilst beyond the scope of this paper, readers are referred to research by Malina et al. (Kozieł & Malina, 2018; Malina et al., 2006, 2007, 2015) that discusses the benefits and limitations of various simple, non-invasive methods of assessing maturation.

The present findings may offer insights towards TID initiatives, accounting for sex and age variations and performance expectations. Whilst merely speculative, TID programs emphasizing 'talent detection' – the detection of new players not currently participating in the sport (anticipated to be from early ages), who may benefit from specific components of fitness tests, psychometric assessments of motivation, as per findings by Martinent et al. (2018), and various perceptual-motor assessments (Faber et al., 2015). Conversely, TID programs that emphasize talent selection – the selection of currently competitive players into performance pathway squads (anticipated older ages), may benefit more from the application of more longitudinal assessment of holistic performance, over isolated assessments of abilities, as per TID research insights (Vaeyens et al., 2008). Further understanding is required to distinguish sex differences. Given the inconsistency in testing outcomes or poor-quality scores presented in articles, specific test recommendations are unknown and warrant further research.

Study Limitations

This study is not without its limitations. One such limitation is the restriction on the sources used to collect literature, thereby neglecting the use of grey literature. Furthermore, it may be suggested that a broader range of databases is used in future research to ensure a full breadth of literature is attained. In summary, whilst best efforts were made to obtain relevant literature through resources accessible to the authors, the use of additional grey literature and databases may have further aided the collection of literature. Finally, given that some of the studies were determined as poor-quality (exhibiting a score <50%) (i.e., Djokic et al. 2017; Romann & Fuchslocher, 2014), this may challenge the established findings for the broader population.

CONCLUSION

The literature review on the processes for identifying talented table tennis players yielded a wealth of conflicting findings. Multifaceted assessments are required to identify talented players, yet the current findings reveal disparities by age and ability. However, selection bias was acknowledged and must be accounted for, namely, within maturational assessment. Moreover, further investigation is required to fully understand the holistic needs of table tennis players, using longitudinal research designs and isolating age groups and sex more clearly, to better distinguish talent for both detection and selection purposes.

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