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Editorial

Luca Santilli & Miguel Crespo

Tennis Development, Development Department, International Tennis Federation, London, UK.

Welcome to the 95th edition of the ITF Coaching & Sport Science Review, the inaugural issue of 2025, celebrating 33 years of publication. This issue offers a wide array of articles on different topics, such as exploring the relationships between parents and coaches in youth tennis, strategies for mental skills and tools, assessing the benefits of modified tennis for adult beginners, a framework for evaluating player competencies, integrating English and tennis in primary education, the impact of neuromuscular fatigue on leg explosive strength, specialized strengthening techniques for tennis players, participation in masters tennis by Turkish women, and the validation of the ITF WTN on-court assessment.

In this editorial we will highlight several relevant initiatives that the ITF is implementing to facilitate the delivery of efficient tennis development programmes globally. These initiatives include the ITF World Coaches Conference, coaches' education system and national tennis centre recognitions, Advantage All events, ITF World Tennis Number updates, the Grand Slam Player Development Programme and the ITF Touring teams.

LITHUANIA TO HOST THE 2025 ITF WORLD COACHES CONFERENCE

The 2025 ITF World Coaches Conference – the showpiece event of the ITF's Coach Education Programme – will take place in Lithuania from 29-31 October 2025. The biennial event, which will be held at the SEB Arena in Vilnius, is being organized by the ITF in conjunction with the national tennis association and a regional tennis organization. The three-day in-person conference, which regularly attracts more than 600 coaches and speakers from over 90 nations around the world, will bring together leading international experts in coach education, player performance, and sport science. This event will follow the success of the last ITF World Coaches Conference held in Colombia (Santilli & Crespo, 2023a).

Global tennis development, growing the game, and bettering the sport for future generations is an integral purpose of the ITF, and education is a key pillar of the ITF's development strategy. The ITF's mission is to raise standards across the board and ensure a global footprint of top-quality coaching around the world, which is why the ITF World Coaches Conference is such a significant event. This is another key event offered by the ITF to engage coaches in continuous professional development and education (Hannays, 2020).

The experts at the conference will present on the latest developments in their fields through a series of practical on-court demonstrations and off-court presentations. The presentations will be delivered in English only. Speakers at past events have included Grand Slam champions, touring coaches, and tennis specialists. These experts have shared their knowledge and experience with those in attendance. Registration and details of the 2025 ITF WCC are available at the official event website, which can be accessed here.

Returning to Europe for the first time since the 2017 edition, Lithuania has demonstrated an outstanding commitment to tennis development over the years. Their success in cultivating players and coaches and hosting competitions aligns with the ITF's strategic focus on player development, participation, and education. The ITF has acknowledged Lithuania's tireless efforts to elevate their tennis standards, and hosting the ITF World Coaches Conference is a testament to these efforts. The ITF Global Tennis Report 2024 (ITF, 2024a) highlights Lithuania's impressive growth in the number of players and coaches, with a notable increase in female engagement since 2019. These successes in participation, education, long-term player development, and organizing top-tier major events showcase their ongoing commitment to advancing tennis in the country.

The Lithuania Tennis Association has expressed happiness and pride in being chosen as the host for such an important event as the ITF World Coaches Conference.

As it is the case for the previous ITF World Coaches Conference, the videos of the presentations will be uploaded in the ITF Academy (ITF, 2024).

ITF'S RECOGNITION OF COACH EDUCATION SYSTEMS OF NATIONAL ASSOCIATIONS

The aim of the ITF's Recognition of Coach Education Systems program is to ensure that the coach education being conducted in our member countries meets minimum standards (ITF, 2025c).

ITF recognition is based on criteria and minimum standards for coach education that were established by the ITF Task Force on Coach Education and subsequently approved by the ITF Coaches' Commission and the ITF Board of Directors (Crespo & van de Braam, 2011). To be recognized by the ITF's Recognition of Coach Education Systems, nations must meet specific criteria across four levels: Gold, Silver, Bronze, and White. These criteria include having a dedicated coach education department, qualified directors and tutors, and following ITF-approved syllabi with specified minimum contact hours. Nations must also provide supporting materials in the national language, maintain a register of certified coaches, and ensure continuous professional development through workshops and mandatory ITF Academy membership. Higher levels of recognition require more advanced coaching programs, access to sports science expertise, and evidence of a licensing program for coaches. Regular tutor training and adherence to ITF standards are essential for all levels (ITF, 2025a).

Countries must provide the ITF with specific information in advance, and then an ITF assessor conducts a 2-day visit to the country in question. During this visit, the Director of Coach Education can explain the system they have in place and can demonstrate all the resources and learning tools used in their program. As of 5 March 2025, countries recognized at the Gold Level include 18 nations from Europe, 4 from the Americas, and 1 from Africa, totalling 23 countries. At the Silver Level, there are 4 countries from Europe, 4 from Asia, 1 from Oceania, and 1 from the Americas, making a total of 10 countries. The Bronze Level includes 5 countries from Europe, 10 from Asia, 1 from Oceania, 1 from Africa, and 7 from the Americas, totalling 24 countries. Finally, the White Level features 7 countries from Africa, 17 from Asia, and 2 from the Americas, totalling 26 countries. In total, there are 83 countries recognized across all levels.

ADVANTAGE ALL WEBINAR ON WOMEN IN COACHING

During an officiating seminar at the Paris 2024 Olympic Games, ITF President David Haggerty emphasized the need for more female coaches to address the imbalance between girls and boys turning professional. He highlighted that increasing the number of women coaches would encourage more girls to stay in the sport and pursue their dreams. The 2024 Global Tennis Report showed progress, with the percentage of female coaches rising to 24.3% from 20.6% in 2019, marking a significant step towards equitable representation in leadership roles. Despite this progress, the ITF remains committed to advancing gender equality and creating a more inclusive future for tennis globally (Masunga & Ancalmo, 2024).

The first ITF Advantage All webinar of 2025 focused on women in coaching, particularly in Oceania, featuring representatives from Tennis Australia, Tennis New Zealand, and the Solomon Islands Tennis Association. The webinar discussed various initiatives aimed at increasing the number of women coaches at different levels. For instance, Tennis Australia reported a record 1138 women coaches, a 55% increase over five years, with efforts to elevate more women to high-performance coaching roles. Tennis New Zealand highlighted the impact of the Wahine Scholarship and the importance of mentors in converting volunteer coaches to professional ranks in line with previous studies (Johnston et al., 2022). The Solomon Islands Tennis Association shared their approach to supporting young female players and increasing female participation through coach education.

The ITF Advantage All initiative, part of the ITF's gender equality strategy, aims to develop tennis as an equal advantage sport, empowering women and girls to reach their full potential. The initiative includes the ITF Advantage All Reward & Recognition Programme, which acknowledges gender equality efforts by member nations that enhance women's participation in tennis through coaching, officiating, and leadership roles (ITF, 2024c). The webinar, titled 'Empowering Women Coaches and Achieving Gender Equality in Oceania Tennis,' is available on the ITF Academy and serves as a valuable resource for those interested in promoting gender equality in tennis.

ITF'S NATIONAL TRAINING CENTRE RECOGNITION PROGRAMME

The International Tennis Federation (ITF) is dedicated to advancing global tennis development, focusing on performance, participation, education, facilities, events, and administration & resources. Since 2017, the ITF has invested over $50 million in these areas, aiming to enhance the sport for future generations (Santilli & Crespo, 2023b). A significant part of this effort involves supporting under-resourced tennis nations, and the ITF's National Training Centre Recognition Programme is a universal initiative designed to raise standards globally.

In 2018, the ITF established criteria for National Training Centres, recognizing them at Gold, Silver, Bronze, or White levels. This accreditation aims to elevate standards in facilities, coaching, and training, fostering the growth and prosperity of tennis worldwide. By the end of 2023, seven nations had their facilities recognized through this programme, including France, USA, Great Britain, Colombia, Lithuania, Hong Kong, and Qatar. As of early 2025, 22 nations have achieved recognition, with the ITF striving to increase this number and improve facility standards globally (ITF, 2024b).

During 2024, 15 additional nations were recognized, with Canada, Netherlands, and Switzerland achieving Gold-level recognition, Tunisia receiving Bronze-level recognition, and 11 other centres awarded White recognition. This demonstrates progress not only in major tennis-playing nations but also in smaller countries. Mauritius, for instance, became the first African nation to have its National Training Centre recognized, earning the ITF Development Award in April.

The programme's objectives are assisting more players and providing quality training environments. The growth achieved in 2024, both in the number of recognized facilities and ongoing applications, has been promising. The ITF aims to establish a global network of training centres by 2028 that nations can

be proud of, supporting player and coach development to the highest standards.

Applicant nations to the ITF's National Training Centre Recognition Programme must provide documentary evidence and undergo reviews to ensure systems and procedures are in place across six areas: facilities and equipment, management, integrity, coaching team, sports science & medicine, and player programmes. The ITF also supports developing tennis nations through Facility Grants, visits from Development Officers and experts, and ITF-approved materials for running effective National Training Centres. National Associations interested in the programme can seek further information from the ITF's Development Officer for their region.

ITF'S WORLD TENNIS NUMBER (WTN)

The ITF's WTN rating will become one of the singles acceptance criteria for ITF World Tennis Tour events from next month. It will become the third measure of acceptance into tournaments, used after all players with a WTA/ATP Singles Ranking and an ITF World Tennis Ranking have been accepted.

The first tournaments implementing the updated criteria will take place in the week of 21 April 2025. This change will therefore apply to any entry deadline on or after 3 April.

The order of singles acceptance criteria for ITF World Tennis Tour events will be:

- Players with a WTA (women) or ATP (men) Singles Ranking
- Players with an ITF World Tennis Ranking
- Players with a verified singles ITF World Tennis Number
- Players with a Top 500 National Ranking
- Unranked players

The WTN is a global rating system that forms a key part of the ITF's global digital strategy (ITF, 2025b). It was developed by the global governing body in collaboration with National Associations. It provides a dynamic and accurate measure of a player's current playing ability, recognizing and rewarding performance at both national and international levels. This innovative rating system has received considerable attention from researchers since its launch (Im & Lee, 2023; Krall et al., 2024).

For entry into ITF World Tennis Tour tournaments, a player must hold a verified singles WTN. "Verified" corresponds to a confidence level of 70% or higher, meaning that sufficient results data has been recorded for an accurate rating. A player's WTN as of the Monday before the entry deadline will be used (where necessary) for acceptance purposes (WTNs are updated weekly). WTNs will be applied to two decimal places (e.g. 16.49 is better than 16.50). WTN will not initially be used for doubles acceptance or for seeding purposes.

The ITF World Tennis Tour is the main artery that delivers players to the top of the game, providing a sustainable pathway for current and future generations of female and male talent to fulfil their potential. Tournament results contribute to WTA and ATP rankings, helping players progress to higher-level competitions on the WTA Tour, ATP Tour, and at the Grand Slams. The introduction of WTN as an acceptance method into the World Tennis Tour will enhance accessibility to the professional player pathway. The World Tennis Tour is usually the first step in the professional careers of players. This update aligns with the ITF's commitment to improve competitive opportunities for players on a global scale based on skill and performance. The introduction of the WTN as part of the ITF World Tennis Tour Singles Acceptance Criteria reinforces its value as a consistent and accurate measure of playing ability, already trusted in ITF World Tennis Tour Juniors and ITF Masters Tours. The WTN is a central component not only of the ITF's mission to enhance the competitive pathway and increase global recreational participation, but also of ITF's digital strategy, with a vision to create the biggest, most thriving, and passionate online tennis community in the world. Therefore, the use of the WTN as the third acceptance criteria for WTT events moving forward promotes an accessible and transparent pathway for players seeking professional tennis opportunities.

GRAND SLAM PLAYER DEVELOPMENT PROGRAMME

For the 2025 season, 56 junior and professional players will benefit from Grand Slam Player Grants, courtesy of the Grand Slam Player Development Programme. This initiative, established in 1986 by the four Grand Slam tournaments in collaboration with the ITF, aims to provide players from developing tennis nations and regions with enhanced access to international competitive pathways, including the Grand Slams. Since its inception, the programme has contributed over US$62 million to bolster player development globally.

The programme's influence is evident, with 61 former and current grant recipients—31 men and 26 women—participating in the Australian Open's singles competitions this year. This support underscores the programme's role in nurturing emerging talent and facilitating their progression to higher levels of competition.

Two players will receive grants of $50,000 each to assist with their competition-related expenses, while 45 players will receive $25,000 each, and nine players will receive $12,500 each. Administered by the ITF on behalf of the Grand Slams, the GSPDP oversees all aspects of the programme, including the nomination of grant recipients. Eligibility for these grants is based on age, gender, and ranking, with junior grants available to girls aged 14-17 and boys aged 15-18, and professional grants open to women aged 18-21 and men aged 19-22.

In 2024, five recipients of the GSPDP grants achieved Top 100 rankings, highlighting the programme's effectiveness in supporting emerging talent. The Grand Slam Board expressed pride in investing in these players' development and congratulated the 2025 grant recipients. The ITF President emphasized the importance of this initiative in the ITF's long-term player development strategy, which aims to create opportunities and provide support for athletes. By collaborating with the Grand Slam tournaments, the programme helps advance the global growth of tennis and ensures that emerging talents have the platform to realize their full potential. The continued success of former and current grant recipients in premier events underscores the programme's impact on shaping the future of tennis.

ITF TOURING TEAM

Each year, the ITF invites groups of talented young players from less-developed tennis nations to join the Grand Slam Player Development Programme/ITF Touring Teams. These players, all aged 18 and under, embark on meticulously planned tours

where they receive guidance from high-performance coaches and compete in events beyond their home regions. This initiative, funded by the Grand Slam Player Development Programme and managed by the ITF, provides opportunities that these players might not otherwise have, allowing them to compete at a high level.

The Touring Team programme, which began in 1987 with the support of the four Grand Slams, aims to expose players from developing tennis nations to the world's top junior tournaments (Molina, 2017). This initiative is crucial for player development both on and off the court, helping young athletes transition to the professional game. In 2025, the Touring Team will travel globally, participating in ITF World Tennis Tour events, under-18 junior competitions, and top-level under-14 regional and international events.

In January, the Touring Team was in Australia, featuring players such as Oskari Paldanius, William Vinciguerra, Kriish Tyagi, Karim Bennani, Mika Buchnik, Elizara Yaneva, Rositsa Dencheva, and Teodora Kostovic. Coaches Roberta Burzagli and Will Hann are leading the team. Their schedule included a training camp in Traralgon, competition at J300 Traralgon, and participation in the Australian Open Junior Championships.

Many players who have been part of the Touring Teams have gone on to achieve significant success, with several reaching the Top 50 in ATP and WTA rankings. Notable alumni include Zhang Shuai, Sorana Cirstea, Victoria Azarenka, Simona Halep, Ons Jabeur, Grigor Dimitrov, and Sebastian Baez. This programme continues to play a vital role in developing future tennis stars and providing them with the platform to excel on the global stage.

We trust you have found this editorial insightful. It aims to showcase some of the initiatives the ITF is undertaking to promote tennis globally.

We also invite new submissions to the ITF CSSR via the platform. Our gratitude goes out to all the authors for their contributions and to everyone who submitted proposals. Detailed guidelines for article acceptance and publication are available on the platform and the latest issue page of the ITF Academy. We hope you enjoy this final edition of the ITF Coaching and Sport Science Review.

REFERENCES

Crespo, M., & van de Braam, M. (2011). The ITF recognition of coaches education systems of National Associations. ITF Coaching & Sport Science Review, 19(54), 17–20. https://doi.org/10.52383/itfcoaching.v19i54.536

Hannays, K. A. (2020). Attitudes of tennis coaches towards continuous education – a Caribbean perspective. ITF Coaching & Sport Science Review, 28(80), 12–15. https://doi.org/10.52383/itfcoaching.v28i80.62

Im, S., & Lee, C.-H. (2023). World Tennis Number. The new gold standard, or a failure. ITF Coaching & Sport Science Review, 30(91), 6–12.

ITF. (2024). ITF Academy. Https://Www.Itf-Academy.Com

ITF. (2024a). ITF Global Tennis Report.

ITF. (2024b). National Training Centre (NTC) Recognition Programme Quick Guide.

ITF. (2024c). The ITF's Gender Equality Strategy. Https://Www.Itftennis.Com/En/about-Us/Governance/Advantage-All/

ITF. (2025a). ITF Criteria for Recognition of Coach Education Systems of National Associations. Https://Www.Itftennis.Com/Media/2237/Recognition-of-Coach-Education-Systems-1.Pdf

ITF. (2025b, March 5). ITF World Tennis Number. Https://Worldtennisnumber.Com/.

ITF. (2025c, March 21). ITF Recognition of Coach Education Systems of National Associations. Https://Www.Itftennis.Com/En/News-and-Media/Articles/Itf-Recognition-of-Coach-Education-Systems/

Johnston, M., Naylor, M., Campbell, A., Fitzmaurice, J., & Ferkins, L. (2022). The female-friendliness of New Zealand's tennis clubs. ITF Coaching & Sport Science Review, 30(87), 28–33. https://doi.org/10.52383/itfcoaching.v30i87.342

Krall, N., Maroulis, N., Mayew, R. L., & Mayew, W. J. (2024). Initial evidence on the impact of the 2023 World Tennis Number algorithm change for predicting match outcomes. ITF Coaching & Sport Science Review, 32(94), 52–58. https://doi.org/https://doi.org/10.52383/itfcoaching.v32i94.559

Masunga, T., & Ancalmo, C. (2024). Female coaches' initiatives that drive the ITF Gender Equality Advantage All Strategy. ITF Coaching & Sport Science Review, 32(92), 46–50. https://doi.org/https://doi.org/10.52383/itfcoaching.v32i93.602

Molina, I. (2017). ITF/GSDF boys' teams - 30 years of history. ITF Coaching & Sport Science Review, 25(73), 12–15. https://doi.org/10.52383/itfcoaching.v25i73.299

Santilli, L., & Crespo, M. (2023a). Editorial. ITF Coaching & Sport Science Review, 30(91), 2–5.

Santilli, L., & Crespo, M. (2023b). Editorial. ITF Coaching & Sport Science Review, 30(89), 2–3.

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Understanding the Interpersonal Dynamics Between Parents and Coaches in Youth Tennis

Ella F. Tagliavini[1], Chris G. Harwood[2], Sophia Jowett[1] & Sam N. Thrower[3]

[1]School of Sport, Exercise and Health Sciences, Loughborough University. [2]Department of Sport Science, Nottingham Trent University. [3]Department of Sport, Health Sciences and Social Work, Oxford Brookes University.

ABSTRACT

Interpersonal relationships between athletes and their parents and coaches is an important factor in the success of youth sport programmes. Despite growing evidence in the parent-coach stress literature, there remains a lack of research which investigates parent-coach relationships. Therefore, a three-part research series was conducted to better understand how these relationships function within the parent-athlete-coach (PAC) triad in youth tennis. Study one employed a collective case study design and utilised pre-interview tasks, semi-structured interviews and conversational threads to collect data from nine PAC triads in three developmental stages. Study two surveyed 284 tennis parents to examine how the responsiveness and quality of parent-coach relationships mediated the association between four behavioural characteristics and parents' basic psychological needs satisfaction (BPNS) in the PAC triad. Finally, a five-phase action research study with three PAC triads was conducted to investigate how parent-coach relationships can be improved. Collectively, the findings highlighted the importance of specific parent-coach relationship qualities and behaviours within the functioning of the triad and stakeholders' experiences in youth tennis. Recommendations for practice are provided in relation to these findings.

Key words: Parent-coach relationships, youth sport, PAC triad

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Corresponding author: Ella F. Tagliavini, e.tagliavini@ucfb.ac.uk

INTRODUCTION AND LITERATURE REVIEW

It is widely known that youth sport can offer young people many physical, psychological, social and developmental benefits. Nevertheless, sport can also be a stressful and highly demanding environment. What type of experiences young athletes have is dependent upon numerous factors but perhaps one of the most important is the relationships they have with their parents and coaches. For example, high-quality coach-athlete relationships can improve participation retention, enjoyment levels and motivation (e.g., Jowett & Nezlek, 2012). On the other hand, parent-athlete relationships built on unconditional support rather than outcomes and performance levels are critical to athletes' development and success (e.g., Dohme et al., 2020). Such relationships have been found to be even more important to athletes in individual sports such as tennis (Rhind et al., 2012).

Despite the recognition and empirical attention sporting relationships have received, the relationship between parents and coaches has been less researched. This is surprising given how long applied researchers and practitioners have argued their importance within youth sport programmes (e.g., Hellstedt, 1987). In response to these claims, research in this area has grown in recent years. Initial research in this area investigated the ways parents and coaches may impact the stress of the other. A notable series of studies

by Gould and colleagues (2006; 2008; 2016) in youth tennis found parents were a salient stressor on the experiences of coaches. Coaches particularly disliked parents who became over-involved, emphasised inappropriate goals and were too performance oriented. From parents' perspectives, Harwood and Knight (2009a; 2009b) found that tennis parents experienced coach-related stressors which included coaches who failed to commit to them and their athlete, provided insufficient advice and failed to attend their child's matches.

Although these studies provided novel insights into the ways tennis parents and coaches perceive each other's involvement, these studies did not investigate the specific interdependent processes that exist between these stakeholders, nor did they explore the positive ways parents and coaches work together. Therefore, in an attempt to address these limitations, more recent research has been conducted both in tennis (i.e., Horne et al., 2020; 2022) and across other sports (i.e., Wall et al., 2019; O'Donnell et al., 2022; Preston et al., 2020). For example, Horne et al. (2020) found tennis parents and coaches experienced limited communication despite them emphasising the importance of frequent, honest communication. The authors also found that parent-coach relationships were marked with a lack of trust and goal congruence with the authors even stating that coaches experienced trepidation about engaging with parents. Horne et al. (2022) further found that parents and coaches were misaligned in the ways they viewed youth tennis programmes which had the potential to limit collaboration; promisingly, however, both stakeholders valued shared responsibility for athletic development.

Overall, it is encouraging to see researchers focussing more on parent-coach relationships. Collectively, this research has provided a greater understanding of the ways in which parents and coaches work with or against each other as well as the types of processes that may underpin more positive definitions of these relationships – an area that has been historically dominated by negative narratives and accounts (e.g., Omli & LaVoi, 2009). Nevertheless, further research is required to deepen our understanding of knowledge in this area by addressing key limitations. From a methodological perspective, a limited number of studies have utilised parents and coaches from the same relationships. This is important to address because utilising multiple stakeholder perspectives from different relationships limits our understanding of the specific relational processes that exist between people (see Poczwardowski et al., 2006). Additionally, an even smaller number of publications have contextualised the parent-coach relationship within the parent-athlete-coach (PAC) triad or taken a developmental approach. Therefore, utilising athletes' perspectives of parent-coach relationships as well as identifying the way in which these relationships operate within larger social systems across sporting pathways can provide a more contextually relevant understanding of these relationships. This is particularly important given that parental involvement, expectations and developmental goals can change as athletes transition into investment stages (Lauer et al., 2010). Finally, given the theoretical and conceptual richness of relationship science both inside (see Sheridan et al., 2014) and outside of sport (see Finkel et al., 2017), it seems reasonable to also suggest parent-coach research could benefit from employing such frameworks in a similar way.

A THREE-PART RESEARCH SERIES

To examine the nature of parent-coach relationships in youth tennis more closely, a research series consisting of three studies was conducted. Study one aimed to address a lack of research which has examined parent-athlete-coach (PAC) triads across the youth tennis pathway. Therefore, the following research question was developed: 'What do the perceptions of PAC tell us about the relational processes that underpin triadic functioning across developmental stages within British youth tennis?

The second study sought to explore parents' perceptions of their relationships with their child's coach. Specifically, the study investigated whether the quality (3Cs; Jowett, 2007) and responsiveness (Reis & Clark, 2013) of the parent-coach relationship mediated the association between four behavioural characteristics and parents' basic psychological needs satisfaction (BPNS; Ryan & Deci, 2002) in the PAC triad.

Building on the findings from the first two studies in the series and underpinned by working alliance (WA) theory (Bordin, 1979), the final study examined how tennis parents and coaches build strong alliances (defined by bond, tasks and goals) with each other. Therefore, the following question was generated: 'How can the WA be used to understand and improve parent-coach relationships in British youth tennis?'.

STUDY ONE

Method

A collective case study design was used which consisted of nine PAC triads across the U10s, U12s and U18s tennis development stages. However, triad one included two athletes whilst triad three consisted of two coaches resulting in a final sample of 29 participants (10 athletes, 10 coaches and 9 mothers). Each participant participated in a pre-interview task which asked them to provide a visual description of how their triad functioned. Participants also attended individual semi-structured interviews which lasted, on average, 70 minutes for parents and coaches and 50 minutes for athletes. Finally, conversational threads (i.e., WhatsApp messages and emails) were provided from each triad which depicted the conversational history between triad members during the three months prior to the start of the study. Abductive reflexive thematic analysis (TA; Braun & Clarke, 2019) was used to analyse the data to create a rich and detailed account of participants' experiences.

Results

Foundations of Relationship Quality

PACs frequently spoke about the importance of a number of qualities that underpinned their relationships within the triad. First, commitment reflected participants' intentions to invest in each other. For triads to function particularly well, however, participants highlighted the need to care for each other as people and not just as stakeholders. Next, trust was defined by whether participants had faith in each other's abilities to execute their responsibilities whilst respect described PACs' appreciation and receptiveness to each member's contributions to the triad. Finally, triadic functioning was also underpinned by the emotional proximity between parents and coaches. This was particularly important for younger-stage triads as it created opportunities for other relationships to develop.

Factors Enabling Team Effectiveness

Alongside specific qualities, certain factors also underpinned how well the PAC triad functioned. Realistic and shared goals that centred around athletes' development rather than rankings or match results facilitated positive functioning as it provided direction and created a mutual purpose amongst members of the triad. Additionally, collaboration was fostered when each member had clear roles but adjusted these roles to the needs and circumstances of the triad. For example,

because coaches were often absent from tournaments, parents were given more license to support athletes during tournaments and feedback relevant information to coaches. Another factor centred around providing support. Parents and coaches were the main support-providers to athletes and each other in the triad. This was operationalised, for example, offering emotional encouragement (i.e., parent support) or providing guidance and advice regarding tournament selection (i.e., coach support). Finally, participants spoke about the importance of being open to receiving and offering role-specific communication. Most communication occurred on a dyadic level due to practical issues but there were instances where participants highlighted the need to bring athletes into the conversation. This communication allowed participants to demonstrate honesty, openness and appreciation as well as allowed the triad to make decisions together. As athletes became older, they took more control for communicating their reflections and feelings with parents and coaches.

STUDY TWO

Method

An online questionnaire was deployed to youth tennis parents both inside and outside the UK. The questionnaire had a completion rate of 37.77% resulting in a final international sample of 284 parents (114 males and 170 females, Mage = 47.13, SD = 5.50). On average, parents had seven years of experience as a tennis parent and the average age of their child-athletes was 12.43 years. The questionnaire underwent an extensive review and validation process by an expert panel consisting of two external senior academics, one member of a tennis national governing body and three tennis parents. As a result and using the current coach of their child, parents were asked to rate how responsive and high-quality their parent-coach relationships were. Parents were also asked to rate how supportive, invested, collaborative and communicative they felt they and their child's coach were with each other, as well as how psychologically satisfied (i.e., BPNS) they were in their PAC triad. Responses to all measures were recorded using seven-point Likert scales (i.e., 1 = Not at all true or Strongly disagree to 7 = Completely true, Strongly agree or Very true).

Results

Initial analysis of the data suggested that parents perceived moderate to high levels of support, investment, collaboration and communication in their relationships with coaches (Mrange = 5.09 to 5.42). On average, parents perceived their parent-coach relationships to be moderately responsive (M = 5.26) and high in quality (M = 6.23), whilst they were satisfied within their PAC triads (M = 5.51). Correlational analysis further revealed significant, positive correlations between the four behavioural characteristics and responsiveness, relationship quality and BPNS (r = .70 to .83). Additionally, responsiveness, relationship quality and BPNS were also significantly and positively correlated with each other (r = .74 to .77).

A two-step structural equation modelling procedure was used to further analyse the mediation and moderation associations between the variables in this study. As a result, the findings showed that support (β = .50) and investment (β = .48) positively predicted responsiveness (R2 = .88) which, in turn, positively predicted BPNS (β = .84; R2 = .71). However, collaboration (β = -.14) and communication (β = .12) were both insignificant. Therefore, whilst responsiveness was found to be a significant and direct predictor of parents' BPNS, responsiveness also served as a mediator between support and investment with BPNS. Next, support, investment and communication positively predicted relationship quality (β = .17 to .60; R2 = .72), whilst collaboration unexpectedly showed a significant negative effect (β = -.29). In turn, relationship quality positively predicted BPNS (β = .79; R2 = .62). Relationship quality also served as a significant mediator between all four behavioural characteristics and parents' BPNS in the triad. Finally, multigroup analyses revealed invariance in these findings across parents of athletes in younger (≤12 years) and older (≥13 years) age groups.

STUDY THREE

Method

To examine how parents and coaches build and maintain relationships with each other, a 6-month action research design was employed consisting of three PAC triads. Triad one was comprised of 37-year-old Natalie, a school teacher who was the mother of 9-year-old Beverly, and Elliot, a 25-year-old LTA senior performance (Level 4) tennis coach. Natalie and Elliot believed Beverly was going through a significant transition within tennis which included playing in more competitive level tournaments (i.e., national) and older age groups. Triad two was formed by Henry who was a 10-year-old tennis player, James who was Henry's father and had five years of experience as a tennis parent, and finally, Katherine who was a 39-year-old Level 4 performance coach. Overall, the triad had been together for four months prior to the start of the study. Finally, triad three consisted of 15-year-old Sienna who was a top-50 UK tennis player. Both her parents, Nathan (father and primary parent) and Rebecca (mother and secondary parent), participated in the study and had limited experience of tennis. The final member of this triad was Sam who had been Sienna's coach for 18 months and was a 35-year-old senior performance coach (Level 4) with 18 years of tennis coaching and 28 years of playing experience.

Following full institutional approval, members of each triad were provided with a research handbook and were asked to participate in five phases. Phase one required members of the triad to individually participate in an online pre-intervention semi-structured interview to discuss the nature of their triad and parent-coach relationships. Parents and coaches were then asked to individually complete a series of three modules. Each module was accompanied by a research workbook and a pre-recorded presentation. Module one introduced participants to knowledge of parent-coach relationship in youth sport. Module two required participants to critically reflect and self-assess the behaviours and qualities in their parent-coach relationship, whilst module three then asked participants to use these self-assessments to set SMART and behaviourally relevant tasks and goals which they could action during the subsequent phases of the study.

Phases two, three and four spanned across a three-month period and required parents and coaches to meet in three formal meetings. The purpose of these meetings was for parents and coaches to jointly agree and set specific tasks and goals that they believed would improve their relationship with each other. Formal meeting (FM) one was chaired by the lead researcher but an agenda was provided to participants to allow them to lead FMs two and three themselves. Parents and coaches were also asked to provide weekly audio diaries to the lead researcher. These diaries were not

shared with participants but were used to generate 'live' data on participants' experiences within their triad. Additionally, a reflexive diary and research log was used by the lead researcher to keep an account of developing codes and themes from the data.

Finally, phase five followed a similar process to phase one in that PACs were asked to participate in a post-intervention semi-structured interview following the completion of the final FM. This was an opportunity for participants to reflect on any changes that occurred within their relationships and triad. Data from phases one and five were analysed using reflexive TA whilst data from phases two, three and four were analysed using case-specific descriptions. This was used to help identify the idiosyncratic nature and execution of participants' goals and tasks and the conversational processes of reflection, negotiation and action that ensued as a result.

Results

The Cognitive and Affective Bond Between Parents and Coaches

Two triads agreed that their parent-coach relationship had improved as a result of the study. Specifically, Nathan (Parent) and Sam (Coach) in triad three emphasised that they felt more comfortable being open and honest with each other, whilst James (Parent) and Katherine (Coach) in triad two agreed that there was a greater sense of trust and respect between them – something they felt might have taken longer to develop if they had not had the opportunity to identify, discuss and modify their behaviours and goals for each other and their relationship. Whilst Natalie (Parent) and Elliot (Coach) did not share any specific improvements to their relationship, they did express a greater sense of appreciation for each other and their relationship. This was because they found it relatively easy to identify and categorise the positive behaviours they engaged in with each other and how much 'they got right'.

Fulfilment in the Lives of Parents, Athletes and Coaches

Participants, including athletes, believed that they had experienced improvements in their lives both inside and outside of tennis. In triad three particularly, Nathan (Parent) found himself with more time for work and his wider family life, whilst Sam (Coach) had more energy and time to invest in his own personal hobbies and interests. For athletes, Sienna (T3) spoke about the improvements she had made in school because of the changes Nathan, Rebecca and Sam had made to her schedule, whilst Henry (T2) experienced greater enjoyment and performance levels as a result of Katherine's (Coach, T2) and James' (Parent, T2) collaboration.

Stronger Interpersonal Connections in the Triad

Participants also discussed improvements to the relationships they had with each other in the triad more broadly. Notably, Natalie (Parent, T1) and Beverly (Athlete, T1) felt that they were able to bond more because Natalie had greater competence and confidence to discuss tennis-specific topics with her daughter. Additionally, Sienna (Athlete, T3) and Sam (Coach, T3) felt that their coach-athlete relationship had become closer and started to feel more like a friendship because of the extra energy and enthusiasm Sam had for his court sessions with Sienna. Finally, changes to the triad as a whole were discussed. Specifically, participants explained a greater shift towards shared decision making processes and more productive conversations that allowed them to resolve differences and move forward together.

The Utility Value of the Intervention

Finally, participants discussed how useful, yet challenging, the intervention was to their experiences as stakeholders in tennis. Participants felt that the research workbook and handbook were helpful resources which allowed them to reflect and assess their relationships and progress. Additionally, having four specific behavioural characteristics to categorise their behaviours and goals in addition to more formal opportunities to jointly discuss these was considered to be useful for their current relationships, as well as to manage any future issues should they arise. Nevertheless, participants spoke about the difficulties they faced when trying to critically appraise their relationships in this way as well as the time required to meet formally. This was particularly difficult because of the stringent time constraints participants had with their existing work, personal and tennis commitments.

DISCUSSION

Overall, the aims of this research series was to better understand how parent-coach relationships operate across the youth tennis pathway. Whilst this section focusses on the contributions of this research to practice, some key contributions to theory and the existing body of literature are important to highlight. From a theoretical standpoint, the findings provide a greater insight into the interpersonal structures and dynamics that underpin positive relationship functioning. By applying existing concepts of responsiveness and relationship quality, for example, the studies demonstrate the constructs (e.g., closeness and care) that underpin positive relationship functioning between parents and coaches. Likewise, the findings also build upon arguments from system theorists to demonstrate how this relationship contributes to a wider network of interpersonal connections (i.e., the PAC triad). Therefore, it can be argued that parent-coach relationships not only play an important role in the outcomes of athletes, but also in the way other interpersonal units function. Nevertheless, future research which investigates this evidence and these claims in further depth would make a positive contribution to this area.

These studies also make important contributions to research in this area. From a methodological standpoint, two out of the three studies utilise interindividual sampling to provide greater clarity of the often implicit relational processes that exist between parents and coaches. For example, utilising participants from the same triads generated opportunities to investigate the way existing constructs such as trust, commitment and communication are fostered and exchanged between stakeholders. Moreover, and perhaps most significantly, the findings highlight the specific behavioural characteristics that can impact the nature of the parent-coach relationship. Specifically, the conceptual definitions of support, investment, collaboration and communication appear to be important in determining the way parents and coaches think and feel about each other. By taking a developmental approach to the studies in this research series, the findings demonstrate the ways in which these behavioural characteristics operate and evolve across the youth tennis pathway.

Implications for Practice

The findings from this research offers several key implications. Starting with governing bodies and sporting organisations, there is a need for educational material to include more parent-coach relationship content. Current educational strategies demonstrate promising but a varied degree of success perhaps due to the brief, online and group-based methods that make the content more accessible (Thrower et al., 2023). In tennis more specifically, the recent increase in formal and informal strategies aimed at parents is encouraging that has at times, included some minor content on the parent-coach relationship (e.g., Thrower et al., 2023). Given how important parents and coaches considered their relationships to be, adding to the curriculum that encourages parents and coaches to understand and identify the interpersonal behaviours that can improve the quality and responsiveness of their relationships could be significantly valuable.

For practitioners, using conjoint strategies could bring parents and coaches together. Practitioners may consider the use of online monthly meetings using a flexible agenda that encourages these stakeholders to reflect on their relationships and communicate about their expectations, goals and actions moving forward. Given misalignment and conflict in these areas as well as inaccessibility and unpredictability can cause tension, conflict and detachment (Horne et al., 2020; Preston et al., 2020), utilising frequent yet brief interventions may foster more positive feelings of trust and commitment. Additionally, practitioners may also consider the use of supplementary resources (such as workbooks, videos and handbooks) that parents and coaches can utilise and refer to at their own pace. Indeed, different variations of interventions and resources that adapt to preferences and circumstances may ensure strategies engage as many stakeholders as possible (Newport et al., 2024).

Finally, there are opportunities for parents and coaches themselves. For example, a common problem highlighted by stakeholders in these studies and the existing literature is the issue regarding time. This appears to be a particular challenge in tennis where coaches are required to be on the court at the expense of engaging with parents. Therefore, opportunities to increase both the frequency and quality of interactions between parents and coaches is important. This could take the form of parent-coach evenings throughout the season or dedicating some time in review meetings to discuss the parent-coach relationship more explicitly. Regardless, it is important that these stakeholders work to identify and negotiate the ways they can enact positive and coordinated behaviours (e.g., support) that work towards mutual goals to ultimately improve and maintain the bond between them.

CONCLUSION

Overall, this research adds to the ever-growing, yet limited, parent-coach relationship literature. Employing developmental and more complex sampling methods as well as using existing conceptual frameworks, these studies demonstrate the specific behaviours, qualities and outcomes associated with relationship functioning between tennis parents and coaches in the PAC triad. Such research not only provides valuable implications for education and practice within youth tennis, but also offers an important foundation for future research and practice in youth sport more widely.

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REFERENCES

Bordin, E. S. (1979). The generalizability of the psychoanalytic concept of the working alliance. Psychotherapy: Theory, Research & Practice, 16(3), 252-260. https://doi.org/10.1037/h0085885

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. Qualitative Research in Sport, Exercise, and Health, 11(4), 589-597. https://doi.org/10.1080/2159676x.2019.1628806

Dohme, L-C., Bloom, G. A., & Knight, C. J. (2020). Understanding the behaviours employed by parents to support the psychological development of elite youth tennis players in England. International Journal of Sport and Exercise Psychology, 19(6), 957-974. https://doi.org/10.1080/1612197X.2020.1827004

Finkel, E. J., Simpson, J. A., & Eastwick, P. W. (2017). The psychology of close relationships: Fourteen core principles. Annual Review of Psychology, 68, 383-411. https://doi.org/10.1146/annurev-psych-010416-044038

Gould, D., Lauer, L., Rolo, C., Jannes, C., & Pennisi, N. (2008). The role of parents in tennis success: Focus group interviews with junior coaches. The Sport Psychologist, 22(1), 18-37. https://doi.org/10.1123/tsp.22.1.18

Gould, D., Lauer, L., Rolo, C., Pennisi, N. (2006). Understanding the role parents play in tennis success: A national survey of junior tennis coaches. British Journal of Sports Medicine, 40(7), 632-636. https://doi.org/10.1136/bjsm.2005.024927

Gould, D., Pierce, S., Wright, E. M., Lauer, L., & Nalepa, J. (2016). Examining expert coaches' views of parent roles in 10-and-under tennis. Sport, Exercise, and Performance Psychology, 5(2), 89-106. https://doi.org/10.1037/spy0000050

Harwood, C. G., & Knight, C. J. (2009a). Stress in youth sport: A developmental investigation of tennis parents. Psychology of Sport and Exercise, 10(4), 447-456. https://doi.org/10.1016/j.psychsport.2009.01.005

Harwood, C. G., & Knight, C. J. (2009b). Understanding parental stressors: An investigation of British tennis parents. Journal of Sports Sciences, 27(4), 339-351. https://doi.org/10.1080/02640410802603871

Hellstedt, J. C. (1987). The coach/parent/athlete relationship. The Sport Psychologist, 1(2), 151-160. https://doi.org/10.1123/tsp.1.2.151

Horne, E., Lower-Hoppe, L., & Green, C. (2022). Co-creation in youth sport development: Examining (mis)alignment between coaches and parents. Sport Management Review, 26(2), 271-292. https://doi.org/10.1080/14413523.2022.2050107

Horne, E., Woolf, J., & Green, C. (2020). Relationship dynamics between parents and coaches: Are they failing young athletes? Managing Sport and Leisure, 27(3), 224-240. https://doi.org/10.1080/23750472.2020.1779114

Jowett, S. (2007). Interdependence analysis and the 3+1Cs in the coach-athlete relationship. In S. Jowett & D. Lavallee (Eds.), Social psychology in sport (pp. 15-27). Human Kinetics.

Jowett, S., & Nezlek, J. (2012). Relationship interdependence and satisfaction with important outcomes in coach–athlete dyads. Journal of Social and Personal Relationships, 29(3), 287-301. https://doi.org/10.1177/0265407511420980

Lauer, L., Gould, D., Roman, N., & Pierce, M. (2010). Parental behaviors that affect junior tennis player development. Psychology of Sport and Exercise, 11(6), 487-496. https://doi.org/10.1016/j.psychsport.2010.06.008

Newport, R.A., Knight, C.J., & Love, T.D. (2024). Support parents of male academy footballers: An action research study. Journal of Applied Sport Psychology, 36(4), 664-695. https://doi.org/10.1080/10413200.2024.2329547

O'Donnell, K., Elliott, S. K., & Drummond, M. J. (2022). Exploring parent and coach relationships in youth sport: A qualitative study. Qualitative Research in Sport, Exercise, and Health, 14(7), 1023-1044. https://doi.org/10.1080/2159676X.2022.2048060

Omli, J., & LaVoi, N. M. (2009). Background anger in youth sport: A perfect storm? Journal of Sport Behavior, 32(2), 242–260.

Poczwardowski, A., Barott, J. E., & Jowett, S. (2006). Diversifying approaches to research on athlete-coach relationships. Psychology of Sport and Exercise, 7(2), 125-142. https://doi.org/10.1016/j.psychsport.2005.08.002

Preston, C., Allan, V., Wolman, L., & Fraser-Thomas, J. (2020). The coach–parent relationship and athlete development in elite youth hockey: Lessons learned for conflict management. The Sport Psychologist, 34(2), 143-152. https://doi.org/10.1123/tsp.2019-0130

Reis, H. T., & Clark, M. S. (2013). Responsiveness. In J. A. Simpson & L. Campbell (Eds.), The Oxford handbook of close relationships (pp. 400–423). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780195398694.001.0001

Rhind, D. J. A., Jowett, S., & Yang, S. X. (2012). A comparison of athletes' perceptions of the coach-athlete relationship in team and individual sports. Journal of Sport Behavior, 35(4), 433-452.

Ryan, R. M., & Deci, E. L. (2002). Overview of self-determination theory: An organismic dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), Handbook of self- determination research (pp. 3–33). University of Rochester Press.

Sheridan, D., Coffee, P., & Lavallee, D. (2014). A systematic review of social support in youth sport. International Review of Sport and Exercise Psychology, 7(1), 198-228. https://doi.org/10.1080/1750984X.2014.931999

Thrower, S. N., Spray, C. M., & Harwood, C. G. (2023). Evaluating the "optimal competition parenting workshop" using the RE-AIM framework: A 4-year organizational-level intervention in British junior tennis. Journal of Sport and Exercise Psychology, 45(1), 1-14. https://doi.org/10.1123/jsep.2022-0080

Wall, J. M., Baugh, L. M., Pradhan, K., Beauchamp, M. R., Marshall, S. K., & Young, R. A. (2019). The coach-parent relationship in Canadian competitive figure skating: An interpretive description. Psychology of Sport and Exercise, 45, 1-10. https://doi.org/10.1016/j.psychsport.2019.101577

RECOMMENDED ITF TENNIS ACADEMY CONTENT (CLICK BELOW)

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Mental skills and tools for coaches: How and why to implement breathing techniques into your coaching

Merlin Van de Braam

Lawn Tennis Association, United Kingdom.

ABSTRACT

Competitive tennis places demands on players from a technical, tactical, physical and mental perspective. Relatively little information and support is available on how to navigate the mental demands of the game compared with other domains. This article aims to help coaches understand more about practical mental skills and mental tools, with a specific focus on breathing techniques to optimise well-being and performance. The research findings surrounding psychological, physiological and behavioural benefits of breathing will be explored, alongside practical coach-friendly recommendations on how to implement breathing techniques and integrate them into coach led practice.

Key words: Psychology, breathing, mental skills, slow-paced breathing.

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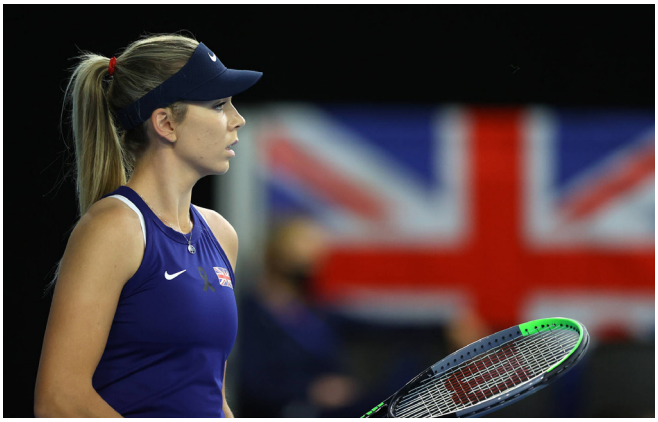
Corresponding author: Merlin.van-de-braam@lta.org.uk

THE PSYCHOLOGICAL DEMANDS OF TENNIS

Tennis places unique demands on competitive players. Some of the greatest players of all time have won just 51% of all points played (O' Shannessy, 2024). Most professional tennis players ranked between 50 and 100 have lost more matches than they have won in any given year (ATP, 2024; WTA; 2024). The knock-out draw format which is common in competitive tennis means that social comparison (beating others) takes precedence over personal bests that exist, for example, in athletics. This knock-out format also means that just one person wins each week. Unlike many team sports, there is low or no coaching support available during live play. Players must problem solve alone, and the duration of the match can vary significantly. Junior and entry level professional tennis players must compete and officiate simultaneously often navigating incorrect line calls that may cost them matches, ranking points and prize money. Finally, tennis requires players to stay composed and actively win a match; you cannot passively 'wind down the clock'.

These unique demands should however be seen as a positive aspect of the game of tennis. They present a rich learning environment where skills and competencies can be tested and therefore developed. Controlling emotions, dealing with pressure, staying focused on the present, committing in the face of adversity, and problem solving are all skills that can serve players on a tennis court. Perhaps more importantly, these traits can also serve as life skills. Coaches can play a role in supporting the long-term development of these key mental skills, so that players can both manage and thrive in the context of these demands whether that is on or off the court.



DEVELOPING MENTAL SKILLS

As tennis coaches, we are familiar with developing attacking, rallying and defensive tactical skills. We are also extensively trained in qualifications to develop effective and efficient technique for the serve, forehand, backhand and net game. From a physical perspective it is understood that a blend of strength, power, flexibility and endurance is needed for tennis (Reid, Quinn & Crespo, 2003). Less is known however amongst the coaching community about the skills that should be developed on the mental side of the game. There are a range of psychological frameworks that can aid the development of mental skills for athletes. Self-determination theory posits that we should develop feelings of competence, autonomy and relatedness in our players (Deci & Ryan, 1985). Well known acronyms such as SMART[1] and TARGET[2] can practically guide us on goal setting and motivation respectively. Whilst these help to underpin some useful practical interventions, very few frameworks provide

a broad, practical, and collectively exhaustive 'road map' for developing a player mentally. One framework of particular utility is the '5Cs framework' (Harwood, Barker & Anderson, 2015). The 5Cs framework focuses on developing psycho-social skills across five areas; commitment, communication, concentration, control of emotion, and confidence. This evidence based and empirically tested model can provide much needed guidance for the coach. A similar framework has been adopted by the ITF and is referenced in their psychology text for coaches (Crespo, Reid & Quinn, 2011).

1= Specific, measurable, agreed, realistic, timed (SMART)

2= task, authority, reward, grouping, evaluation, and timing (TARGET) (Epstein, 1987)

UTILISING MENTAL TOOLS

Once a coach has a clear understanding of 'what' they are trying to achieve i.e. the 5Cs, the 'how' then becomes important. A useful, practical and simple approach can be to make use of what the author refers to as 'mental tools'. When it comes to the mental tools we can use, there are a range of them.

- Goal setting: This could be a short-term tactical goal for the next point, next drill, or a goal for the summer season. If a player sets a goal (process or outcome) it can primarily drive commitment.
- Body language: This is our observable behaviour on court. It can give us an advantage, or our opponent an advantage if not done well.
- Visualisation: This what takes place in the 'minds-eye' (Morris, Spittle & Watt, 2005). Research shows that positive visualisation can improve performance and it uses the same parts of the brain as actual practice.
- Self-talk: These are positive words said to oneself during play. Tennis players can often be very harsh on themselves. When done well, positive self-talk can replace negative self-talk which can have an impact on confidence among other mental skills
- Breathing: Purposefully focusing on and controlling the pace and way in which we breath to derive positive physical, mental and performance benefits. Breathing technique will be the main focus of this article.
- Routines: Routines can be framed as the combination of all mental tools put together, in combination with practical and general behaviours like playing with strings, bouncing the ball, or using a towel to wipe away sweat. Routines are important because they are always in the control of the player and provide consistency. In a match setting when things are uncertain and unknown, routines bring peace of mind and comfort in an otherwise quite unsettling environment.

BREATHING: WHAT DOES THE RESEARCH SAY?

Even the greatest players in the world find it difficult to control their emotions. Post match press conferences are replete with players describing how they try to stay calm and challenges they experience managing nerves. For example, Rafael Nadal in the 2017 US Open Final press conference is quoted as saying "I was not calm. I was nervous". Research by Laborde et al. (2022) reviewed a broad range of previous studies that investigated breathing techniques and found that slow paced breathing (as defined by six or less breaths per minute) led to improved performance across a range of sports. Breathing has also been associated with increased relaxation and alertness as well as reduced arousal, anxiety and anger (Gocmen et al., 2012). Jimenez & Molina (2017) found that breathing can result in an improvement in Heart Rate Variability (HRV) which is widely acknowledged by health practitioners as a reliable marker of well-being and health.

BREATHING: HOW DOES IT WORK?

Our brain, heart and lungs are connected, and our nervous system has two branches. One is referred to as 'fight/flight' and the other is known as 'rest/digest'. Slow paced breathing triggers the 'rest/digest' branch of our autonomic nervous system which can, in the context of stressful competition, play a positive role to calm a players mental and physical state. With approximately six minutes of dead time per set (change-overs) and one hundred seconds of dead time per game (between points), tennis provides ideal opportunities for introducing slow paced breathing techniques.

BREATHING: WHAT SHOULD I RECOMMEND TO MY PLAYERS?

The current literature and research does not provide strong and overwhelming consensus on the most optimal way to execute great breathing technique. However, there appears to be some consensus across four key aspects:

- Six breath cycles or less per minute seems to be required to see any impact from breathing.
- An inhale to exhale ratio of 1 to 1 is desirable. In explanation, players should aim to inhale for a similar length of time as they exhale. Longer exhales and breaks in between breaths may be preferential but evidence here is limited.
- Nasal breathing: It is generally agreed that nasal breathing is better than mouth breathing. However, if exertion is high then "in through the nose and out through the mouth" may be the most practical and balanced solution.
- Belly breathing (or diaphragmatic breathing) should be employed. Practically, this would see a player expand their belly to draw breath in as opposed to raising or tensing shoulders and the upper rib cage. Belly breathing ensures that the diaphragm is working to pull air into the lungs.

SUMMARY

Tennis can place significant demands on athletes at all levels of the game however coaches can support the long-term development of mental skills and practically make use of mental tools. Whilst there are many options available, breathing techniques have been the focus of this article and have been shown in sport-based research to be a useful tool that tennis players can use to support regulation and control of emotions by positively impacting physiology and psychology. These techniques can be used before, during and after the match or practice. Slow paced breathing can be introduced by coaches, alongside a suite of other mental tools cited in this article. It is important to recognise that any

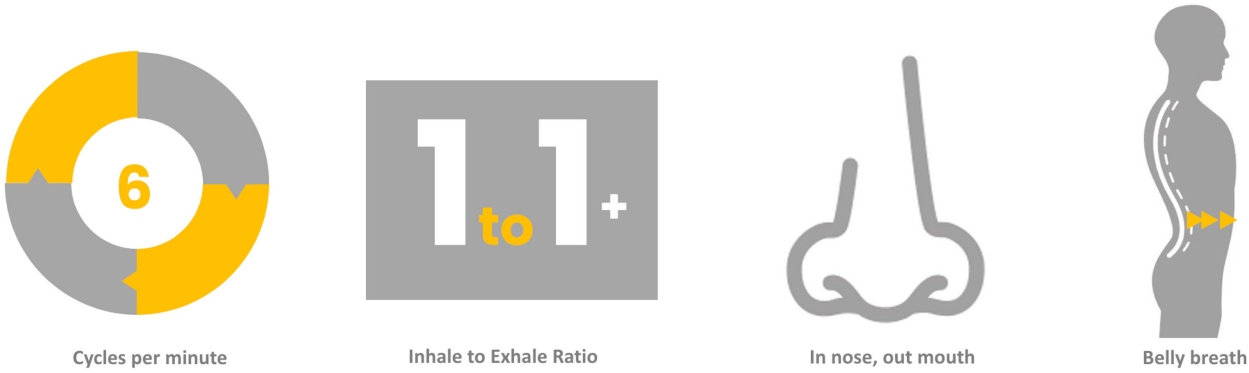


Figure 1. *Practical and evidence-based breathing recommendations for tennis players.*

effects require prolonged practice and implementation, just like any other skill – 'once off' interventions have been shown as ineffective (Laborde et al, 2022). It is also worth noting that breathing can help to reduce competitive anxiety, however it is not a 'silver bullet'. Coaches should consider the broader environment that is set by parents and significant others, as well as the motivational climate in training and competition (see Balaguer, Duda & Crespo, 1999). A final recommendation would be for coaches to engage and work with appropriately qualified and accredited sport psychologists to maximise impact in the area of mental skills development.

CONFLICT OF INTEREST AND FINANCING

No conflicts of interest are to be declared for this study, which received no funding.

REFERENCES

ATP (2024). PIF ATP Rankings. Retrieved 8th June from https://www.atptour.com/en/rankings/singles

Balaguer, I., Duda, J., & Crespo, M (1999). Motivational climate and goal orientations as predictors of perceptions of improvement, satisfaction and coach ratings among tennis players. Scand J Med Sci Sports: 9: 381-388

Crespo, M., Reid, M., & Quinn, A. (2011). Tennis Psychology. ITF; London.

Deci, E. L., & Ryan, R. M. (1985). Conceptualizations of intrinsic motivation and self-determination. Intrinsic motivation and self-determination in human behavior, 11-40.

Göçmen, R., Aktop, A., Pınar, Y., Toktaş, N., & Kristýna Jandačková, V. (2023). The Effect of Heart Rate Variability Biofeedback on Basketball Performance Tests. Applied Psychophysiology and Biofeedback, 48(4), 461-470. https://doi.org/10.21203/rs.3.rs-2783021/v1

Harvard Medical School (2020). Relaxation techniques: Breath control helps quell errant stress response. Retrieved May 30th 2024 from https://www.health.harvard.edu/mind-and-mood/relaxation-techniques-breath-control-helps-quell-errant-stress-response

Harwood, C. G., Barker, J. B., & Anderson, R. (2015). Psychosocial development in youth soccer players: Assessing the effectiveness of the 5Cs intervention program. The Sport Psychologist, 29(4), 319-334.

Jiménez, S., & Molina, J.A. (2017). Effect of heart rate variability biofeedback on sport performance, a systematic review. Applied Psychophysiological feedback. 42: 235-245.

Laborde, S., Zammit, N., Iskra, M., Mosley, E., Borges, U., Allen, M. S., & Javelle, F. (2024). The influence of breathing techniques on physical sport performance: A systematic review and meta-analysis. International Review of Sport and Exercise Psychology, 17(2), 1222-1277.

Morris, T., Spittle, M., Watt, A. (2005). Imagery in Sport. Champaign, IL: Human Kinetics.

O' Shannessy, C. (2024). Brain game tennis. Retrieved 9th June from https://www.braingametennis.com

Reid, M., Quinn, A. & Crespo, M. (2003). Strength and Conditioning for Tennis. ITF; London.

WTA (2024). PIF WTA Rankings. Retrieved 8th June from https://www.wtatennis.com/rankings/singles

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Examining the Potential of Modified Tennis for Adult Beginner Players

Jennifer Roth & Sanghoon Kim

Michigan State University, USA.

ABSTRACT

Modified tennis for youth has been shown to promote both enjoyment and skill development for participants (Buszard et al., 2020). However, the role of modified tennis for adults is not as clear in terms of equipment and curricular focus. The potential of modified tennis for beginner adult tennis players is important to explore with the recent growth of pickleball. This study investigated the outcomes and experiences of adult beginner players who participated in a modified tennis and pickleball program. Results showed that participants preferred the red felt tennis ball and 23-inch rackets in modified tennis. Participants had a higher rate of perceived competence for modified tennis than pickleball. While not significant, participants reported marginally higher levels of enjoyment, commitment, socialization, and behavioral intention in pickleball. These results suggested that novices in racket sports may have comparable experiences in modified tennis and pickleball. This study provides valuable insights and suggestions for modified tennis programming for adults.

Key words: Modified tennis, adults, pickleball.

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Corresponding author: Jennifer Roth, nalepaje@msu.edu

INTRODUCTION

Modified Tennis

Modified tennis has been shown to have a positive impact on youth participants skill acquisition and engagement (Buszard et al., 2020). This approach is rooted in a constraints-led approach, which emphasizes the adaptation of individual (athlete characteristics), environmental (playing conditions), and task (rules, equipment, playing area)-related constraints to facilitate learning and skill development through game-like situations. Task constraints are the simplest to adapt as they can be changed quickly and deliberately by the coach in the practice setting. Task constraints can increase or decrease the complexity of skills through changes made to equipment, rules, and playing area to meet the developmental needs and skill levels of the athletes (Hill & Green, 2008). The foundation of the constraints-led approach is non-linear pedagogy or the belief that learning is dynamic and content-dependent. Therefore, the constraints-led approach utilizes game-based conditions where athletes learn through the dynamic interaction between task, individual, and environmental constraints. Less emphasis is put on direct instruction and coaches provide feedback to reinforce skill learning during gameplay. These types of modifications not only make sport more accessible but also enhance skill development and enjoyment, leading to increased motivation and long-term participation (Buszard et al., 2020). Research in modified youth sports has established many benefits for players, however limited research has been conducted with the adult population.

Modified Tennis for Adults

While the benefits of modified tennis equipment and a games-based approach to learning used within the constraints-led

approach have been evidenced as beneficial for youth players, such as better skill development and enhanced enjoyment (Buszard et al., 2020), there is little research on the potential benefits for adult beginner tennis players. Although various modified versions of tennis have been developed over the last few years, such as Touch Tennis in the UK, there is a lack of empirical studies examining the outcomes and benefits for adult beginners and identifying the most suitable modifications for this demographic. One study examined the effects of using lower-compressed tennis balls on various player outcomes, such as perceived exertion, enjoyment, mood states, and mental effort, as well as match characteristics like average strokes per match and strokes per rally. The findings showed that adult players who used lower-compressed balls experienced longer rallies, enhanced mood, reduced perceived exertion, greater enjoyment, and increased time spent on strokes (Kilit et al., 2024).

There is also a lack of research on the impact of a games-based approach to learning for adult beginner tennis players. Tactical-game centered approaches in sports utilize games as the primary context for players to acquire tactical, technical, and strategic skills through problem-solving (Alaoui et al, 2018). This approach contrasts with the traditional method of teaching tennis, which relies on a technical approach that emphasizes skill drill practice focused on the replication and repetition of specific techniques. Research with youth players has shown improvements in both skill performance and tactical understanding of the sport, as well as higher levels of fun and enjoyment (Alaoui et al., 2018). With adult participants, one study by Hublin et al. (2021) found that players who learned through a games-based approach showed significantly higher precision in cross-court forehands, better balance during strokes, and a higher perceived forehand performance compared to those taught using traditional methods. However, this study utilized standard tennis equipment. To date, no research has explored the combined effects of using both modified tennis equipment and a games-based approach for adult beginner players.

Market Trends and Competitive Forces in Racket Sports

The global racket sports market is expanding rapidly, led by traditional sports like tennis and badminton, with the notable rise of pickleball. Each sport appeals to different regions and consumer segments. This growth is driven by increased health awareness, better accessibility, and broad appeal across age groups, signaling continued market expansion.

Pickleball's recent growth has been particularly notable, especially in the United States, where its popularity among adult beginner tennis players is of increasing interest. Recognized as one of the fastest-growing sports in the country, pickleball has seen participation from 36.5 million people in the past year, with approximately 8.9 million core players, according to USA Pickleball and the Sports and Fitness Industry Association (SFIA, 2023). Additionally, around 130 new pickleball locations are being established monthly across the U.S., with the 18–34 age group representing the largest demographic of players.

Pickleball shares some similarities with tennis, such as using a court, net, and a similar game objective, but it differs by utilizing a paddle, a wiffleball, and minimal overhead swing patterns. Compared to other racket sports, pickleball is increasingly popular among adults due to its smaller court, slower ball, and predominance of underhand strokes, which reduce strain on the elbow and shoulder. It also offers accessible exercise with lower injury risk and fosters social interaction through its competitive nature, which players can quickly engage in after learning (Stroesser et al., 2024). In contrast, tennis requires more complex movement and stroke patterns, is played with a heavier, faster ball on a larger court, and has a steeper learning curve, which can reduce social engagement opportunities for beginners.

Tennis faces the challenge of becoming more accessible, much like pickleball, by lowering entry barriers for prospective players and enhancing the overall enjoyment of the sport and its training process. This approach is essential for tennis to maintain its competitive advantage in the racket sports industry. One potential option is to offer a modified version of tennis to adult beginner tennis players that utilizes modified equipment to promote skill learning and enjoyment. Thus, this study investigated the outcomes and experiences of adult beginners who participated in modified tennis and pickleball programs. Specifically, this study compared participants' perceptions and experiences of modified tennis (i.e., ball type, racket size, and course size) as well as those between modified tennis and pickleball, using enjoyment, commitment, perceived exertion, competence, socialization, perceived fit with traditional tennis, and behavioral intention.

Purpose

This study aimed to understand the outcomes and experiences of adult beginners who completed a 6–8-week racket sport course featuring both tennis and pickleball. It specifically compared participants' perceptions and experiences of modified tennis (informed by a constraints-led approach) with those of pickleball, focusing on enjoyment, commitment, perceived exertion, competence, socialization, perceived fit with traditional tennis, and behavioral intention.

METHODS

Participants

Participants were recruited from three different locations in the United States through targeted advertisements on social media platforms and facility websites. To ensure sample homogeneity, a screening process was implemented, incorporating both a survey questionnaire and consultations with facility administrators. Only individuals with less than one year of experience in tennis and pickleball were eligible to participate in the study. As a result, a total of 153 adult players were eligible and participated in this study. Of these, 92 participants completed all required sessions and surveys. Participants were mostly aged 18-24 (30.4%) and 35-44 (21.7%), with 59 females and 33 males. The majority of participants identified as Caucasian or White (44.6%), followed by Hispanic and Latino (22.8%) and Asian (16.3%) ethnicities. The researchers identified survey participants interested in joining a focus group and subsequently conducted focus group interviews with 24 of them (10 males, 14 females, age range: 20-74 years).

Measures

This study employed a mixed-methods approach, incorporating both quantitative and qualitative approaches. The surveys assessed enjoyment and commitment (enthusiasm) using constructs from the Sport Commitment Questionnaire-2 (SCQ-2; Scanlan et al., 2016). Perceived exertion was evaluated with the Borg RPE Scale, which asks participants to rate the intensity of their effort on a scale from 6 to 20, where 9 indicates "extremely light" and 20 represents "maximal exertion" (Williams et al., 2017). Perceived competence was measured using the Perceived Competence subscale of the Intrinsic Motivation Inventory (IMI; McAuley et al., 1989). Social connectedness was assessed using items adapted from Lee and Robbins (1995). Behavioral intention was evaluated by combining items from Till and Busier (2000) and Zeithaml et al. (1996).

The initial focus group interview questions were developed by subject matter experts and researchers to align with the study's purpose and were subsequently refined based on survey findings. Further adjustments were made to the questions to capture more nuanced participant perspectives that could not be fully explored through the quantitative approach. During the interviews, the researchers conducted follow-up questions as needed in response to specific questions or answers.

Programs and Procedure

The programs were provided in three locations in the United States resulting in seven classes. To enhance validity and minimize potential biases, each class followed a structured 6–8-week curriculum, with an equal distribution of 3-4 tennis sessions and 3-4 pickleball sessions. To standardized practice time, each session was set at approximately 50 minutes. The tennis sessions incorporated controlled variations in instructional conditions, including ball type (foam vs. felt tennis ball), court size (44’ vs. 42’), the inclusion of the kitchen line rule, and the player-to-coach ratio, which was maintained within a narrow range to ensure

instructional consistency. Participants could choose between a 23" or 25" tennis racket, balancing equipment suitability with uniform instructional delivery. The pickleball sessions adhered to standard rules and equipment specifications across locations.

The curriculum was developed by researchers, drawing on previous programs for adult beginner players and existing modified versions of tennis tailored for adults. To ensure instructional consistency, all coaches across locations were provided with a standardized curriculum, including game-based learning strategies, fundamental skill instruction (e.g., forehand and backhand), and match play using underhand serve and simplified scoring. Additionally, coaches received instructional guidelines to align their coaching methods with the study's objectives, thereby minimizing potential discrepancies in coaching approaches and enhancing the validity of the study. After receiving approval from the Institutional Review Board, participants were recruited and enrolled in the programs at no cost, with each participant receiving a free tennis racket. They completed pre-, mid-, and post-surveys at the beginning, midpoint, and conclusion of the tennis and pickleball program, receiving a gift card for each completed survey. Additionally, participants who took part in a focus group were given an extra gift card as an incentive.

Data Analysis

For the quantitative data analysis, descriptive statistics were calculated for all participants, with items from each scale summed and then averaged per participant. Since normality was not met for some variables in the assumption test, the Wilcoxon Signed-Rank Test was used to assess differences in average scale scores across conditions, including ball types, racket sizes, and comparisons between modified tennis and pickleball, because normality was not met for some variables in the assumption test. All analyses were performed using SPSS statistical software.

A hierarchical content analysis was conducted to identify common themes within the qualitative data (Miles et al., 2013). Both deductive and inductive approaches were used by two separate researchers, who convened at multiple stages of the analysis to reach consensus on emerging themes. Specifically, the researchers first created meaning units using an open-coding phenomenographic approach to the focus group transcripts. Then, meaning units for participants using the red felt ball (n = 11) were combined and the meaning units for those who played with the red foam ball (n = 13) were combined. An inductive approach was then used to create categories based on meaning units, which were then deductively placed in higher-order themes based on the research questions. At each stage of this analysis, the researchers met to reach consensus before progressing to the next phase of data analysis.

RESULTS

Quantitative Results

Differences between ball and racket types

Table 1 presents a comparison of participants' experiences based on ball and racket sizes. For ball type, a statistically significant increase was found in the mean scores between pre- and post-class for the felt ball across several constructs, including satisfaction, enjoyment, competence, and behavioral intention, with higher scores reported after the course. In contrast, no statistically significant differences were found in the mean scores for the foam ball across the constructs, except for competence. Commitment scores in the post-test were lower than those in the pre-test, which is statistically significant. For racket size, a statistically significant increase in competence and behavioral intention was found with the 23-inch racket, while the 25-inch racket showed a significant increase in satisfaction and competence.

Table 1

Results of Wilcoxon Signed-Rank Tests for Pre- and Post-Experience with Ball and Racket Types.

Variable	Felt ball				Foam ball			
	Pretest *M*	Posttest *M*	*z*	*p*	Pretest *M*	Posttest *M*	*z*	*p*
Satisfaction	4.87	5.72	-4.43	.001**	5.26	5.29	-.63	.52
Enjoyment	5.34	5.70	-2.17	.02*	5.61	5.59	-.31	.76
Competence	4.15	4.78	-3.48	.001**	4.27	4.37	-2.13	.03*
Perceived fit	4.98	5.23	-.99	.227	5.23	5.31	-.56	.57
Commitment	4.00	4.22	-1.61	.09	4.67	4.09	-2.66	.01*
Socialization	5.01	5.14	-.99	.21	5.03	5.02	-.17	.86
Behavioral intention	4.63	5.40	-2.78	.01*	5.06	5.17	-.96	.33

Variable	23-inch racket				25-inch racket			
	Pretest M	Posttest M	*z*	*p*	Pretest M	Posttest M	*z*	*p*
Satisfaction	5.22	5.60	-1.78	.07	5.03	5.70	-3.18	.001**
Enjoyment	5.60	5.73	-1.85	.06	5.31	5.57	-1.01	.31
Competence	4.14	4.47	-2.12	.03*	4.27	4.73	-3.52	.001**
Perceived fit	5.12	5.32	-1.08	.27	5.05	5.22	-.74	.45
Commitment	4.50	4.34	-.02	.97	4.10	3.99	-.84	.39
Socialization	5.02	5.03	-.34	.72	5.01	5.14	-.62	.53
Behavioral intention	4.86	5.36	-2.51	.01*	4.78	5.24	-1.53	.12

** p < .001, *p < .05.

Differences between modified tennis and pickleball

Table 2 shows a comparison of participants' experiences with modified tennis and pickleball. Participants reported greater enjoyment with pickleball, although this difference was not statistically significant. Regarding competence, higher scores were reported for the modified tennis, but this difference was also not statistically significant. However, in terms of commitment, participants gave significantly higher scores to pickleball, indicating a statistically significant difference. For socialization, participants also reported higher scores for pickleball, but this was not statistically significant. However, participants perceived the modified tennis as a better fit with traditional tennis, and this difference was statistically significant. Finally, participants reported higher scores for pickleball in behavioral intention, but the difference was not statistically significant.

Table 2

Results of the Comparison of Participants' Experience Between Modified Tennis and Pickleball

Variable	Modified tennis vs. Pickleball			
	Modified Tennis *M*	Pickleball *M*	*z*	*p*
Enjoyment	5.66	5.94	-4.83	.14
Competence	4.54	4.50	.87	.76
Perceived fit	5.30	4.82	-3.68	.001**
Commitment	4.20	4.73	-1.96	.04*
Socialization	5.11	5.36	-1.47	.11
Behavioral intention	5.28	5.65	-1.65	.09

** p < .001, *p < .05.

Qualitative Results

Six themes emerged from the qualitative data analysis including the player experience, equipment/format, Modified Tennis vs. Pickleball, Modified Tennis vs. traditional tennis, future participation intention, and recommendations for future programming.

Player experience

Many of the participants directly (n = 16) mentioned enjoying the overall experience of playing both sports in the pilot programming. Participants felt the social aspect of the classes was one of the most enjoyable aspects, noting they enjoyed playing with different players throughout the class and meeting new people (n = 11). They also discussed liking the modified tennis equipment that was used in the class, citing the ball as easy to control, little movement required, and that it felt appropriate for beginner players (n = 8). Participant 10 made this clear when they said "I liked how it [the red ball] gave you, you know, instead of just the regular ball, I feel like the ease of it gave you a little more confidence when you just start learning. And I did like that." However, there were some elements of modified tennis that participants did not enjoy such as having a range of skill levels in the class. For those with low skill ability, participants enjoyed playing higher skilled participants. However, the higher skilled participants did not enjoy playing with less skilled players.

Equipment/format

In terms of the modified tennis equipment used in the pilots, participants who played with the red felt tennis ball had more positive perceptions toward the equipment than participants who played with the foam tennis ball. For the red felt ball participants, most were unaware of racket size differences or had favorable opinions about both sizes (n = 9). This contrasts with those who played with the foam tennis ball as they saw the racket as a child or preferred a traditional sized racket. This was made clear by Participant 19 who said "And not that I'm an expert on tennis, but for me, personally, I feel if you're an adult, starting out with tennis, and you're gonna end up using the heavier, bigger racket, I feel like it just makes sense to start off with that."

Regarding the ball type, like the racket, there was a more positive perception of the ball for players who use the red felt ball. The felt ball was perceived as easy to control as it moved slowly and was effective at neutralizing skill levels (n=9). Participant 3 explained this perception when they said "It was it felt softer and lighter. And because it did stay in the air longer, it gave me more time to react to set up my returns." Only one player who played with the red felt ball mentioned perceiving the ball as a child ball. For the players using the red foam ball, there was a perception of the ball as a child tennis ball or beginner only tennis ball with some who mentioned that the felt ball would have been better to use (9). Participant 13 explained this perception when they said, "You know, even like, when my daughter trains, you know, she's nine years old, the ball that they use is even faster than that."

When focusing on the format of Modified Tennis, participants had a positive perception of the scoring and believed it was easy to understand (n = 7). When asked about the kitchen rule, many players felt like it didn't have a role in Modified Tennis or made it more complicated (n=8), while two participants believed it helped to neutralize skill differences.

Modified tennis vs. pickleball

Participants viewed pickleball as the more challenging sport of the two sports they played (n = 8). Participants cited difficulties hitting the ball in the intended sport and the pickleball scoring format as the challenges. Six participants directly mentioned liking Modified Tennis more as it was easy to learn and less complicated than pickleball. This was made clear by Participant 14 who said "I liked like that you got to let the tennis ball bounce. Whereas in pickleball, you end up doing like a lot of the weird stuff when we're supposed to like run to the net and be really close. And so, I definitely liked the kind of like farther from the net aspect of the tennis." Finally, two participants mentioned enjoying pickleball more due to the social aspect of the sport and the accessibility of playing. This was supported by Participant 18 who said, "The perception of tennis is, you know, you have special clothes, and you know, and maybe that's appealing, but when you think about even the name pickleball it's just okay, we're just gonna go and have some fun."

Modified tennis vs. traditional tennis

Participants in this study noted that playing traditional tennis provided a better workout than modified tennis (n=7). They cited that playing modified tennis was less intense, less exercise, and required less effort and energy than traditional tennis. However, participants felt that red ball tennis was easier to learn and play (n = 9) as it was easier to control the ball and have success quicker. Participant 11 described this difference when they said "But we were able to, a lot of the beginners I played with, it was easier to volley for a little while. Whereas, when I've played years ago with a regular yellow tennis ball, we didn't get that right away. So, it wasn't as fun, it was more just chasing the ball because we weren't able to volley as much."

Recommendations for modified tennis for adults

Participants provided recommendations for future modified tennis classes that focused on one major theme. Participants recommended more skill instruction and skill development into the curriculum (n=13). While they enjoyed the game-based play, participants noted that some basic technical instruction on hitting the ball and movement patterns would have been helpful. This was evident by Participant 21 who said "And one of the things I did notice is that there were really no lessons on technique or anything like that. It was basically just these are the basic rules and here you go, which was fine. But I guess if I could add something to it would be just little bit of lessons on technique and hitting the ball and managing space on the court."

DISCUSSION

This study aimed to understand the outcomes and experiences of adult beginners who completed a 6–8-week racket sport course featuring both modified tennis and pickleball. It specifically compared participants' perceptions and experiences of modified tennis (ball type, racket size, and court size) with those of pickleball, focusing on enjoyment, commitment, perceived exertion, competence, socialization, perceived fit with traditional tennis, and behavioral intention.

Modified Tennis

Ball type

In modified tennis, felt balls generated greater effects and interest among participants than foam balls. Participants reported significantly higher levels of satisfaction and enjoyment when using the felt ball. It was also found that the felt ball increased participants' competence. Most importantly, participants who used the felt ball reported that they were more likely to continue participating in the future and spread positive word-of-mouth about the experience. Within the qualitative data, participants expressed more favorable perceptions of the felt ball than those who played with the foam ball. Specifically, individuals who used the foam ball were more likely to perceive it as a tool designed for children rather than an effective learning instrument for adults.

These findings indicate that the felt ball can play a significant role in enhancing skill development and boosting confidence among participants. Its perceived alignment with traditional tennis may also help ease the transition for beginners, making the felt ball an effective tool for generating both enjoyment and competence in new players to tennis overall. Furthermore, the resemblance

between modified tennis with the felt ball and traditional tennis could encourage sustained participation by providing a more accessible entry point for beginners, ultimately fostering their long-term enjoyment and commitment to the sport (Buszard et al., 2020).

Racket size

The quantitative results were somewhat mixed. Participants using the 23-inch racket reported increased competence and a stronger behavioral intention. In contrast, the 25-inch racket was associated with higher satisfaction and improved competence, but it did not appear to influence behavioral intention. Notably, there were no statistically significant differences in enjoyment across racket sizes, suggesting that while preferences exist, the overall impact on enjoyment may be minimal. These findings highlight the importance of carefully considering equipment selection in the design of instructional tennis programs, particularly for adult beginners. Like the ball type, the qualitative data showed that participants who used the foam tennis ball were more likely to perceive the rackets as children's equipment compared to those who used the felt tennis ball. This perception of modified equipment as being exclusively for children mirrors challenges encountered during the implementation of modified equipment in youth tennis, where parents often viewed the equipment as inferior to traditional "adult" gear and believed their children should use adult-sized equipment instead (Gould et al., 2016). However, more recent research on stakeholders' perceptions of modified tennis equipment for children has demonstrated a shift towards more positive views, recognizing the equipment as valuable for learning and development (Buszard et al., 2020). If modified equipment is consistently implemented for adults and efforts are made to establish it as part of the official adult tennis programs, these stereotypes may gradually diminish over time.

A valuable finding from this study's qualitative aim was the participants' recommendation for incorporating more skill development and instruction into the programming. Although match play and game-based activities were enjoyable, participants expressed a desire for more guidance on technique and movement from coaches. While games-based learning is an effective way to learn sport skills for youth, the balance between direct skill instruction and game-based learning must be further studied with adult beginners in tennis.

Modified tennis and pickleball

Although the differences were not statistically significant, the quantitative data showed that participants reported marginally higher levels of enjoyment, commitment, socialization, and behavioral intention when engaging in pickleball. Conversely, players reported a greater sense of a better perceived alignment with traditional tennis when participating in modified tennis. The qualitative findings corroborate the quantitative data, as participants highlighted the relative ease of learning modified tennis, attributed to the slower pace of the tennis ball and the more straightforward rules compared to pickleball. These results suggest that novices in racket sports may have comparable experiences in modified tennis and pickleball. Through the qualitative data, participants attributed the play opportunities and community already established in pickleball as reasons for the higher level of behavioral intention and commitment to pickleball.

An interesting finding is the higher rates of perceived competence for modified tennis found in the quantitative data, as perceived competence is a primary source of motivation and engagement in physical activity for adults (Stodden et al., 2009). An increase in perceived competence for participants can lead to continuing participation in the sport. Furthermore, tennis is reported to have a long learning curve due to the complex movement patterns and techniques, making it difficult for beginner players to engage in match play and game-based play quickly. This was supported by the qualitative data, which showed that participants attributed the higher perceived competence and simple learning curve of red ball tennis to the equipment and rules, which made skills less complex and easier to understand. From this finding, modified tennis for adults may offer an opportunity for beginners to learn the tactical elements of the sport quicker as they can engage in match play and experience competition sooner. Also, for those who cannot play traditional tennis, modified tennis may offer a viable way for players to engage in the sport (Stroesser et al., 2024).

Another valuable finding within the quantitative data is that participants perceived modified tennis as more closely aligned with traditional tennis than pickleball. When considered alongside the observed increase in perceived competence, this suggests that modified tennis formats can effectively support individuals in skill development and confidence-building. This alignment may facilitate a smoother transition to traditional tennis, making it a strategic tool for beginner engagement. Additionally, the closer fit between modified and traditional tennis may foster sustained participation by offering a more accessible entry point for novices, ultimately contributing to their long-term involvement in the sport (Buszard et al., 2020). This could be proposed as a strategy for tennis to continue its growth and achieve a competitive edge in the increasingly competitive racket sports market.

CONCLUSIONS

Building on previous literature, the findings of this study underscore the importance of offering modified programming and selecting appropriate modified equipment not only for adult beginner tennis players but also for modified sports in general. This study provides valuable insights, suggesting that future modified programming for adult tennis should adopt a balanced approach that integrates both skill instruction and game-based play to enhance the effectiveness of these programs. In the present study, it is difficult to understand which of the independent variables had the most influence on the participants' experience of the two sports. However, the qualitative data provided some insight into which aspects of red ball tennis and pickleball led to significant differences. Future research should examine the impact of various equipment options, programming strategies, and rule modifications on player outcomes, to gain a deeper understanding of how these factors influence player perceptions and experiences.

There were several limitations in this study which made it challenging to generalize the findings. First, participants only engaged in each sport for 3-4 total hours which may not be enough time for them to fully engage in each sport. Additionally, total time spent in each sport differed between locations with some locations with three hours in each sport and others with four hours in each sport. Future research needs to examine outcomes after participants have had a longer and more sustained exposure to each sport. Second, this study involved pilot programming in three locations across the United States and coaches were required to follow a curriculum developed by the researchers. However, it was clear from the focus groups, that participants classes varied from location to location meaning not all participants had the same experiences in the classes. These discrepancies and the number of independent variables could have influenced the outcomes and should be considered in future studies to ensure more uniformity and reliability in the findings. Based on the limitations, it is recommended that future research be conducted in a more controlled environment to understand whether findings can be replicated.

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REFERENCES

Alaoui, M., Kpazaï, G., Portmann, M., & Comtois, A. (2018). Outcome of the Teaching Games for Understanding (TGFU) approach when applied to tactical understanding of strategy and tactics in the game of tennis for young people. Journal of Medicine and Science in Tennis, 6-10.

Buszard, T., Oppici, L., Westerbeek, H., & Farrow, D. (2020). Implementation of a modified sport programme to increase participation: Key stakeholder perspectives. Journal of sports sciences, 38(8), 945-952.

Gould, D., Pierce, S., Wright, E. M., Lauer, L., & Nalepa, J. (2016). Examining expert coaches' views of parent roles in 10-and-under tennis. Sport, Exercise, and Performance Psychology, 5(2), 89.

Hill, B., & Green, B. C. (2008). Give the bench the boot! Using manning theory to design youth-sport programs. Journal of Sport Management, 22(2), 184-204.

Hublin, T., Barbaros, P., & Rupčić, T. (2021). The Game-Based Method is More Efficient than the Conventional Training Method in Teaching Tennis to Adult Beginners. Croatian Journal Educational/Hrvatski Casopis za Odgoj I Obrazovanje, 23(3).

Kilit, B., Arslan, E., Soylu, Y., & Lane, A. M. (2024). Does Playing Tennis with a Low-Compression Ball Effect Psychophysiological Responses and Match Characteristics in Recreational Adult Players? Sports, 12(3), 80.

Lee, R. M., & Robbins, S. B. (1995). Measuring belongingness: The social connectedness and the social assurance scales. Journal of counseling psychology, 42(2), 232.

McAuley, E., Duncan, T., & Tammen, V. V. (1987). Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis. Research Quarterly for Exercise and Sport, 60, 48-58.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2013). Qualitative data analysis: A methods sourcebook. Thousand Oaks, CA: Sage.

Scanlan, T. K., Chow, G. M., Sousa, C., Scanlan, L. A., & Knifsend, C. A. (2016). Sport Commitment Questionnaire-2 (SCQ-2) [Database record]. APA PsycTests. https://doi.org/10.1037/t50814-000

Sports & Fitness Industry Association (SFIA). (2023). 2023 Sports, Fitness, and Leisure Activities Topline Participation Report. Sports & Fitness Industry Association.

Stodden, D., Langendorfer, S., & Roberton, M. A. (2009). The association between motor skill competence and physical fitness in young adults. Research Quarterly for Exercise and Sport, 80, 223–229. https://doi.org/10.1080/02701367.2009.10599556

Stroesser, K., Mulcaster, A., & Andrews, D. M. (2024). Pickleball Participation and the Health and Well-Being of Adults—A Scoping Review. Journal of Physical Activity and Health, 1(aop), 1-14.

Till, B. D., & Busler, M. (2000). The match-up hypothesis: Physical attractiveness, expertise, and the role of fit on brand attitude, purchase intent and brand beliefs. Journal of advertising, 29(3), 1-13.

Williams, N. (2017). The Borg rating of perceived exertion (RPE) scale. Occupational medicine, 67(5), 404-405.

Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1996). The behavioral consequences of service quality. Journal of Marketing, 60(2), 31-46.

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Model for determining playing competencies for different levels of beginner and intermediate tennis players – Part 1

Taj Dolenc & Ales Filipcic

Faculty of Sport, University of Ljubljana, Slovenia

ABSTRACT

A competence model that covers various aspects of the game of tennis and enables tennis coaches to design and review their training programs for beginners and intermediate tennis players. The model considers the learning level of the students, the tactical aspects (perception, anticipation, decision factors, 5 game situations, and tactical intent), the technical aspects (stroke mechanics), and the training aspects (development fields).

Key words: competency model, teaching, game-based approach.

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Corresponding author: Taj Dolenc, dolenc.taj@gmail.com

INTRODUCTION

Tennis is a globally popular sport that combines skill, strategy and athleticism. It appeals to a wide range of ages and skill levels and offers both recreational enjoyment and competitive opportunities at various levels. The International Tennis Federation (ITF) encourages teachers and coaches to use innovative teaching and learning methods by simplifying procedures and modifying the sport to better meet the needs of new learners.

To address this issue, alternative teaching methods focused on specific tennis situations and tactics have been developed. These approaches are commonly referred to in the literature as “game-based approach” (GBA) (Manninen et al., 2024). In recent years, the GBA has been supported and practiced by many practitioners across Europe and the United States. Furthermore, the authors confirmed strong support from the ITF and leading tennis federations worldwide as well.

Turner et al. (2002) suggest that GBA emphasizes tactical demands rather than technical skills when teaching tennis to beginners. These lightweight balls are easier to hit, and as players master basic strokes, they transition to 'soft' balls (red, orange, or green) inflated to lower pressures, resulting in slower flight and lower bounce (Pluim, 2014). It allows intermediate players more time to return shots, extends rallies, and enhances their overall experience. This structure facilitates a gradual development in technical skills and tactical understanding for young players.

Training models should integrate elements of learning and enjoyment, allowing coaches to evaluate and enhance the skills of less skilled and skilled players through play activities. The GBA emphasizes experiential learning, where players uncover game strategies through participation, reinforcing that "the game is the best teacher" (Harvey & Light, 2015). GBA, which incorporates elements of both complex and non-linear pedagogy, can be used to more holistically

shape and enhance students' learning of movement skills. Nonlinear pedagogy (NLP) is advocated as an approach that views movement skill acquisition with a strong emphasis on exploratory behavior and the development of individual movement skills (Chow et al., 2021). In NLP, the design of the exercise microstructure is based on the continuous, intertwined relationships between decision-making, action, perception and cognition in sport performance and learning contexts, which is extremely useful for tennis instruction.

The aim of the first part of the article is to create a comprehensive model of tennis teaching/development by integrating different aspects, areas, and skills (see Figure 1). The individual parts of the model are explained in more detail below.

THE LEARNING PROGRESS IN TENNIS

As with any other sport, there are three stages in learning to play tennis: Understanding the basics of tactical principles, developing perception, motor skills and technique, and gaining playing experience.

	Tactics			Technique	Training
Learning level	**Perception/ Anticipation/ Decision factor**	**Game situations**	**Tactical intention**	**Stroke mechanics**	**Field of development**
Knowledge (understanding)	Incoming ball (5 ball controls)	Serving	Trading	Balance	Playing competencies*
Skill (doing)	Opponent	Receiving	Neutralising opponent's advantage	Timing	Motor abilities & skills
Experience (using/adapting)	Player (own position on court)	Playing at the baseline	Creating an opportunity	Rhythm	Mental abilities & skills
		Approaching or at the net	Finishing the point	BIOMEC	Note: Biological factors should be considered
		Passing	Changing pace or playing defensive	PAS	

*Playing competencies: tactical and technical skills

Figure 1. *A comprehensive model of tennis teaching/development by integrating different aspects, areas, and skills.*

Level 1: Understanding the tactical principles

At the basic level, it is crucial that players understand the basic objectives of the game. Minimal distractions are required at this stage. In the beginning, the racket can be an obstacle. Being unfamiliar with the weight, grip, and size of the racket, it is often difficult to control, which hinders the development of proper technique. This can lead to frustration and slow progress as beginners find it difficult to concentrate on their swing and the ball at the same time (Banwell et al., 2013).

At this level, the beginner tennis players must intuitively grasp the basic tactical principles. They should reach a decisive "eureka" moment and, as a first step, understand three primary strategies for winning points, such as staying in contested rallies to force the opponent into errors, exploiting open spaces on the court, or reducing the opponent's time to perceive, prepare and execute the shot. Understanding the logic behind any tactical intent is paramount; without this understanding, players will struggle to apply their skills effectively in real-game situations. Strengthening this foundation is the cornerstone for long-term success in tennis.

Level 2: Developing perceptual, motor, and technical skills

The acquisition of new technical skills for each of the three main strategies begins with an understanding that forms the basis for the development of perceptual, movement, and technical skills. The goal is to translate understanding into actual performance. Initially, the performance will not be perfect, but through countless repetitions, players will refine their techniques and develop the skills required to execute the instructions effectively. It is important to realize that while perfecting skills takes time, the basic logic of movements and strategies should not simply be forgotten (Rosenbaum et al., 2001).

Level 3: Gaining Experience

The final stage of learning progression is gaining game experience. The ability to use skills and game knowledge to find the best solutions in certain game situations can make a difference for players. While much of this experience is gained in competition, coaches play a crucial role in shaping this experience through targeted adjustments in training. One of the most important adaptations is the regular introduction of different conditions. Players must learn to adapt not only to the opponent's style of play but also to different surfaces, balls, weather conditions, and other external factors (Williams & Hodges, 2023).

DECISION FACTORS IN TENNIS

As already emphasized, decision-making is crucial to success in tennis. Players must consider several factors when determining their next move on the court. We can identify three important decision-making factors that significantly influence a player's decision: the opponent, the incoming ball, and the player's position (García-González et al., 2014).

GAME SITUATIONS IN TENNIS

Players must perform their technical characteristics in a tennis-specific situation. They must adapt their stroke selection to the tactical situation. There are five main scenarios in which players can develop different tactical intentions: serving, returning, both on the baseline, approaching or at the net, and passing (Crespo & Miley, 2002). Each situation is unique and requires a specific strategic approach. Young and beginner players need to be taught the importance of adapting their tactics; they should learn to have at least two options for each situation to avoid becoming predictable.

In summary, game situations need to be practiced in an environment very similar to official games to build confidence and experience, especially for younger players and beginners. By focusing on serving, returning, both on the baseline, approaching or at the net, and passing, players can develop comprehensive skills that allow for greater adaptability and success on the court.

TACTICAL INTENTIONS

Strategy and tactics are related concepts in sports performance. Tennis players should have a tactical intention (i.e. what they hope to achieve) for each stroke that affects movement, preparation, execution and retreat on the court after the stroke. Tactical intent can also be influenced by the state of the game; depending on the game situation, intent can change several times during a point. Tactical intentions are: trade, build, create an opportunity, finish the point, neutralize the opponent's advantage, stay in the point, play defensively, and turn the point around (LTA, 2024). For this article, we have used tactical intentions that are suitable for beginners and intermediate tennis players.

STROKE MECHANICS

In several sports, fast and precise movements lead to high performance and success. Successful tennis players show greater accuracy when hitting fast balls than their less successful opponents. The tennis movement, a complex whole-body exercise, is performed under time pressure and unpredictable, variable, and dynamic conditions.

The optimal technique can be defined as that which provides the most efficient combination of power and control in stroke and movement technique. Player development based on scientific knowledge allows for an individualized approach that takes into account the key mechanical characteristics of each skill, while also promoting feel and considering a player's physical attributes. An understanding of biomechanics from a sports medicine perspective is also important if player development is to occur with minimal risk of injury. The technique of strokes and movements, both groundstrokes and serves and returns, is changing and tennis players and coaches are constantly looking for solutions to increase efficiency and economy. The most important biomechanical principles for tennis can be easily recalled with the acronym BIOMEC, which means: balance, inertia, opposite force, impulse force, elastic energy, and coordination chain (Crespo & Miley, 2002).

Three shoulder rotations (use of angular momentum) are important for an effective serve, namely: twist (frontal plane), shoulder over shoulder (transverse plane), and somersault (horizontal plane). The coordination chain comprises “the segments of the body that act like a system of chain links, whereby the force generated by one link or part of the body is successively transmitted to the next link” (Crespo & Miley, 2002). The optimal coordination (timing) of these body segments enables an efficient transfer of speed through the body from one body segment to the next. Another important aspect of the effective application of biomechanical principles is the loading and execution of the lower limb drive (leg drive), which, according to coaches, is crucial for serves and baseline shots and significantly influences upper body movements. The lower and upper body have completely different requirements when executing tennis strokes and movements (Lester et al., 2023). Tennis players also use the elastic energy principle to “recharge" (pre-stretch) themselves in the preparation phase of the serve, return, and groundstrokes, which leads to more power. When muscles are stretched, the muscles and tendons store energy, just as a rubber band stores energy when it is stretched.

In a GBA, technique is simply a way of executing a tactic. With every stroke in tennis, the racket must pass the impact zone. Elderton (2024) introduces the concept of PAS principles, which define the path, angle, and speed of the racket. The path of the racket can be from low to high (topspin), from high to low (underspin), at the same height, and in the direction of the target (as opposed to a circular swing path). The angle of the racket can be vertical: open to the sky (racket face pointing upwards), vertical (racket face pointing straight up and down), and "closed" (racket face pointing downwards). At a horizontal angle, the racket can be oriented as follows: outside, inside, or parallel. The racket can be in the impact zone: accelerating, decelerating, or maintaining its speed. The concepts of BIOMEC and PAS are closely linked, the first determines the effectiveness of the performance, and the second influences the success of the strokes and movements.

FIELD OF DEVELOPMENT

The development of a tennis player can be traced through five key areas: tactical, technical, motor, mental, and biological development (Liu et al., 2024). Psychological components such as self-confidence, self-esteem, personality, and motivation are important in tennis, but technical and tactical skills are often considered the most important. The technique is necessary to execute movements precisely, while tactics means making quick and correct decisions during the game. While talented players usually develop these skills more effectively than average players, continuous development during youth and adolescence is essential for progression to a professional level.

Playing competencies

Tactical development involves learning strategies, different tactical intentions, and decision-making skills required for success on the court. For beginners, this means understanding how to position themselves effectively, where to place their strokes, and how to read their opponent's movements (Kolman et al., 2019).

Technical development focuses on building the fundamental skills required to play tennis. Beginners work on their balance, timing, rhythm, as well as the trajectory, angle, and speed of the racket to ensure they can execute each stroke effectively. Good technical skills provide a solid foundation for all aspects of the game and make it easier for players to progress (Elderton, 2010).

Tactical and technical development is a long-term, never-ending process that is based on the consideration of biomechanical laws, the level of motor skills, the fundamentals of motor learning, the individual physical and personal characteristics of the athlete, etc. Even top tennis players refine their tactical and technical skills to the unattainable limits of perfection.

Motor development

Motor development refers to physical skills that are essential for athletic performance. These include coordination, agility, balance, and speed. For beginner tennis players, improving motor skills is crucial as these skills will help them move more efficiently on the court. Good motor skills also contribute to overall athleticism, which is beneficial in all sports.

Mental development

Tennis players benefit from psychological skills to constantly and successfully control their thoughts. Psychological skills are made up of a variety of different elements, such as motivation, concentration, stress management, and anxiety. To perform better, they need to develop their psychological skills. Players can control their behavior, thoughts, and physical sensations using psychological skills, which helps them to play better. Research has shown that tennis coaches are increasingly interested in learning about and incorporating mental training approaches into their daily work with players, and are gradually becoming aware of the importance of mental skills for performance in tennis Mental training is the practice of developing internal skills that help athletes achieve their goals by teaching them to control their psychological states in line with those goals. The main goals of mental training for athletes are to improve their performance and overall

well-being. According to experts, young athletes who have strong psychological traits and skills can better cope with these difficulties and stresses and prevent burnout or early retirement from sport.

Biological factors

The growth and maturity status of young athletes have a significant impact on their body size, and individual differences in the growth and maturity status of young athletes could have an impact on selection, as larger physical characteristics can provide advantages in most sports (Söğüt et al., 2023).

Individual differences in growth and maturation appear to contribute to the selection of elite junior players in tennis, favoring males and females with advanced maturation and comparatively high height and weight for their age. This has important implications for the identification and development of tennis talent (Myburgh et al., 2016).

Biological age plays a crucial role in tennis performance and athlete development, as physical characteristics such as size, strength, and power are closely linked to maturation, especially during puberty. Changes in body composition can vary with early or advanced maturity, especially in females. Considering the demands that sport places on coordinative abilities and aerobic and anaerobic conditioning, coaches need to create a development plan that is tailored to each athlete's maturation and respects their biological individuality (Vilela Brito, 2020).

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REFERENCES

Banwell, G. H., Roberts, J. R., Halkon, B. J., Rothberg, S. J., & Mohr, S. (2013). Understanding the Dynamic Behaviour of a Tennis Racket under Play Conditions. Experimental Mechanics, 54(4), 527-537. https://doi.org/10.1007/s11340-013-9803-9

Chow, J. Y., Komar, J., & Seifert, L. (2021). The Role of Nonlinear Pedagogy in Supporting the Design of Modified Games in Junior Sports. Front Psychol, 12, 744814. https://doi.org/10.3389/fpsyg.2021.744814

Crespo, M., & Miley, D. (2002). Advanced coaches manual. International Tennis Federation.

Elderton, W. (2010). Tactical and technical development considerations for 10 and under players. ITF Coaching & Sport Science Review, 18(51), 30-32. https://doi.org/10.52383/itfcoaching.v18i51.612

Elderton, W. (2024). Ball Control - The Unsung Hero of Tennis Play. Retrieved 2024/11/21, from https://tennisone.tennisplayer.net/club/lessons/elderton/control/ball.php

García-González, L., Moreno, A., Gil, A., Moreno, M. P., & Villar, F. D. (2014). Effects of Decision Training on Decision Making and Performance in Young Tennis Players: An Applied Research. Journal of Applied Sport Psychology, 26(4), 426-440. https://doi.org/10.1080/10413200.2014.917441

Harvey, S., & Light, R. L. (2015). Questioning for learning in game-based approaches to teaching and coaching. Asia-Pacific Journal of Health, Sport and Physical Education, 6(2), 175-190. https://doi.org/10.1080/18377122.2015.1051268

Kolman, N. S., Kramer, T., Elferink-Gemser, M. T., Huijgen, B. C. H., & Visscher, C. (2019). Technical and tactical skills related to performance levels in tennis: A systematic review. Journal of Sports Sciences, 37(1), 108-121. https://doi.org/10.1080/02640414.2018.1483699

Lester, M., Peeling, P., Girard, O., Murphy, A., Armstrong, C., & Reid, M. (2023). From The Ground Up: Expert Perceptions of Lower Limb Activity Monitoring in Tennis. J Sports Sci Med, 22(1), 133-141. https://doi.org/10.52082/jssm.2023.133

Liu, S., Wu, C., Xiao, S., Liu, Y., & Song, Y. (2024). Optimizing young tennis players' development: Exploring the impact of emerging technologies on training effectiveness and technical skills acquisition. PLoS One, 19(8), e0307882. https://doi.org/10.1371/journal.pone.0307882

LTA. (2024). Tennis Skills, Techniques and Tactics. Retrieved 2024-11-20, from https://www.lta.org.uk/4ab8ae/siteassets/roles/further-education/units-12-and-07-tennis-skills-techniques-and-tactics.pdf

Manninen, M., Magrum, E., Campbell, S., & Belton, S. (2024). The effect of game-based approaches on decision-making, knowledge, and motor skill: A systematic review and a multilevel meta-analysis. European Physical Education Review. https://doi.org/10.1177/1356336x241245305

Myburgh, G. K., Cumming, S. P., Coelho E Silva, M., Cooke, K., & Malina, R. M. (2016). Growth and maturity status of elite British junior tennis players. Journal of Sports Sciences, 34(20), 1957-1964. https://doi.org/10.1080/02640414.2016.1149213

Pluim, B. M. (2014). The evolution and impact of science in tennis: Eight advances for performance and health. British Journal of Sports Medicine, 48(SUPPL. 1), 3-6. https://doi.org/10.1136/bjsports-2014-093434

Rosenbaum, D. A., Carlson, R. A., & Gilmore, R. O. (2001). Acquisition of intellectual and perceptual-motor skills. Annu Rev Psychol, 52, 453-470. https://doi.org/10.1146/annurev.psych.52.1.453

Söğüt, M., Ödemiş, H., & Durmuş, D. (2023). Growth and maturity status of young elite and sub-elite tennis players. ITF Coaching & Sport Science Review, 31(89), 21-26. https://doi.org/10.52383/itfcoaching.v31i89.373

Turner, A., Crespo, M., Reid, M., & Miley, D. (2002). The Games for Understanding (GFU) Teaching Approach in Tennis. ITF Coaches Review, 26, 4-9.

Vilela Brito, A. (2020). Biological age vs. chronological age: the impact on the development of the young tennis athlete. ITF Coaching & Sport Science Review, 28(80), 38-41. https://doi.org/10.52383/itfcoaching.v28i80.69

Williams, A. M., & Hodges, N. J. (2023). Effective practice and instruction: A skill acquisition framework for excellence. J Sports Sci, 41(9), 833-849. https://doi.org/10.1080/02640414.2023.2240630

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Model for determining playing competencies for different levels of beginner and intermediate tennis players – Part 2

Taj Dolenc & Ales Filipcic

Faculty of Sport, University of Ljubljana, Slovenia

ABSTRACT

In the first part of the article, the factors that influence the teaching of beginners and advanced tennis players were presented in detail, such as the learning level of the students, the tactical aspects (perception, anticipation, decision factors, 5 game situations and tactical intention), the technical aspects (stroke mechanics) and the training aspects (development fields). In the second part of the article, the factors for determining playing ability are used for various game situations and presented below using an example with instructions for the practical application of the model.

Key words: competency model, teaching, game-based approach.

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Corresponding author: Taj Dolenc, dolenc.taj@gmail.com

INTRODUCTION

The aim of the second part of the article is to give a practical example of the application of the model, also from the point of view of skill/competence development for beginner and intermediate tennis players.

In developing the competency model, we have considered all the areas shown in Figure 1, which is part of the first part of the article. We considered 3 phases of learning (Zetou et al., 2012), the influence of perception, anticipation and decision making in tennis (Broadbent et al., 2017; Loffing & Hagemann, 2014; Vickers, 2007), game situations (Crespo & Miley, 2002), tactical intention (Del Villar et al., 2007; García-González et al., 2014; Sanchez Mencia et al., 2023), stroke mechanics (Kwon et al.) and area of development. Within the areas, we paid the most attention to playing competencies - tactical and technical skills (Elderton, 2010; Hopper & Rhoades, 2023; Kolman et al., 2019).

COMPETENCY MODEL FOR BEGINNER AND INTERMEDIATE TENNIS PLAYERS

In the following, some basic playing competencies are listed, considering the learning level, the tactical aspects (perception, anticipation, decision-making factors, 5 game situations, and tactical intention), the technical aspects (stroke mechanics), and the training aspects (development fields), which are shown in Figure 1.

The order considers the gradation, as the competencies are always listed at the beginning, where we want the tennis players to understand the tactical idea of which factors influence the tactical decision and intention. At the same

time, the complexity of the movement tasks (tennis strokes and movement in 5 development areas) increases with understanding. The coach works systematically, considering the athlete's biological development, helping tennis players to develop fundamental game skills. As this is a long-term model that also considers other factors (philosophy, conditions, teaching objectives, etc.), we have not specified the size of the court (red, orange, green) and the type of balls for the game skills. We leave the choice of these factors and the time aspect of development to the coaches.

The competency model defines factors and areas for long-term development and allows tennis teachers and coaches to interpret and apply them individually, especially the time it takes students to achieve each competency. In addition, tennis teachers and coaches can use their own approaches, methods, and exercises to progress from one level of play to the next.

Serving

The player starts the rally with a fluid throw from below or above the shoulder in a balanced position towards or away from the partner and can catch and throw the incoming ball.

The player starts the rally with a fluid underarm or overarm serve in good balance with the partner to start the rally in cooperation with the partner through the central corridor.

The player starts the rally with the serve and a forearm movement away from the opponent, to move the opponent and "hit the first shot in the open court."

The player starts the rally with the first serve with a twist shoulder rotation and continues the rally after the return in the middle, forehand, or backhand corridors, depending on the position of the opponent, to move the opponent. The player starts the rally with the second serve to the opponent's body with a twist shoulder rotation and continues the rally in the central corridor to neutralize the opponent's possible advantage.

The player creates an opportunity with the first serve by making a twist or a shoulder-over-shoulder rotation in three possible directions (wide, body, T) to create an advantage by making a better shot in three corridors, depending on the three decision factors. The player opens the rally with the second serve in a preferred direction with a suitable combination of ball rotation, height, and depth and plays the first shot close to the baseline with optimal balance to neutralize the opponent's potential advantage.

The player creates an opportunity with the first serve by using all three shoulder rotations (including somersault), effective external and internal shoulder rotation, and a coordination chain in three possible directions (wide, body, T) by making the opponent move, take time or force a shot outside the optimal returning window, to use a better shot and end the rally within three shots. The player uses various second serves as unpredictably as possible to neutralize the opponent's potential advantage or to create an advantage in the rally.

Returning

The player catches the ball thrown by his partner over his shoulder at hip height and throws it to his partner with a fluid throw from bottom to top.

The player hits the incoming overarm serve in a balanced position at hip height and with a fluid movement of the racket from bottom to top and forward towards the central corridor and returns to an optimal position on the court.

The player hits the incoming serve in the direction of the follow-through to move the opponent through an early torso turn and fluid acceleration in height, length, and speed of the ball and returns to an optimal position on the court so that the second shot can be played into an open court.

The player hits the fast incoming serve through the central corridor by judging the correct distance to the baseline and using leg loading, leg drive, and the correct number of parts of the coordination chain. After the long shot, the player covers the court optimally and the second shot is played considering the position of the opponent and the incoming ball, to maintain balance in a rally or neutralize the opponent's advantage.

The player recognizes/anticipates a slower/shorter incoming ball, uses the forehand or backhand early after the bounce, and uses the optimal number of parts of the coordination chain (more often with the forehand and preferably several times in succession) with the aim of dominating the rally or finishing the point.

Both on the baseline

The player exchanges the ball with the partner on the floor within a sufficiently wide corridor in a low balance position, moving the racket from behind and parallel to the ground, with the aim of staying in the rally.

The player passes the ball to his partner with a fluid throw from the bottom to the top, standing and catching the ball at hip height.

The player exchanges the ball with a forehand and a backhand with his partner, by controlling the height, length, and speed of the ball in a balanced position with a fluid shot at hip height, with the aim of establishing a rally in the central corridor and returns to an optimal position on the court.

The player passes the ball to his partner with a fluid throw from bottom to top, catches the ball while standing at hip height, and returns to an optimal position on the court.

The player hits the ball from the comfort zone at the baseline towards one of the three corridors with the aim of moving the opponent by adjusting the height, length, and speed of the ball with an early torso turn and a fluid acceleration through the contact zone.

The player changes the direction of shots from the challenge zone at the baseline within the forehand and backhand corridors with the aim of opening or closing the court by using heavy topspin shots and creating a situation to change direction down the line and surprise the opponent.

The player on the baseline recognizes higher balls that go into the comfort zone early on and uses the inside-out/in forehand (preferably several times in succession) with the aim of dominating the rally or finishing the point.

The player on the baseline chooses his shots (better shot if possible) considering all three decision factors to create opportunities by recognizing and anticipating shorter, slower/higher balls early and taking time off the opponent with powerful shots close to the baseline.

The player on the baseline chooses the shots depending on the position of the opponent and the incoming ball to maintain balance in a rally, or neutralizing the opponent's advantage with movement patterns that enable the execution of faster shots with topspin rotation using the opposite force, elastic energy, and the entire coordination chain.

Approaching or at the net

The player looks for a suitable position at the net and catches the ball with one or both hands at shoulder height, which is delivered by a throw or a shot from below from various positions on the court, then throws it from top to bottom and away from the partner.

The player moves to the net and blocks the incoming ball with the racket at shoulder height with the aim of directing it away from the partner.

During the rally at the baseline, the player recognizes that the opponent is in trouble, and if the incoming ball is shorter/slower/higher, the player plays an approach and/or volley away from the opponent with the aim of ending the rally.

A player who puts his opponent in a defensive position, in which he defends with a lob, ends the rally with an overhead smash in optimal dynamic balance, considering all three decision factors.

During the rally at the baseline, the player recognizes that he has gained an advantage due to the three decision factors in anticipation and enters the court before the incoming ball lands and chooses between three options: well approach, drive-volley, or drop-shot to end the rally.

Passing

The player realizes early on that his shot was poorly executed (slow, shorter) and that his opponent has an advantage in the point, so he moves further away from the baseline with the aim of defending with a high, loopy shot and staying in the rally.

If the player is put under time pressure by his opponent and is in the challenge zone, he plays a shot in the same direction or in the comfort zone, where he keeps his balance and uses the possible number of parts of the coordination chain to optimally cover the court and stay in the point.

In a longer rally, the player uses a change of rhythm with a combination of higher and heavily rotated balls or lower slice shots (more often with the backhand) with the aim of preparing the partner to play outside the optimal impact zone and forcing him to make a mistake by changing the pace of the rally.

The player who is in the defensive zone and is under great time pressure from the opponent plays a passing shot or a lob in dynamic balance according to the 3 decision factors with the aim of staying in the point or finishing the point.

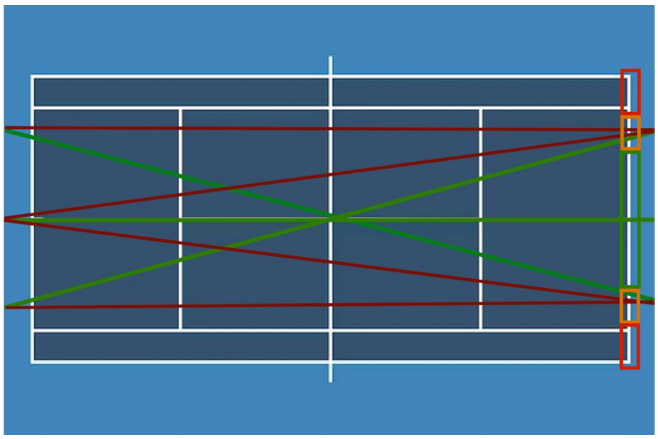

Figure 2. *Display of corridors (that determine the direction of play in different game situations and movement zones (comfort = green, challenge = orange, defensive = red) on the baseline.*

PRACTICAL APPLICATION OF THE MODEL

The proposed competencies can be observed and measured in real time during an official match, a friendly match/training, or by analysing a video. To correctly assess the success rate, players perform a single competency during a match 6 to 10 times. We suggest at least a 70% success rate at a single competency before increasing the difficulty and demands from the player with a new competency. With this tool, coaches can easily identify the player's possible struggles and immediately start improving their player's game.

CONCLUSIONS

Crespo et al. (2024) suggest more playing competency models are to be made with a clear description of standards, evidence and their practical application from beginners to advanced tennis players. This competency model emphasises the construction of playing competencies, its gradation and how it can be measured in real time specific to beginner and intermediate level tennis players. It allows coaches to form new playing competencies according to their students' level. They can gradually improve their game by focusing on different aspects of the game simultaneously with the consideration of the biological role and creating a long-term development plan to suit each player's needs.

As tennis is evolving quickly, a more strategic approach is obligatory. Introducing innovative teaching methods is key to maintaining interest and encouraging the growth of tennis across diverse populations. With the appropriate long-term development plan coaches will not only help players grow and learn through technical and tactical demands but will also instill more fun and love for the sport.

CONFLICT OF INTEREST AND FUNDING

The authors declare that they do not have any conflict of interest and that they did not receive any funding to conduct this research.

REFERENCES

Broadbent, D. P., Ford, P. R., O'Hara, D. A., Williams, A. M., & Causer, J. (2017). The effect of a sequential structure of practice for the training of perceptual-cognitive skills in tennis. PLoS One, 12(3), e0174311. https://doi.org/10.1371/journal.pone.0174311

Crespo, M., Martínez-Gallego, R., & Filipcic, A. (2024). Determining the tactical and technical level of competitive tennis players using a competency model: a systematic review. Frontiers in Sports and Active Living, 6. https://doi.org/10.3389/fspor.2024.1406846

Crespo, M., & Miley, D. (2002). Advanced coaches manual. International Tennis Federation.

Del Villar, F., García, L., Iglesias, D., & Moreno, M. P. (2007). Expert-Novice Differences in Cognitive and Execution Skills During Tennis Competition. Perceptual and Motor Skills, 104(1989), 355-365. https://doi.org/10.2466/pms.104.2.355-365

Elderton, W. (2010). Tactical and technical development considerations for 10 and under players. ITF Coaching & Sport Science Review, 18(51), 30-32. https://doi.org/10.52383/itfcoaching.v18i51.612

García-González, L., Moreno, A., Gil, A., Moreno, M. P., & Villar, F. D. (2014). Effects of Decision Training on Decision Making and Performance in Young Tennis Players: An Applied Research. Journal of Applied Sport Psychology, 26(4), 426-440. https://doi.org/10.1080/10413200.2014.917441

Hopper, T., & Rhoades, J. (2023). Biomechanical insights on Tennis Canada's skill fundamental phases: Ecological dynamics, force generation and reading gameplay. ITF Coaching & Sport Science Review, 32(91), 18-25. https://doi.org/10.52383/itfcoaching.v32i91.405

Kolman, N. S., Kramer, T., Elferink-Gemser, M. T., Huijgen, B. C. H., & Visscher, C. (2019). Technical and tactical skills related to performance levels in tennis: A systematic review. Journal of Sports Sciences, 37(1), 108-121. https://doi.org/10.1080/02640414.2018.1483699

Kwon, S., Pfister, R., Hager, R., L. , Hunter, I., & Seeley, M. K. Influence of Tennis Racquet Kinematics on Ball Topspin Angular Velocity and

Accuracy during the Forehand Groundstroke. Journal of Sports Science and Medicine, 16(4), 505-513.

Loffing, F., & Hagemann, N. (2014). On-court position influences skilled tennis players' anticipation of shot outcome. J Sport Exerc Psychol, 36(1), 14-26. https://doi.org/10.1123/jsep.2013-0082

Sanchez Mencia, E., Campos-Rius, J., González Santamaría, X., & Borrajo Mena, E. (2023). Tactical skills in tennis: A systematic review. International Journal of Sports Science & Coaching, 19(2), 894-907. https://doi.org/10.1177/17479541231216268

Vickers, J. N. (2007). Perception, cognition, and decision training. The quiet eye in action. Human Kinetics.

Zetou, E., Koronas, V., Athanailidis, I., & Koussis, P. (2012). Learning tennis skill through game Play and Stay in elementary pupilsls. Journal of Human Sport and Exercise, 7(2), 560-572. https://doi.org/10.4100/jhse.2012.72.19

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English, tennis and respect for diversity in Primary Education: We are all ASD

Ángela Isabel Carmona Blanco

CEIP Virgen de Guadalupe, Arroyomolinos, Cáceres, Spain.

ABSTRACT

This article presents scientific and didactic foundations on the potential of introducing tennis in Primary Education to acquire skills in the area of Foreign Language (LE), in this case through English, from the Area of Physical Education (PE). All of the above is considered from the perspective of the treatment of students with special educational needs associated with disability, more specifically those with autism spectrum disorder (ASD). In this sense, the important physical, psychological and social benefits of sport, in general, and tennis, in particular, in children with ASD are founded, as well as the positive effect of teaching an LE on the development of their social skills and communicative competences. On the other hand, scientific bases are presented on the opportunity to develop programs in the school context that allow teaching Spanish through PE. Next, methods and strategies that have proven effective with ASD students in PE classes are discussed. Finally, contemplating all the above, examples of activities aimed at learning tennis and English simultaneously are presented, promoting the recognition and respect for diversity, the empathetic and inclusive attitude, as well as the acceptance of other realities, especially that of ASD students.

Key words: Physical Education, school, autism, autism spectrum disorder.

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Corresponding author: Ángela Isabel Carmona Blanco, angelacarmonablanco@gmail.com

INTRODUCTION

Students with special needs associated with disabilities in Spain amounted to 262,732 people during the 2022-2023 academic year, 84.20% of whom were in ordinary education and 15.80% in special education (Autism Confederation Spain, 2024). During the aforementioned 2022-2023 academic year, students with autism spectrum disorder (ASD) accounted for 29.71% of the total who had special needs associated with disability, becoming the largest category, increasing since the 2011/2012 school year by 310.36%, representing 0.94% of non-university students (Autism Confederation Spain, 2024). In this sense, it should be said that ASD is a neurodevelopmental condition that is characterized by limitations in social interaction and communication skills, as well as by a high presence of repetitive behaviours and, although previously motor disorders were considered marginal in these people, recent research has highlighted their importance, showing sports practice a positive impact on them, both in psychosocial skills and motor behaviour (Grosprêtre et al., 2024). Thus, as the prevalence of ASD increases, there is a growing need to develop physical activity interventions in school that address the behavioural challenges of these individuals (Munn et al., 2024).

The results of a recent systematic review of the scientific literature, which aimed to examine bullying against students with disabilities during Physical Education (PE) classes at school. showed the need to carry out a collaborative approach between students, teachers and families, towards the development of sports programs that can empower students with disabilities, as well as to help identify the main barriers to participation towards the creation of a safe and inclusive learning environment (Gusliana et al., 2024). Along the same lines, the results of another systematic review, focused on analysing the results of research over the last 10 years on disability awareness and inclusion programmes in PE classes, showed that these help to improve the attitude of the school community towards people with disabilities, being especially effective due to the direct contact inherent in classes in this area (Luarte-Rocha et al., 2023).

In relation to all of the above, a meta-analysis that aimed to explore the effect of physical exercise intervention on the fundamental motor skills (HMF) of children with attention deficit hyperactivity disorder (ADHD) and/or ASD, concluded that these interventions can improve their gross motor skills (Ye et al., 2023), In this sense, it is important to consider the specific benefits obtained depending on the type of activity practiced, with aquatic therapy showing a greater effect on stability skills, while table tennis or horseback riding have better results in fine manual control and hand-eye coordination (Ye et al., 2023). Likewise, another meta-analysis that aimed to discuss the effects of physical activity intervention on children and adolescents with ASD, concluded that physical activity has a significant positive impact on social interaction capacity, communication ability, motor skills, and the degree of ASD (Huang et al., 2020). On the other hand, a systematic review concluded that, compared to control groups, physical activity interventions had a great positive

effect on general sleep problems in children and adolescents with ASD, and could constitute an effective alternative to pharmacological treatments, sleep education programs for parents and behavioural interventions. effective but have several limitations, such as possible side effects or high economic cost (Liang et al., 2024).

Despite the significant benefits of physical activity in children with ASD, a meta-analysis of nine studies that used the degree of participation in moderate to vigorous physical activity (MVPA), measured with accelerometers, in ASD students, concluded that, compared to those who presented typical development (TDC), their MVPA level was 30 min/day lower. 12% and 8% lower during PE and recess, respectively, being 4 times more likely to not comply with the MVPA recommendation compared to those with BDD (Abadi et al., 2023). Thus, children with ASD would be clearly below compliance with a series of guidelines developed by a group of experts in accordance with the protocols of the World Health Organization (WHO) who, using and updating different systematic reviews, advise performing an average of 60 minutes/day of MVPA during childhood and adolescence (Bull et al., 2020). In this sense, focusing more specifically on the age group of Primary Education students, in which this practical proposal is framed, a study revealed that children aged 6 to 11 years with ASD performed significantly less physical activity than their peers in the general population Gehricke et al., 2020).

With regard to tennis, the results of an intervention with 4 children with ASD between 7 and 9 years of age, using the procedure from least to most prompting, consisting of offering the student a series of indications ordered from least to most intrusive, from least to most helpful, until the task is correctly performed, showed their effectiveness in each of the 4 subjects, significantly increasing their tennis skills (Yanardag et al., 2011). In this same line of action, a pilot study that aimed to determine the effectiveness of a tennis teaching and training program for people with ASD, combining specific tennis skills with others aimed at people with ASD, showed significant improvements after the intervention in specific tennis skills, in hand-eye coordination and leg strength. as well as social and communication skills (Shanok & Sotelo, 2022). In relation to the above, the results of a research with 18 people aged 7 to 19 years with ASD, using an adapted tennis program, called ACEing Autism, quantifying motor participation behaviours, showed a longer time with both appropriate behaviours (AC) for motor skills and those supported for motor skills (MA) than those inadequate for motor skills. spending more than 50% of their time in CA during the program. (Munn et al., 2024).

With regard to the teaching of English as a foreign language (FL) to students with ASD, a study carried out with children between 8 and 12 years of age with ASD concluded that the teaching of an LE, from the point of view of both caregivers and parents, it had a significant positive effect on their social skills and willingness to communicate compared to a control group, elicited through motivational modulation in a novel environment (Golshan et al., 2019). In fact, a systematic review of 12 scientific articles, which included a total of 328 children between 3 and 12 years of age diagnosed with ASD (169 bilingual and 159 monolingual), concluded that, although communication and language skills are among the domains most affected in people with ASD, bilingualism does not pose any added difficulty for the development of their language (Garrido et al., 2024)

In relation to the opportunity to propose programs in the school context that allow teaching a foreign language through CLIL (CLIL), a systematic review of 35 articles showed the great usefulness of these programs (Gil-López et al., 2021), achieving a higher success rate in the development of LE, both written and oral. than traditional methods (García-Calvo & Salaberri, 2018). In this sense, games and sports were the most used PE content in learning a Spanish as a foreign language through CLIL, considering that this type of content encourages communication between students to improve written and spoken expression skills (Gil-López et al., 2019). On the other hand, it is worth highlighting the interdisciplinary potential of tennis in Primary Education, both to develop from the PE area to other areas of the school (mathematics, foreign language...) (Fuentes-García & Carmona, 2021a), as well as offering important physical, psychological, and social benefits to children who practice it (Araújo et al., 2014). In relation to the above, a study with children aged 6 to 12 years concluded that the practice of tennis through coordination exercises and games achieved significant improvements in their executive functions and physical fitness (Ishihara et al., 2017), while another study concluded that children aged 5 and 6 years who practice tennis have a greater attention span and visual contribution to maintain balance than their counterparts who do not play sports (Rym et al., 2019). Likewise, an intervention with children aged 6 to 11 years concluded that, after 12 months of frequent tennis practice, working memory improved in them, and cognitive flexibility increased (Ishihara & Mizuno, 2018). The importance of this improvement in cognitive flexibility through tennis in the study should be highlighted, as a meta-analysis highlights the existence of cognitive flexibility difficulties in people with ASD (Lage et al., 2024).

Before delving into the practical proposal that we propose, it should be said that, despite the fact that tennis presents some difficulties to be developed in PE classes, due to its technical and organizational complexity, approaches by different authors present effective methodological solutions to positively overcome them in the context of Primary Education (Fuentes-García & Carmona, 2021a; Fuentes-García & Carmona, 2021b; Fuentes et al., 2020; Fuentes, 2013, Sanz et al., 2004), and even integrating tennis, as PE content, with English (Fuentes et al., 2005).

On the other hand, a review of the scientific literature that analysed the quality of the information on the content of physical activity and the description of the teaching methodology in children with ASD revealed that only 42% and 12% of the publications included, respectively. the teaching methods and styles used (Bentholm & Ramskov, 2023), which is why it seems relevant to us to offer specific guidance on what type of activities could be likely to be useful during PE classes with ASD children.

PRACTICAL PROPOSAL

This proposal is framed in the context of Spain, more specifically in Organic Law 3/2020, of December 29 (LOMLOE), establishing Primary Education three cycles, each of them of two years, starting with the first year of the first cycle (6 years) and structured in the following areas: a) Knowledge of the natural environment, social and cultural - Natural Sciences and Social Sciences-; b) Artistic Education - Plastic and Visual Education, and Music and Dance; c) Physical Education; d) Spanish Language and Literature and,

if any, Own Language and Literature; e) Foreign Language; f) Mathematics. In addition to these areas, in some of the courses of the third cycle (fifth and sixth years), Education in civic and ethical values is added. In this law, one of the aspects to be highlighted, closely linked to our proposal, is to use PE and sport to promote personal and social development, strengthen the habits of physical-sports activities in order to promote physical and mental well-being, as well as the personal and social development of the students.

In relation to the above, the LOMLOE identifies students with special educational needs as those who face barriers that limit their access, presence, participation or learning, derived from disability or serious behavioural, communication and language disorders, the latter two cases very characteristic of people with ASD. In this sense, the LOMLOE expressed the need for students with special educational needs to receive the specific educational support and attention necessary to achieve the learning objectives appropriate to their own development.

In relation to this proposal, we also consider Decree 107/2022, of 28 July, which establishes the organisation and curriculum of Primary Education for the Autonomous Community of Extremadura, which proposes a strong connection of the PE area with, among other issues, the recognition and respect for diversity, the empathetic and inclusive attitude or the use of social skills; while learning an LE enhances the acceptance of other realities that will enrich them while developing tolerance and awareness of social diversity.

Methods and strategies for the development of the practical proposal

For the practical proposal we will use the following methods and strategies that have proven their effectiveness in PE classes with ASD students:

- Anticipation: preparing the child for the intervention well in advance, for example, using in-depth interviews beforehand, to increase participation and motivation, to know the individual attitude and conditions of the children to participate in physical activity (Arnell. 2018).
- Visual aids (Bittner et al., 2018; Bremer et al., 2015; Bremer & Lloyd, 2016. Casey et al., 2015), in the case of environmental distribution, photographs of real objects, task cards with images or pictograms, In the latter case, we will especially use pictograms from the Aragonese Centre for Augmentative and Alternative Communication (ARASAAC), which are freely accessible, which are free of charge (ARASAAC, 2025a)
- Teacher demonstrations (Bittner et al., 2018).
- Basic Sign Language for Non-Verbal Children (Bass et al., 2009), or the Dictionary of Spanish Sign Language of the State Confederation of Deaf People (CNSE) (2025).
- Direct and intensive motor skills instruction (Ketcheson et al., 2017),
- Procedure from least to most incitement for the teaching of tennis, with indications ordered from least to most intrusive (Yanardag et al., 2011).
- Music to structure work periods (Dieringer et al., 2017).
- External motivation through positive verbal feedback and high-fives or hugs (Bahrami et al., 2016).
- Tablets and apps to show the exercises or activities to be performed, such as the application aimed at children with ASD, for example, the so-called Exercise Buddy (EB app) (Exercise Buddy, 2025), consisting of a system of modelled videos that provide effective instruction on the correct performance of motor skills in children with ASD (Bittner et al., 2018).
- Dynamic communicators, such as the multiplatform, free and customizable communicator AsTeRICS Grid, which allows the use of pictograms, images and orthographic signs to facilitate communication, initially developed at the Technikum Wien University of Applied Sciences, within the ToRaDes project and in which ARASAAC is currently collaborating (ARASAAC, 2025b).
- Use of tennis to improve working memory, cognitive flexibility (Ishihara & Mizuno, 2018), executive functions, physical fitness (Ishihara et al., 2017), attentional capacity (Rym et al., 2019), or socialization (Araújo et al., 2014).
- To jointly develop LE and PE, due to the significant positive effect on the social skills and willingness to communicate of children with ASD (Golshan et al., 2019), as well as because CLIL programs in the school context show a higher success rate in the development of an LE than traditional methods (García-Calvo & Salaberri, 2018), promoting communication among students (Gil-López et al., 2019).

Considering all of the above, as well as the great possibilities of introducing tennis in school from an inclusive point of view (Fuentes et al., 2020a; Fuentes et al., 2020b), we propose, by way of example, different activities, to be carried out in the school context, but also susceptible to be developed in associations or therapeutic centres focused on people with ASD, tennis clubs or academies, etc.

Examples of activities:

- Using the AsTeRICS Grid dynamic communicator and ARASAAC pictograms, especially to ASD students the tennis and English activity that they are going to carry out during the week with their classmates at school. Thus, as can be seen at the top of the communicator there is a space in which those pictograms that we select will be inserted, considering that each image is a folder that, in turn, contains more folders, until we reach the pictograms themselves. Thus, for example, within the so-called "sports" is the pictogram "tennis". In this way, we can construct a phrase or, even, by touching the button that symbolizes the "Play" by sound (voice) indicate the phrase that reflects the sum of the pictograms. This communicator also allows writing to be combined with pictograms, being able, for example, to type the word "the" through the keyboard and then place a pictogram that symbolizes "tennis", thus contracting the phrase "tennis".

Thus, the pictograms selected in this case can be seen in this space below (Figures 1 and 2):

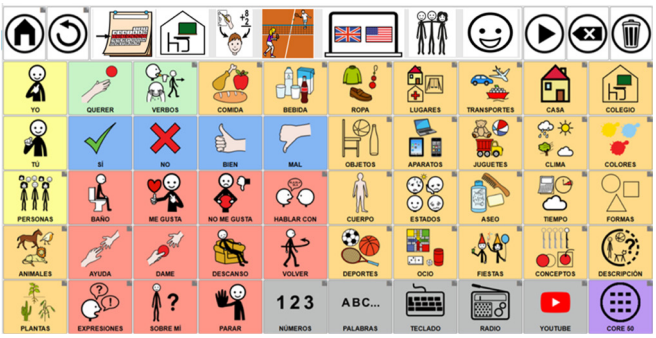

Figure 1. *AsTeRICS Grid dynamic communicator with ARASAAC pictograms in the upper space enabled for this purpose.*

"This week at school you will learn tennis and English with your friends, and you will be very happy"

Figure 2. *Phrase that is constructed using ARASAAC pictograms that represent "week", "school", "learn", "tennis", "English", "friends" and "happiness".*

- The following is explained to all students, with and without ASD in PE class, using cards of a certain size, using ARASAAC pictograms, explaining the meaning:

"Today and tomorrow, we will learn tennis and English as a team and to adapt the sport by communicating through images" (Figure 3).

Figure 3. *Phrase that is constructed using ARASAAC pictograms that represent "today", "tomorrow", "learn", "team", "tennis", "English", "adapted sport" and "images".*

- Using the CNSE's Dictionary of Spanish Sign Language (2025). it is explained to the students that if during the development of the whole session they need some kind of "help", they should, having both palms of their hands facing upwards, bring them closer to their own body (conversely if they offer help); if you want to continue with the activity you are doing, indicate the "continue" by placing one hand with the palm of the hand facing down and fingers together and the other hand perpendicular, also with fingers together and separated from the first, raising the latter until it touches the upper one twice in a row (action of going up and down); while if you want to end an activity, indicate the "finish" by initially placing your thumbs open. index and middle fingers of both hands and looking downwards and then raising them at the same time as the fingertips are joined (Figure 4).

Figure 4. *Following the order from left to right and top to bottom. following the CNSE's Dictionary of Spanish Sign Language, the hand gestures representing "help", "continue" and "finish".*

- The teacher will show the students a sheet containing tennis vocabulary, containing fundamental elements of the game through photographs or pictograms, in this example from ARASAAC, and the word of its meaning in Spanish and English: racquet, ball, grip, tennis court, net, lines of court or court's lines, and playmate or schoolmate (Figure 5), on the other hand. The teacher carries large cards in his hands, each containing the photograph or drawing of one of the elements. After the teacher shares this vocabulary, with the help of demonstrations, and leaves rackets and tennis balls scattered around the space, the teacher or the students themselves verbalize or show one of the words using the cards, the others having to run, dribble, throw upwards..., a tennis ball, until they touch the indicated element. ... To indicate the way of travelling, the teacher will use music that facilitates both this aspect and the structure of the work periods themselves. Thus, if the teacher plays slow music, they must move on foot, if it is fast music, they must do it running, while if the teacher or students verbalize a word when there is no music, they must, without moving from the place, try to represent its meaning through gestures and if they show the card containing an image, they must say aloud in English its meaning.

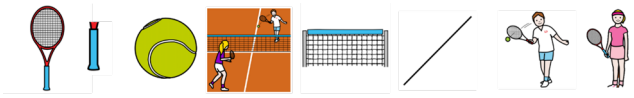

Figure 5. *Phrase that is constructed using ARASAAC pictograms representing "tennis racket", "tennis ball", "tennis racket grip", "tennis court", "tennis net", "tennis court lines", "partner" and "partner".*

On the other hand, the indications of slow music, fast music and silence can be used by pictograms (Figure 6).

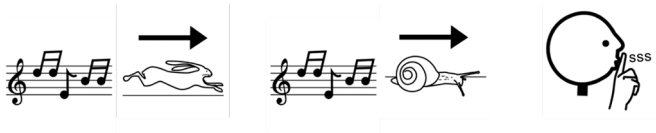

Figure 6. *Phrase that is constructed using ARASAAC pictograms that represent "fast music", "slow music" and "silence".*

- The students, after clear demonstrations by the teacher, must exchange. in pairs or in groups of four, shots in collaborative ways, being able, depending on their level of play, to give a previous touch to the ball, to prepare it before hitting it or even let it bounce twice to facilitate the subsequent hitting. When the teacher verbalizes a preposition of place or shows with ARASAAC pictograms in English -"on", "under", "between", in front, behind...- (Figure 7), the students must, in pairs, invent a situation by playing with the place, area, height... of blow that reflects each preposition. In cases where the teacher shows the card, the children must say aloud in English the preposition that reflects the pictogram, while verbalizing the preposition, they must indicate which of the cards means the preposition in question. The teacher will progressively provide a greater amount of feedback, to adjust the step-by-step instructions during the development of the game according to the level of performance of the students, thus trying to solidify and expand their level of competence. During the game, both the teacher and the students will use positive verbal feedback and high-fives or hugs in the event of achieving goals or making an effort to achieve them.

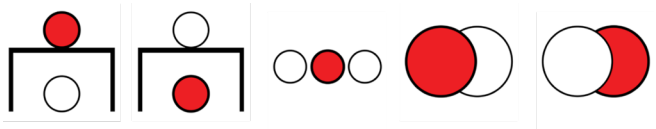

Figure 7. *Phrase that is constructed using ARASAAC pictograms that represent "above", "below", "between", "in front" and "behind".*

- In pairs, the students begin the activity showing a very sad face, as if they were crying or about to do so, they manage to introduce, cooperating, very close to the net to make it simple, 2 balls in a row both put a less sad face: 2 more normal face; two more, laughter; while, if they put 2 more, they must laugh out loud (Figure 8) All the children have to end up laughing out loud. The teacher, depending on the level shown by each child, may facilitate the task, for example, allowing two dribbles or giving a previous touch to place the ball before hitting it towards the opponent's field, Afterwards the exercise is repeated, but manifesting joy through facial gestures, then through body gestures and, finally, using pictograms that represent these moods.

Figure 8. *Phrase that is constructed using ARASAAC pictograms that represent "great sadness", "sadness", "normal state", "joy", and "great joy".*

On the other hand, the teacher or the students themselves can make indications with large cards to indicate whether the ball has gone in, if in doubt, or if a game is played to show the rules of tennis through some type of match (Figure 9).

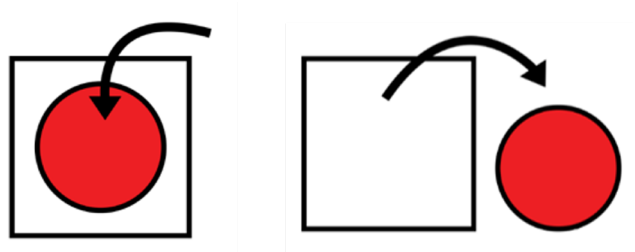

Figure 9. *Phrase that is constructed using ARASAAC pictograms that represent "inside" and "outside".*

- By way of conclusion, at the end of the class, the teacher with the students reads messages such as the following, which show the importance of recognizing and respecting diversity, as well as having an empathetic and inclusive attitude with their classmates, For the construction of the sentences you can, for example, use the dynamic communicator AsTeRICS Grid and ARASAAC pictograms, combining the writing of words, through the use of the keyboard, with the use of pictograms (Figure 10).

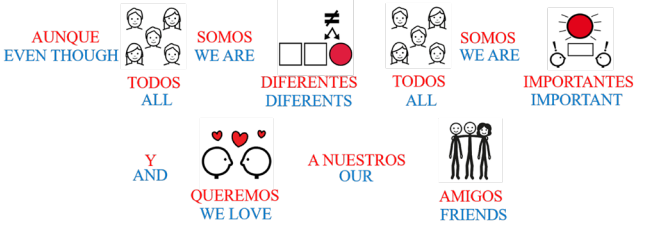

Figure 10. *Phrase that is constructed using ARASAAC pictograms that represent "everyone", "different", "everyone", "important", "we want" and "friends".*

CONCLUSIONS

Children with ASD represent a large percentage of students with special needs associated with disabilities, and it is essential in Primary Education to promote actions aimed at the recognition and respect for diversity. The practice of tennis has been shown to provide important physical, psychological and social benefits in children with ASD, and there are specific methods and strategies that provide greater effectiveness than traditional methods. The learning of an LE has shown its usefulness for the acceptance of other realities and tolerance or awareness of social diversity and, when developed jointly with the PE area, to have a significant positive effect on the social skills and willingness to communicate of children with ASD.

CONFLICT OF INTEREST

The author declares that she has no conflict of interest.

RERERENCES

Abadi, M. R. H., Zheng, Y. W., Wharton, T., Dell, C., Vatanparast, H., Johnston, J., & Kontulainen, S. (2023). Children with Autism Spectrum Disorder Spent 30 Min Less Daily Time in Moderate-to-Vigorous Physical Activity than Typically Developing Peers: a Meta-Analysis of Cross-sectional Data. Review Journal of Autism and Developmental Disorders, 10(1), 144-157. https://doi.org/10.1007/s40489-021-00262-x

ARASAAC. (23 de febrero de 2025a). Catálogo de pictogramas en color. ARASAAC. http://old.arasaac.org/pictogramas_color.php

ARASAAC. (23 de febrero de 2025b). Comunicador dinámico AsTeRICS Grid. Aula Abierta de ARASAAC. https://aulaabierta.arasaac.org/asterics-grid_inicio

Araújo, M. L., Soares, A., Fuentes, J. P. (6-8 de agosto de 2014). O tênis no desenvolvimento humano de crianças em risco social: um projeto piloto para as aulas de Educação Física. X Seminario Internacional de Educação Física, Lazer e Saúde. Universidade Federal de Santa Catarina, Florianópolis, Brasil.

Arnell, S., Jerlinder, K., & Lundqvist, L. O. (2018). Perceptions of Physical Activity Participation Among Adolescents with Autism Spectrum Disorders: A Conceptual Model of Conditional Participation. Journal of Autism and Developmental Disorders, 48(5), 1792-1802. https://doi.org/10.1007/s10803-017-3436-2

Bahrami, F., Movahedi, A., Marandi, S. M., & Sorensen, C. (2016). The Effect of Karate Techniques Training on Communication Deficit of Children with Autism Spectrum Disorders. Journal of Autism and Developmental Disorders, 46(3), 978-986. https://doi.org/10.1007/s10803-015-2643-y

Bass, M., Duchowny, C., & Llabre, M. (2009). The Effect of Therapeutic Horseback Riding on Social Functioning in Children with Autism. Journal of Autism and Developmental Disorders, 39(9), 1261-1267. https://doi.org/10.1007/s10803-009-0734-3

Bentholm, A. & Ramskov, D. (2023). Quality of reporting on physical activity content and description of teaching: A scoping review on children with autism. European Journal of Adapted Physical Activit, 16(8), 1-24. https://doi.org/10.5507/euj.2022.014

Bittner, M., Myers, D., Silliman-French, L., & Nichols, D. (2018). Effectiveness of Instructional Strategies on the Motor Performance of Children with Autism Spectrum Disorder. Palaestra, 32(2), 36-43.

Bremer, E., Balogh, R., & Lloyd, M. (2015). Effectiveness of a fundamental motor skill intervention for 4-year-old children with autism spectrum disorder: A pilot study. Autism, 19(8), 980-991. https://doi.org/10.1177/1362361314557548

Bremer, E., & Lloyd, M. (2016). School-Based Fundamental-Motor-Skill Intervention for Children With Autism-Like Characteristics: An Exploratory Study. Adapted Physical Activity Quarterly, 33(1), 66-88. https://doi.org/10.1123/apaq.2015-0009

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., Carty, C., Chaput, J.-P., Chastin, S., Chou, R., Dempsey, P. C., DiPietro, L., Ekelund, U., Firth, J., Friedenreich, C. M., Garcia, L., Gichu, M., Jago, R., Katzmarzyk, P. T., Lambert, E., Leitzmann, M., Milton, K., Ortega, F. B., Ranasinghe, C., Stamatakis, E., Tiedemann, A., Troiano, R. P., van der Ploeg, H. P., Wari, V., & Willumsen, J. F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. British Journal of Sports Medicine, 54(24), 1451-1462. https://doi.org/10.1136/bjsports-2020-102955

Casey, A. F., Quenneville-Himbeault, G., Normore, A., Davis, H., & Martell, S. G. (2015). A Therapeutic Skating Intervention for Children With Autism Spectrum Disorder. Pediatric Physical Therapy, 27(2), 170-177. https://doi.org/10.1097/pep.0000000000000139

Confederación Autismo España. (2024). Datos de alumnado general no universitario con trastorno del espectro del autismo: curso 2022/2023.

Confederación Estatal de Personas Sordas (CNSE). (8 de marzo de 2025). Diccionario de la Lengua de Signos Española. https://fundacioncnse-dilse.org/

Decreto 107/2022, de 28 de julio, por el que se establecen la ordenación y el currículo de la Educación Primaria para la Comunidad Autónoma de Extremadura. Diario Oficial de Extremadura, 151, de 5 de agosto 2022, 38119-38501. https://doe.juntaex.es/pdfs/doe/2022/1510o/22040159.pdf

Dieringer, S. T., Zoder-Martell, K., Porretta, D. L., Bricker, A., & Kabazie, J. (2017). Increasing physical activity in children with autism through music, prompting, and modeling. Psychology in the Schools, 54(4), 421-432. https://doi.org/10.1002/pits.22003

Exercise Buddy. (23 de febrero de 2025). APP ExerciseBuddy. Google Play. https://play.google.com/store/apps/details?id=com.exerciseconnection.exercisebuddy&hl=es_419

Fuentes, J. P., Menayo, R., Carmona, A. I. y Palacios, A. B. (2005). La Educación Física y el inglés en la LOCE: el tenis como propuesta práctica de interdisciplinariedad. El Patio de Educación Física, 4, 1-16.

Fuentes, J. P. (2013). Variables didácticas en la enseñanza del tenis. En B. Sañudo (Ed.), Tenis y mujer (pp.171-196). INDE.

Fuentes, J. P., Muller, J. y Furlaneto, O. A. (2020a). Tenis, escuela e inclusión: Perspectiva socializadora y práctica. INDE.

Fuentes, J. P., Müller, J, Furlaneto, O. A., Sanz, D. (2020b). Tênis nas escolas: mitos e posibilidades. En C. Corrêa, C. A. Abaide, J. Zarpellon y J. P. Fuentes (Ed.), Tênis: Um olhar multidisciplinar (pp. 59-80). Editora CRV

Fuentes-García, J. P., & Carmona Blanco, A I. (2021a). Interdisciplinarity and tennis in primary education. ITF Coaching & Sport Science Review, 29(85), 25–27. https://doi.org/10.52383/itfcoaching.v29i85.307

Fuentes-García, J. P., & Carmona Blanco, Ángela I. (2021b). Transversal competences in primary education through tennis. ITF Coaching & Sport Science Review, 29(85), 22–24. https://doi.org/10.52383/itfcoaching.v29i85.308

García-Calvo, S., & Salaberri, M. S. (2018). Physical Education and English: constructivist vs traditional approaches in bilingual and non-bilingual education. Sportis. Scientific Technical Journal of School Sport, Physical Education and Psychomotricity, 4(2), 364-387. https://doi.org/10.17979/sportis.2018.4.2.3330

Garrido, D., López, B., & Carballo, G. (2024). Bilingualism and language in children with autistic spectrum disorder: a systematic review. Neurologia, 39(1), 84-96. https://doi.org/10.1016/j.nrl.2021.04.010

Gehricke, J. G., Chan, J., Farmer, J. G., Fenning, R. M., Steinberg-Epstein, R., Misra, M., Parker, R. A., & Neumeyer, A. M. (2020). Physical activity rates in children and adolescents with autism spectrum disorder compared to the general population. Research in Autism Spectrum Disorders, 70, Article 101490. https://doi.org/10.1016/j.rasd.2019.101490

Gil-López, V., Sierra-Díaz, M. J., & González-Víllora, S. (2019). The effects of Content and Language Integrated Learning in the Physical Education subject in Primary Education. Sportis. Scientific Technical Journal of School Sport, Physical Education and Psychomotricity, 5(3), 562-585. https://doi.org/10.17979/sportis.2019.5.3.5527

Gil-López, V., González-Víllora, S., & Hortigüela-Alcalá, D. (2021). Learning foreign languages through content and language integrated learning in physical education: A systematic review. Porta Linguarum(35), 165-182. https://doi.org/10.30827/portalin.v0i35.15785

Golshan, F., Moinzadeh, M., Narafshan, M. H., & Afarinesh, M. R. (2019). The Efficacy of Teaching English as a Foreign Language to Iranian Students with Autism Spectrum Disorder on Their Social Skills and Willingness to Communicate. Iranian journal of child neurology, 13(3), 61-73. <Go to ISI>://MEDLINE:31327970

Grosprêtre, S., Ruffino, C., Derguy, C., & Gueugneau, N. (2024). Sport and Autism: What Do We Know so Far? A Review. Sports Medicine-Open, 10(1), Article 107. https://doi.org/10.1186/s40798-024-00765-x

Gusliana, H. B., Ardiyanto, S. Y., Setyawan, H., Putro, B. N., Kurniawan, A. W., Zulbahri, Z., Gerdijan, N., Eken, O., Latino, F., & Tafuri, F. (2024). Legal Review of Bullying Cases against Students with Disabilities in Physical Education Learning at Schools: A Systematic Review. Revista Panamericana De Salud Publica-Pan American Journal of Public Health, 57, 840-848. <Go to ISI>://WOS:001279517000001

Huang, J. F., Du, C. J., Liu, J. J., & Tan, G. X. (2020). Meta-Analysis on Intervention Effects of Physical Activities on Children and Adolescents with Autism. International Journal of Environmental Research and Public Health, 17(6), Article 1950. https://doi.org/10.3390/ijerph17061950

Ishihara, T., Sugasawa, S., Matsuda, Y., & Mizuno, M. (2017). Improved executive functions in 6-12-year-old children following cognitively engaging tennis lessons. Journal of Sports Sciences, 35(20), 2014-2020. https://doi.org/10.1080/02640414.2016.1250939

Ishihara, T., & Mizuno, M. (2018). Effects of tennis play on executive function in 6-11-year-old children: a 12-month longitudinal study. European Journal of Sport Science, 18(5), 741-752. https://doi.org/10.1080/17461391.2018.1444792

Ketcheson, L., Hauck, J., & Ulrich, D. (2017). The effects of an early motor skill intervention on motor skills, levels of physical activity, and socialization in young children with autism spectrum disorder: A pilot study. Autism, 21(4), 481-492. https://doi.org/10.1177/1362361316650611

Lage, C., Smith, E. S., & Lawson, R. P. (2024). A meta-analysis of cognitive flexibility in autism spectrum disorder. Neuroscience and Biobehavioral Reviews, 157, Article 105511. https://doi.org/10.1016/j.neubiorev.2023.105511

Ley Orgánica 3/2020, de 29 de diciembre, por la que se modifica la Ley Orgánica 2/2006, de 3 de mayo, de Educación. Boletín Oficial del Estado, 340, de 30 de diciembre de 2020, 122868-122953. https://www.boe.es/boe/dias/2020/12/30/pdfs/BOE-A-2020-17264.pdf

Liang, X., Haegele, J. A., Tse, A. C. Y., Li, M. H., Zhang, H., Zhao, S., & Li, S. X. (2024). The impact of the physical activity intervention on sleep in children and adolescents with autism spectrum disorder: A systematic review and meta-analysis. Sleep Medicine Reviews, 74, Article 101913. https://doi.org/10.1016/j.smrv.2024.101913

Luarte-Rocha, C., López-Casanova, L., Navarro-Gajardo, V., Pleticosic, Y., Sagredo-Aravena, R., de Campos, L., & Campos-Campos, K. (2023). Awareness programs towards people with disabilities in the school context, physical education and health. A systematic review of the last 10 years. Retos-Nuevas Tendencias En Educacion Fisica Deporte Y Recreacion(50), 1281-1288. <Go to ISI>://WOS:001068291400001

Munn, E. E., Hill, L. F., Lang, D. M., Brock, S. J., Hastie, P., & Pangelinan, M. M. (2024). Academic learning time in physical education (ALT-PE) during an adapted tennis program for children with autism spectrum disorders. International Journal of Developmental Disabilities, 70(4), 756-765. https://doi.org/10.1080/20473869.2022.2143619

Rym, B., Hamdi, C., Haithem, R., & Sonia, S. (2019). Diurnal variations of postural stability and attentional capacities in 5-6-year-old tennis players. Chronobiology International, 36(4), 517-529. https://doi.org/10.1080/07420528.2018.1564321

Sanz, D., Julián, J. A., Fuentes, J. P. y Del Villar, F. (2004). El tenis en la escuela. Desarrollo de las unidades didácticas. En D. Sanz (Ed.), El tenis en la escuela (pp. 157-230). Paidotribo.

Shanok, N. A., & Sotelo, M. (2022). A pilot tennis program for training fitness and social behaviors in individuals with autism spectrum disorder. Journal of Sports Medicine and Physical Fitness, 62(8), 1118-1126. https://doi.org/10.23736/s0022-4707.21.12414-4

Yanardag, M., Birkan, B., Yilmaz, I., Konukman, F., Agbuga, B., & Lieberman, L. (2011). The effects of least-to-most prompting procedure in teaching basic tennis skills to children with autism. Kinesiology, 43(1), 44-55. <Go to ISI>://WOS:000305794700005

Ye, Y., Ning, K., Wan, B. J., & Shangguan, C. Z. (2023). The Effects of the Exercise Intervention on Fundamental Movement Skills in Children with Attention Deficit Hyperactivity Disorder and/or Autism Spectrum Disorder: A Meta-Analysis. Sustainability, 15(6), Article 5206. https://doi.org/10.3390/su15065206

RECOMMENDED ITF TENNIS ACADEMY CONTENT (CLICK BELOW)

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Neuromuscular fatigue and explosive strength in the legs. New approach to physical preparation in tennis

Alberto Osete, Ignacio Mechón, Javier Gil Herrera, Fernando Cabaleiro, Diego González & Franco Squillari

Argentine Tennis Association, Argentine.

ABSTRACT

Despite the numerous existing studies, neuromuscular fatigue continues to be an inexhaustible topic in the study of sports training. The article addresses the study of explosive power in legs in tennis training for high competition. While most of the existing literature points to the decrease in endurance performance and coordination motor skills after a strenuous match, our study, carried out on a sample of 204 athletes between 12 and 18 years old within the framework of competitions organized by the Argentine Tennis Association, demonstrates how the explosive power of the legs increases after a long-lasting match. Considering that the sporting fact is multifactorial and that the physiological, neurological and psychological factors that must be considered to enhance training, two conclusions emerge from the study: the value of the finding to reevaluate tennis training and the importance of research in real competition situations.

Key words: Neuromuscular fatigue, leg power, high-competition tennis

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Corresponding author: Alberto Osete, alberto@albertoosete.com

INTRODUCTION

All sports have within the development of their game, particular characteristics referring to physical, technical, tactical and psychological effort, which makes sports training a complex activity, which implies the consideration of the numerous variables that intervene in the sporting fact when making decisions regarding the methodology to be used (Bompa and Harft, 2009).

However, one of the primary tasks when undertaking a sports physical training plan (also tactical technical) is to study and analyse the primary motor skills involved and complementary sub-capacities of their game to design a program that maximizes results and reduces the risk of injury (Issurin, 2010).

Competitive tennis matches are one of the sports with the longest total duration; in Grand Slam tournaments to 5 sets they can last up to more than 4 hours, which is why endurance and its link with neuromuscular fatigue is one of the capacities that need to be analysed. In this spectrum, an important point to investigate is the incidence that the appearance of fatigue has on performance, and which are the physical aspects that can be most altered. To contribute to this type of study, the team of physical trainers of the Argentine Thesis Association developed research focusing on one of the physical capacities involved in physical performance within a tennis match in competition that has been little studied: the explosive power of the legs in a situation of neuromuscular fatigue at the end of a tennis match in a high competition tournament. Contrary to the general opinion that fatigue affects explosiveness (Kraemer & Ratamess, 2004), our study aims to show that, at least in the moments after the match, such explosiveness shows higher levels than at the beginning of the match. The following objective was proposed: to show in a competitive situation the incidence of fatigue on the explosive power of the legs in players of both sexes in the Juniors category.

PREVIOUS STUDIES

Although the concept of fatigue dates to the beginning of the twentieth century, its content continues to be constantly transformed. In the last thirty years, progress has been made in its characterization from various aspects, many of which point to its multifactorial and systemic character.

Gómez Campos et al. (2009) dedicate an interesting article to reviewing the existing literature on the mechanisms involved in acute fatigue to show the different pathways that are related to the process of gestation and development. The work covers more than 50 articles published in scientific journals between 1995 and 2008, a journey that leads them to propose that the etiological mechanisms responsible for fatigue have been considered by both physiologists and biochemists from three different angles: the perspective of improving performance in high-performance sport, the functional recovery of subjects with pathologies or injuries in the nervous system or the study of subjects with neuromuscular pathologies.

The authors point out that, despite the large number of studies, due to the multifactorial nature of fatigue, the mechanisms associated with its aetiology have not yet been clearly determined. One way to organize this complexity is to consider peripheral and central fatigue, depending on whether the factors affect the muscles or the brain. Following Rossi and Tirapegui (1999), they consider that peripheral fatigue may be metabolic or come from a decrease in neuromuscular function (due to a decrease in muscle glycogen or protein degradation), while central fatigue is caused by an imbalance of amino acids with the consequent alteration of neurotransmitter activity (pp. 544).

In relation to metabolic fatigue, Snyder (1998) hypothesizes that because of high-intensity exercise, glycogen depletion occurs; Depending on the intensity and duration of the effort, there is a use of different energy systems to supply the needs using other substrates, but they deplete the reserves so that the athlete enters a situation of fatigue. Along the same lines, the works of Bangsbo et al., (2006) and Nédélec et al., (2012) can be cited.

Duchateau et al. (2002) and Boerio et al. (2005) point out in their conceptualizations that adaptations to fatigue have been widely studied under conditions of voluntary and electrical isometric muscular actions and conclude that much less is known about actual fatigue, that is, specific fatigue in a game situation since most studies are based on the interpretation of laboratory data.

Other approaches to muscle fatigue consider the existence of subjective fatigue that is influenced by psychological and social factors such as performance expectations, cognitive effort for decision-making or emotional self-regulation (López-Chicharro & Fernández Vaquero, 2006).

These general studies are complemented by specific works in which specific situations are analysed.

Theoretically, much has been said about exercises or sports activities of long duration and intensity that produce an increase in lactic acid in the blood and muscles, influencing the appearance of fatigue, giving an increase in the concentration of H+ ions causing a decrease in PH, a factor that is associated with the inhibition of the enzyme phosphofrutokinase producing a decrease in glycolysis (Rosi & Tirapegui, 1999), that is, these authors propose an increase in acidosis as a negative factor in the obtaining of Adenosine Triphosphate (ATP).

In this regard, Dr. Néstor Lentini , Argentine physiologist and traumatologist, director of the Department of Exercise Physiology of the CENARD (National Centre for High Performance Sports of Argentina), points out that in the latest research it has been proven that phosphocreatine reserves decreased by exercise or sports activity recover within two minutes of the end of the demand, for this reason, obtaining energy reserves in a non-oxidative system is not significant, they quickly enter a regenerative process of obtaining ATP by moving from ADP diphosphate to ATP triphosphate.

Other authors attribute muscle fatigue to electrolyte imbalance due to long-term demands in hot environments with excessive water loss, referring to an alteration of the plasma membrane potential with alteration in the conduction of nerve impulses (Roses & Javierre, n.d.).

A study by Lepers et al. (2002) with cyclists subjected to a 5-hour effort at an intensity of 55% of their maximum aerobic capacity found a decrease in voluntary contraction of the quadriceps muscle by 18%, at the end of the course. In another similar study by the same author (2013) also with cyclists, it is concluded in a similar way finding a reduction in the muscular capacity of the legs after prolonged cycling.

Girard and Millet (2007) in laboratory studies aimed at racquet sports, arrive at a hypothesis with their research and potentially point out that performance may be limited (as the match progresses) due to reduced central activation linked to changes in neurotransmitter metabolism or in response to afferent sensory feedback. They indicate that, alternatively, with inhibition of the excitability of motor neurons due to changes in the metabolic or mechanical properties in the spinal structure or also by ionic disturbances and perturbations in the excitation-contraction coupling properties.

Our conclusions in this task of investigating different sources of analysis and research of neuromuscular fatigue and personal consultations with specialists in the sports world is that most of the studies are oriented to the decrease in endurance performance and coordination motor skills, without addressing what happens to the explosive power in the legs after a strenuous tennis match.

Therefore, the aim of our research was to study an unexplored bias: the explosive power in legs in a competitive tennis match.

METHODOLOGY

Study Framework

For a few years now, within the development program of the Argentine Tennis Association, together with the physical preparation team, he stored data to investigate the incidence of neuromuscular fatigue in terms of explosive strength or leg power (smash jumps, serve, braking, starts to a short ball, changes of direction, explosive mobility, among others) in a tournament tennis match. The work was carried out in the Development Area directed by Franco Squilliari by the Physical Preparation team of the Argentine Tennis Association made up of professors Alberto Osete, Ignacio Menchón, Javier Gil Herrera, Fernando Cabaleiro and Diego González.

Hypothesis

From the observation of the behaviour of the players after each match, a general hypothesis was outlined according to which the power of the legs increases with respect to their initial state at the end of high competition matches.

Design

To validate it, an observational cross-sectional study was designed on the performance in the male and female juniors' category (12 to 18 years old) in a competitive situation over a period (2015, 2016, 2017, 2018, 2019, 2023). The condition of competence (different from a laboratory analysis) has a determining value for the verification of the hypothesis since all the elements involved in this situation concur in competition, especially tension, nervousness and stress that are impossible to generate in the laboratory.

Sample

The population was composed of 204 male and female participants in the National Tournaments of the AAT, Junior's category (12 to 18 years old) during the years described in the previous text.

Instrument and procedure

The methodological design was carried out with direct measurement on two tests: Abalakov jump and long jump. In the first case, each player, in a standing position with parallel feet on a jumping plate connected to an Azón Jump 4.0 program, performed two vertical jumps with arm and leg momentum. Of the jumps, made 3 to 5 minutes before heading to the tennis court, the best of the two was recorded. The same operation was repeated 3 to 5 minutes after the end of the match, also recording the best. In this way, in the period indicated there was a set of 120 jumps (70 for men, 50 for women).

Regarding the second type of jump, each player in the pre- and post-match instance, made two forward falling jumps falling with two feet; The distance reached from the starting line to the heel of the furthest back foot was measured, recording the greatest distance reached. 84 cases were tested, 50 male and 34 female. The length of matches and sets played were also considered.

RESULTS

The following figures and tables show the results obtained in the study.

Figure 1 corresponds to 147 Abalakov jump shots (with arm impulse) and shows how the second jump after the match is superior to the first one -before the match- in 72% of the cases, both in matches of high volume in time (more than 2 and a half hours) and high intensity of play, and in matches shorter in time and intensity.

With another motor pattern of explosive force, the long jump was performed on firm foot, start with two feet and fall with two feet, continues to verify that the trend improves in the jump after the match.

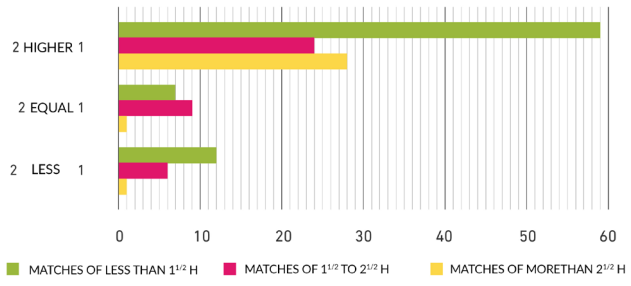

Figure 1. *Jumping plate based on the Abalakov jumps.*

Clarification: 2 before the match; 2 after the match.

Figure 2 shows that the height reached in the post-match data improves the performance in leg power is also not an element that affects the power of the jump after the match.

The results in percentage are shown in Figure 2.

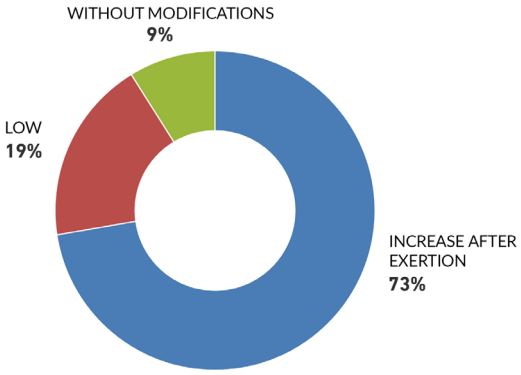

Figure 2. *Results in percentages of pre- and post-effort jumps: Abalakov, CMJ and horizontal jump.*

Table 1 presents the results in numbers of pre- and post-effort jumps Abalakov CMJ and horizontal jump in numbers.

Table 1
Results in numbers of jumps pre and post effort Abalakov CMJ and horizontal jump.

Climb after exertion	Casualty	No modifications	Total
148	38	18	204

Looking at Figures 1 and 2 and Table 1, the data taken, a total of 204, in many matches of different tournaments, were surprising: in the case of the Abalakov jumps, out of 147 cases evaluated, at a percentage of 72%, the jump was higher after the match, including long matches of 2 hours, to three sets. With the other types of jumps, the trend was similar, obtaining higher jumps after the match.

This revelation leads us to conceptualize that in terms of explosive power efforts, the neuromuscular and general fatigue accumulated after the effort of a tennis match, is not only not affected, but improves performance.

The athletes, physical trainers, neuromotor specialists consulted also showed surprise at the results obtained, since it demystifies the generalized opinion that after a prolonged and intense effort there is a decrease in performance, since, at least, in relation to what is observed in terms of explosive power, performance is greater.

Limitations of the study

Outside of our analysis population (Juniors of 4 categories of competitive players with the best ranked Argentines), we cannot guarantee the effectiveness of the hypothesis. However, it can be inferred that the results are generalizable to other categories of tennis and possibly to other sports. Our study represents an interesting advance, and it would be desirable for the Federations of other sports to investigate along the same lines, to give more reliably with the conclusion we reached with our 204 cases of tennis in junior's competition.

On the other hand, the task was not focused on results, we did not propose to take performances, that would be within a framework of individual tests, the object of study explained in the text of rationale was comparative percentages were taken between the before and after the matches analysing the explosive strength of the legs, which is very involved in tennis.

CONCLUSIONS

The work carried out shows that at the end of a match, after 5 minutes, the motor gestures of the explosive force shown in smash hits, serve, braking starts, reactive speed, are not affected in their performance.

Considering the multiplicity of factors that combine to make a certain behaviour appear in a sporting event, in conjunction with the sports areas consulted, we can propose an explanatory hypothesis with reasons of neuromotor, physiological and psychological order.

From neuromotor skills, it can be conjectured that if movement positively influences brain functions, it is feasible that in this prolonged and high-intensity activity, by increasing lactate production, lactate, acting as a neurotrophin triggering factor (BDNF) has a significant impact on the Central and Peripheral Nervous System, improving cortical synaptic plasticity. This would be complemented from a physiological analysis, since the dominant energy system in tennis is the non-oxidative -also called anaerobic- (the term is not absolute since there is formation of lactic acid that increases with the prolongation of the effort).

From psychology, we can understand that after a match, the players – winners and losers – lower their level of pressure, as an internal struggle between desire and demand; At the end of this duality, the athletes are more freed from the demands of the test, that is, looser than in the jumps prior to the competition.

However, these hypotheses need to be tested with more tests carried out in the same tournament effort. We want to emphasize the value of the numbers obtained by

our study: they are made on the very practice of the sporting effort. We believe that it is important to pay attention to them since they could have consequences in the way we carry out our training and towards other sports, if studies are carried out in the same direction as the present.

Practical applications: What and how to do

The results obtained, evidenced in the following graphs and tables, show that the starting hypothesis could be verified since in most of the cases considered there is a positive difference in favour of the jumps made once the match is over. These conclusions lead us to propose some initial recommendations that contemplate the results achieved.

In the warm-up or pre-match activation, several visual reactive exercises must be included to stimulate the neuromuscular system before the match.

Examples:

- After a previous mobility, articular of shoulders, hips and legs and gentle mobility of movement to activate the cardiocirculatory system, peripheral capillarization, increase in muscle temperature, decrease in muscle viscosity, joint lubrication.
- Various reactive activation exercises at high intensity, stimulating the visual perceptual system for quick reading and consequent response
  - With the ball: respond in a backward direction to a defensive ball, to an attacking forward ball, to a high ball to take it up with a smash jump, in fronton quick short volleys, all done with specific movements of tennis.
  - No ball: Progressions in short distances, short kicks, changes of speed, changes of support and exit, few repetitions a lot of speed.
- Concentration, visualization and game planning exercises that your coach elaborates, if you enter the court with confidence, confidence and high self-esteem, your tension, your pressure will be closer to your optimal point

CONFLICT OF INTEREST AND FUNDING

The authors declare no conflicts of interest and did not receive funding to conduct this research.

REFERENCES

Bangsbo, J., Mohr, M., & Krustrup, P. (2006). Physical and metabolic demands of training and match-play in the elite football player. Journal of Sports Sciences, 24(07), 665-674. https://doi.org/10.1080/02640410500482529

Boerio, D., Jubeau, M., Zory, R., & Maffiuletti, N. A. (2005). Central and peripheral fatigue after electrostimulation-induced resistance exercise. Medicine & Science in Sports & Exercise, 37(6), 973-978.

Bompa, T., & Haft, G. (2009). Periodization. Theory and methodology of training. Human Kinetics.

Duchateau J et al. (2002) Reflex regulation during sustained and intermittent submaximal contractions in humans J Physiol. https://doi.org/10.1113/jphysiol.2002.016790

Girard O, Millet GP. Neuromuscular fatigue in racquet sports. NeurolClin. 2008; 26 (1):181-194. https://doi.org/10.1016/j.ncl.2007.11.011

Gómez-Campos, R., Cossio-Bolaños, M.A., Brousett Minaya, M y Hochmuller-Fagaca, R.T (2009) Mecanismos implicados en la fatiga aguda. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte, vol. 10, nº 40.

Issurin, V. B. (2010). New horizons for the methodology and physiology of training periodization. Sports medicine, 40, 189-206.

Kraemer, W. J., & Ratamess, N. A. (2004). Fundamentals of resistance training: progression and exercise prescription. Medicine & science in sports & exercise, 36(4), 674-688. https://doi.org/10.1249/01.MSS.0000121945.36635.61

Lepers, R, Maffiuletti, N.A., Roccehtte L., Brugniaux, J., Millet, G.Y (2002) Neuromuscular fatigue during a long-duration cycling exercise. Journal of Applied Physiology Vol. 92, nº 4. https://doi.org/10.1152/japplphysiol.00880.2001

Lepers, R, Knechtle, B., & Stapley, P.J. (2013). Trends in triathlon performance:effects of sex and age. Sports Medicine, 43(9), 851-863. https://doi.org/10.1007/s40279-013-0067-4
López-Chicharro J, Fernández-Vaquero A. (2006) Fisiología del ejercicio. Madrid: Médica Panamericana.
Nédélec, M., McCall, A., Carling, C., Legall, F., Berthoin, S., y Dupont, G. (2012) Recovery in soccer. Sports Medicine, 42 (12). https://doi.org/10.2165/11635270-000000000-00000
Rosés, J.M., Javierre, C. (n.d). Trabajo muscular y fatiga en el ejercicio físico. Obtenido el 17 de julio de 2023.
Rossi, L., Tirapegui, J. (1999) Aspectos atuais sobre o exercicio físico, fadiga e nutricao. Rev. Paul. Educ. Fís., São Paulo, 13(1): 67-82. https://doi.org/10.11606/issn.2594-5904.rpef.1999.137760
Snyder, A. (1998). Overtraining and glycogen depletion hypothesis. Medicine and Science in Sports and Exercise, v.30, n.7, p.1146-50

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Specific strengthening methods for tennis players

Salvatore Buzzelli

Italian Tennis and Paddle Federation (FITP), Italy.

ABSTRACT

This article proposes an innovative methodology to develop the ability to express muscle strength, without the use of overload, effective and completely free of risk of injury. This is based on the personal experience of the author as a physical conditioning trainer of top tennis players. It introduces alternative strength training methods for tennis players that minimize joint and spinal stress while enhancing functional strength. It presents two innovative tools—the BuzzChain and TR Buzz—which utilize body weight and neurophysiological principles to improve lower-limb and upper-limb strength without traditional overloads. It does not aim to demonize the use of overloads in strength training in general but to make tennis physical trainers and coaches reflect on the possibility of alternative, however effective, functional paths for tennis players. These methods offer a safer and more sport-specific alternative to conventional weight training, potentially reducing injury risks and enhancing on-court performance. However, while the proposed approach is practical and innovative, empirical validation and structured research are needed to substantiate its effectiveness.

Key words: Legs strength, toning of upper limbs, BuzzChain, TR Buzz.

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Corresponding author:
salvatorebuzzelli1@gmail.com

INTRODUCTION

Since the dawn of time, and Milone da Crotone was the most striking example, as he was was a legendary Greek wrestler, renowned for his strength, winning six Olympic titles, to improve muscle strength, it is essential to use forms of training that involve the use of overloads to be imposed on the body in its entirety or parts of it as for example in the upper or lower limbs (Zatsiorsky et al., 2024).

When reflecting about it, when the so-called "weights" are being used, nothing is done but placing a load above the biomechanical link that to be trained, a load sufficient to stimulate it in terms of increasing the basic tone, while it is moved. So, if the goal is to improve the strength of the legs, the load would be placed on them, the same thing would occur for the upper limbs. The effects of strength and conditioning interventions in tennis players has attracted a considerable interest in the literature (Deng et al., 2025).

This article does not aim to demonize the use of overloads in strength training in general but to make tennis trainers and technicians reflect on the possibility of alternative, however effective, paths for tennis players in particular. The alternative training methods presented are practical, low-cost, and designed to reduce joint stress. The emphasis on functional strength rather than maximum strength aligns well with the sport's physical demands.

In the next section, a reflection of neurophysiological principles, such as the cross-cord reflex and post-activation potentiation (PAP), will provide a solid theoretical basis for the proposed training methods. The integration of these concepts will help justify the benefits of the new methods proposed.

Furthermore, this article is based on decades of both on- and off- court practice and research on the intricacies of the functional implementation of physical conditioning principles and methods applied to tennis training as documented in previous works (Buzzelli, 2020; 2021; Senatore & Buzzelli, 2022).

DESCRIPTION

The objective of this article is to present a specific, functional, and modern training protocol for the development of strength of the upper and lower limbs in tennis players of different levels of play that minimizes the risk of injury, using body weight as the main resistance and introducing two innovative tools: "BuzzChain" (Figures 1 and 2) and "TR Buzz" (Figures 3, 4, 5) (Buzzelli, 2007-2024). These tools were designed for exactly these purposes: optimizing muscle toning and preventing specific tennis injuries in tennis players.

In fact, the implementation of strength training using high overloads, although effective for increasing maximum strength, involves high biomechanical stress on the joints and the spine, increasing the risk of overload injuries. This has been studied at different levels of the game with a special attention in post-pubertal (Martin et al., 2025) and juniors (Baiget et al., 2025).

In the context of tennis training, where body structural integrity is crucial for sporting performance and career longevity, it is necessary to adopt alternative strengthening strategies that minimize the risk of trauma (Squillante, 2020).

The "BuzzChain" training approach was developed in 2007 following clinical observations on a professional tennis player (254 ATP) who previously used overloads and had chronic low back pain (Zemková et al., 2020).

The adaptation of proprioceptive exercises on a suspended chain (BuzzChain) made it possible to generate significant muscular stress, comparable to that induced by overloads, while reducing painful symptoms. The use of the "BuzzChain", with single-leg exercises (½ squat, pistol squat), has proven to improve performance in vertical jump tests (SJ and CMJ), personally evaluated with the Bosco Platform.

Ten-year personal experience with Prof. Carmelo Bosco also suggested a correlation between the improvement of explosive strength and maximal strength, although the latter was not quantified to avoid pain flare-ups. The effectiveness of the method has also been confirmed by clinical observations of other athletes, including other ATP and WTA professional tennis players.

Figure 1 & 2. BuzzChain 1 & 2.

The approach to training the strength of the upper limbs with "TR Buzz" was launched in 2009 following the reflection that tennis is characterized by rapid and repeated movements, with high impacts on the dominant upper limb during the forehand and serve strokes. Therefore, the goal of strength training in tennis players is not to develop high maximal strength, but rather to increase rapid strength and the ability to absorb impact forces.

Rapid strength, fundamental for the speed of execution of specific tennis shots, is influenced by maximum strength, but also by the recruitment capacity of motor units and intermuscular coordination.

Considering the masses involved (tennis ball ≈ 50 g, racket ≈ 300-350 g), the emphasis of training should be placed on optimizing the speed of movement and the precision of the technical gesture, rather than on increasing maximum strength.

Increasing the distance between the body and the ball and optimizing the kinematics of the shot (for example, through throwing exercises with appropriate tools) allow the speed of the racket-ball complex to be maximized, optimizing rapid strength.

The elegance of the human movement is regulated by complex neurological mechanisms, which modulate the activation and inhibition of the muscles involved (Reschechtko & Pruszynski, 2020).

The "cross reflex" (Pillastrini et al., 2020) is a fundamental mechanism for bilateral coordination and balance during activities such as walking and running.

The training protocol proposed with "TR Buzz" is based on the application of these neurophysiological principles to improve musculoskeletal function and athletic performance.

The "TR Buzz" tool, inspired by the principles of TRX (Hetrick R., 2001), exploits the cross interdependence of the limbs to stimulate the neuromuscular system in a functional and integrated way. This approach allows you to improve intermuscular coordination and joint stability, reducing the risk of injuries.

The cross interdependence of the limbs, stimulated using the "TR Buzz", activates neural circuits that improve bilateral coordination and the capacity for dynamic stabilization.

Proprioceptive training, integrated into the use of the "TR Buzz", refines the central nervous system's ability to perceive and respond to variations in position and movement, optimizing neuromotor control (Aman et al., 2015).

TOOLS AND METHODS

Characteristics and protocol for strengthening the lower limbs with the “BuzzChain”

The progression begins with the acquisition of balance on the suspended chain, and then gradually introduces specific exercises, such as the “½ Squat” and the single leg “Pistol Squat”. The intensity of the exercises is modulated by varying the knee flexion angle, the number of repetitions and series, and recovery times. The TUT (Time Under Tension) is controlled by varying the execution times of the eccentric, isometric and concentric phases of the exercise.

Various execution methods can be used such as:

- 3-1-x: 3 seconds for the eccentric phase, 1 second for the isometric phase, explosive time (x) for the concentric phase, or
- 6-3-x: 6 seconds for the eccentric phase, 3 seconds for the isometric phase, explosive time (x) for the concentric phase.

The concentric phase (x) is performed explosively, to stimulate the recruitment of fast-twitch muscle fibers. The training volume is controlled through the number of repetitions (2-3) and sets (3-5), with 3–4-minute recovery between sets.

The intensity is modulated using body weight, with the possibility of adding overloads (belt with additional weights) to increase resistance. At the end of each series, 3 explosive jumps are performed on the spot, to exploit the PAP phenomenon and increase neuromuscular performance.

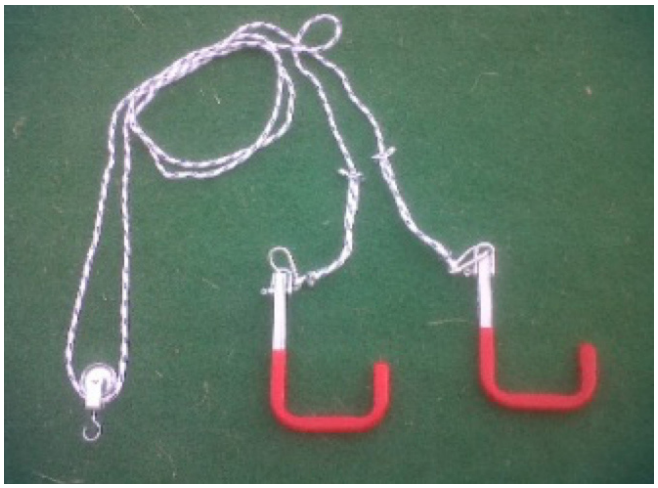

Figure 3. TR Buzz equipment.

Figure 4. TR Buzz exercise 1.

Figure 5. TR Buzz exercise 2.

Performing exercises on the "BuzzChain" requires high neuromotor and proprioceptive control, improving the ability to dynamic stabilization of the joints. Varying the TUT and performing explosive exercises stimulate the recruitment of motor units and intermuscular coordination. The use of body weight and the modulation of the TUT allow you to generate high muscle stress, favoring an increase in strength and minimal hypertrophy.

The addition of overloads further increases the intensity of the training, stimulating more significant muscular adaptations. The execution of explosive exercises (jumps) after strength exercises induces the PAP phenomenon, improving neuromuscular performance by increasing the recruitment of motor units and the speed of muscle contraction.

Clinical experience reports significant benefits and comforting results in using this training protocol. Athletes report a preference for this type of training over using traditional weightlifting. The use of this protocol is safe and effective even in children, with due precautions. This functional training protocol represents an effective approach to strengthening the lower limbs, combining the benefits of strength, proprioceptive and neuromotor training. Further studies are necessary to quantify the effects of this training protocol on maximal strength, hypertrophy and athletic performance.

Characteristics and protocol for strengthening the upper limbs and core with “TR Buzz”

The “TR Buzz” was born from the awareness that training with tools that require symmetrical and synchronous engagement of the limbs (such as the TRX) does not reflect the biomechanics of sports movements, which are predominantly asymmetrical and alternating (Buzzelli, 2021). In fact, human motor activity is regulated by complex neurophysiological mechanisms, including the cross reflex (Gervasio et al., 2015), which coordinates limb movements in an alternating and synergistic way.

The "TR Buzz" was designed to improve the tonic strength of the upper limbs, stimulate the cross reflex and improve intermuscular coordination, using a pulley that constrains the movements of the limbs in an alternating manner. It consists of a mountain rope (approximately 10 mm in diameter and 3.20 m in length) with two handles at the ends, which runs through a pulley.

The pulley, when attached to a solid support placed at a variable height of 2-2.50 m, reduces the length of the rope to approximately 1.5 m per side, allowing the execution of exercises that simulate the asymmetric and alternating movements of the upper limbs. The protocol involves the execution of exercises that involve alternating traction of the upper limbs, with the body inclined in relation to the ground.

RESULTS

The "TR Buzz" allows the player to train the agonist and the antagonist muscles in a functional and specific way for sports movements in general and tennis in particular. In fact, it activates the agonists during the traction phase and necessarily inhibits the antagonist muscles during the release phase and the return to the starting position. The inclination of the body, which must remain inclined but upright, activates the core muscles improving stability and coordination (Akuthota et al., 2008). The progression is based on the gradual increase in the number of repetitions, the series, the progressive inclination of the body with respect to the ground and the complexity of the exercises, with particular attention to correct execution and balance (Osawa et al., 2013).

They are normally proposed based on gender and age as well as the level of physical performance, from 2 to 4 sets of 7 to 14 repetitions per arm. Recovery between sets is 1'30", interspersed with medicine ball throws (while sitting), weighing 7% of body weight (Buzzelli, 2007; 2024) for post-activation strengthening (PAP).

PRACTICAL APPLICATIONS

Several practical aspects should be noted when applying these innovative methods.

From a periodization perspective, trainers and coaches should use the general principles followed in their strength training prescriptions to find specific guidelines on how the sessions should progress athletes from basic to advanced exercises using these tools.

In terms of material, the equipment is safe and effective even in young athletes, reducing the risk of injuries to the shoulders, elbows and wrists. The exercises used in training with "TR Buzz" include exercises for loosening the shoulder girdle, strengthening the Forearm Pronators, Rotator Cuff, Deltoid, Biceps Brachialis, Triceps Brachialis, Pectoralis, Trapezius, Latissimus Dorsi, Rectus Abdominis, Obliques and Transverse Abdominals, Lumbar muscles. The routine can be viewed on Youtube under "The TR Buzz" (Buzzelli, n.d.).

Training with "TR Buzz" improves core strength, coordination and stability, optimizing athletic performance. Unlike elastic bands that increase tension and slow down the movement as their elongation increases, the "TR Buzz" allows you to apply high force at the beginning of the movement and reduce resistance during the final phase, simulating the dynamics of tennis hitting movements (Hetrick, 2001). Personal experience reports significant benefits and comforting results in using this training protocol. Further studies would be necessary to quantify the effects of this training protocol on maximal strength, coordination and athletic performance.

Study limitations and future research

Regarding the limitations of this article, the author acknowledges that while the methods, procedures, and practical applications are described in detail, there is no mention of a controlled research study, using a systematic methodology, the participant sample and recruitment, testing protocols, assessment criteria, or performance hypotheses, data and outcomes as this is not a research manuscript. Therefore, this is an example of practical intervention with tennis players.

Future research directions should be aimed at the testing of the methods with different age groups and the implementation of longitudinal studies with the inclusion of results (i.e. EMG data that could be available) and their proper statistical analyses, which could demonstrate the activation levels compared to traditional weight training.

CONCLUSIONS

The tennis player, to give greater incisiveness to his shots, needs to develop high gradients of dynamic strength for both the upper and lower limbs. The most used practice to achieve this goal is traditionally to rely on exercises with overloads. Considering that the execution of tennis techniques repeated over time, both for hitting the ball (torsions of the trunk) and for moving on the court (sudden changes of direction), are in themselves traumatic for the joints and especially for the spine, it was thought and put into practice an innovative methodology to train strength in an alternative way, which contributed to a reduction to the minimum possible of risks from trauma caused by poor execution of exercises with overloads, especially those placed on the spine, and by the extent of the overload itself (Knudson & Bahamonde, 2001).

The experience verified in the results indicated that these methods also act significantly in the prevention of accidents. In fact, by using body weight and tools that allow its amplification (“BuzzChain” and “TR Buzz”), thanks to some measures and techniques (medullary reflex and positional instability), the objectives of obtaining good levels of strength and reduction and prevention of injuries were achieved effectively and safely. "BuzzChain" and "TR Buzz", two simple, effective tools, without risk of injury in their use, which can be an alternative to an entire gym, both in training fields that do not have them, and when you are out and about for tournaments.

It is hoped that the paper has successfully outlined the practical application of these methods, making them accessible for coaches and athletes. The detailed exercise descriptions help illustrate how these tools can be integrated into training. It is reiterated that maintaining a good level of muscular strength is essential to be able to compete at your best, even more so if what is done does not involve risks and helps prevent injuries.

CONFLICT OF INTEREST AND FUNDING

The author declares that he does not have any conflict of interest and that he did not receive any funding to conduct the research.

REFERENCES

Akuthota, V., Ferreiro, A., Moore, T., & Fredericson, M. (2008). Core stability exercise principles. Current Sports Medicine Reports, 7(1), 39-44. https://doi.org/10.1097/01.CSMR.0000308663.13278.69

Aman, J. E., Elangovan, N., Yeh, I.-L., & Konczak, J. (2015). The effectiveness of proprioceptive training for improving motor function: A systematic review. Frontiers in Human Neuroscience, 8. https://doi.org/10.3389/fnhum.2014.01075

Baiget, E., Fernández-Fernández, J., Díaz, M., & Colomar, J. (2025). Effects of Postactivation Performance Enhancement From Upper-Body Flywheel Overload on Tennis-Serve Performance. International Journal of Sports Physiology and Performance, 1(aop), 1-7. https://doi.org/10.1123/ijspp.2024-0458

Buzzelli, S. (2007-2024). Notes, studies and personal research.

Buzzelli, S. (2020). The "Sigma Test": a new methodology for evaluating a tennis player, ITF Coaching & Sport Science Review, 28(82), 3–6. https://doi.org/10.52383/itfcoaching.v28i82.7

Buzzelli, S. (2021). From "sigma test" to customized training. ITF Coaching & Sport Science Review, 29(84), 4–5. https://doi.org/10.52383/itfcoaching.v29i84.142

Buzzelli, S. (2021). El SensoBuzz. Youcanprint.

Buzzelli, S. (n.d.). Salvatore Buzzelli. Retrieved March 13, 2025, from www.salvatorebuzzelli.it

Buzzelli, S. (n.d.). YouTube channel. Retrieved March 13, 2025, from YouTube

Deng, N., Soh, K. G., Xu, F., & Yang, X. (2025). The effects of strength and conditioning interventions on serve speed in tennis players: a systematic review and meta-analysis. Frontiers in Physiology, 15, 1469965. https://doi.org/10.3389/fphys.2024.1469965

Gervasio, S., Kersting, U. G., Farina, D., & Mrachacz-Kersting, N. (2015). The effect of crossed reflex responses on dynamic stability during locomotion. Journal of Neurophysiology, 114(2), 1034-1040. https://doi.org/10.1152/jn.00178.2015

Hetrick, R. (2001). Total Resistance Exercises by former U.S. Navy SEAL.

Knudson, D., & Bahamonde, R. (2001). Effect of endpoint conditions on position and velocity near impact in tennis. Journal of Sports Sciences, 19(11), 839-844. https://doi.org/10.1080/026404101753113787

Martín-Miguel, I., Escudero-Tena, A., Bustamante-Sánchez, Á., & Conde-Ripoll, R. (2025). Enhancing Groundstrokes Velocity and Accuracy in Post-pubertal and Adult Tennis Players: A Systematic Review of Interventions. Perceptual and Motor Skills, https://doi.org/10.1177/00315125251320133

Osawa, Y., Oguma, Y., & Ishii, N. (2013). The effects of whole-body vibration on muscle strength and power: A meta-analysis. Musculoskeletal Neuronal Interactions.

Pillastrini, P., Marchetti, M., Abbruzzese, G., & Megighian, A. (2020). Neurofisiologia del movimento. Piccin.

Reschechtko, S., & Pruszynski, J. A. (2020). Stretch reflexes. Current Biology, 30(18), R1025-R1030. https://doi.org/10.1016/j.cub.2020.07.092

Senatore, F., & Buzzelli, S. (2022). Development of reaction times in young tennis players using the SensoBuzz application. ITF Coaching & Sport Science Review, 30(88), 34–38. https://doi.org/10.52383/itfcoaching.v30i88.344

Squillante, A. (2020). Allenamento della Forza. Giacomo Catalani Editore.

Zatsiorsky, V. M., Kraemer, W. J., & Fry, A. C. (2004). Allenamento della forza. Scienza e pratica. Calzetti.

Zemková, E., Kováčiková, Z., & Zapletalová, L. (2020). Is there a relationship between workload and occurrence of back pain and back injuries in athletes? Frontiers in Physiology, 11, 894. https://doi.org/10.3389/fphys.2020.00894

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Masters tennis participation in Turkiye: Women's masters

Elif Bozyiğit

Pamukkale University, Faculty of Sport Science, Pamukkale, Denizli, Turkiye

ABSTRACT

This research examined women's participation in masters tennis competitions in Turkiye in the last 10 years. The descriptive analysis method was used in the research. The researcher obtained the data provided as open access. A total of 53.016 data were rearranged and transferred to the analysis program. The participation variables of women tennis players in Masters Tours were obtained according to the year they participated, age categories, national-international competitions, and cities. Descriptive statistics were made with these variables and visualized through graphics. It was determined that there were 6627 participants in Masters Tours between 2016 and 2024. The results showed an increase in women's participation in masters tennis competitions in Turkiye according to years and age categories. It is thought that the increase in the number of Masters Tours and the strategy of ITF to reach more tennis players support the increase in women's participation in Turkiye and the rest of the world.

Key words: Masters Tennis, Masters Tennis Tour, Female Participation, Women Tennis Player

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Corresponding author: ebozyigit@gmail.com

INTRODUCTION

Masters Tennis tournaments, often referred to as veteran or senior competitions, are events designed for tennis players aged 30 and older. These tournaments celebrate the longevity of athletic excellence, providing a platform for players to continue competing at a high level beyond their prime years in the professional circuit. Governed by organizations like the International Managed by the International Tennis Federation (ITF), the Masters Tennis Tours are structured according to thirteen age categories from 30+ to 90+, ensuring fair competition between players in similar age groups (ITF, 2025). These tournaments are held worldwide, drawing both amateur enthusiasts and former professionals, offering a vibrant community and fostering camaraderie among players. As well as reigniting the competitive spirit, Masters Tennis promotes health, fitness, and a lifelong love of the sport and underpins this with its latest slogan, "Passion to Play: Meet, Compete, Improve, Repeat." With regional, national, and international events culminating in prestigious championships, the Masters Tennis circuit is a testament to the enduring appeal of tennis across generations. The tournaments are included in the ITF program, and players from anywhere worldwide can register and participate in the tournament they want according to the announced dates. To participate in the tournament, you must have an International Player Identification Number (IPIN, 2025). More detailed and up-to-date information can be obtained from the ITF official website.

Tennis is one of the sports branches that is the focus of a great number of academic studies in the fields of performance, health, psychology, etc. When these studies are searched with the keywords "adult tennis" in the Web of Science academic database, it is striking that the focus of the studies is generally on determining physical and physiological profiles (Vodak et al., 1980; Sanchis-Moysi et al., 2004), health benefits, health parameters, match characteristics, and performance and health areas (Figure 1). In some studies, on older individuals, topics such as participation in physical activity and well-being (Joseph et al., 2006; Lee & Hung, 2011) have been addressed, and tennis has been included among other branches or activities. In the study conducted by Legg et al. (2017), specifically regarding tennis, the experiences of adults participating in tennis leagues were investigated by examining the issues of social benefits and sense of community. However, no studies have been found in this study that attempts to describe the participation of adult female individuals who turn to tennis in their free time and participate in national and international (ITF) masters competitions and the decrease or increase in the number of participants. It has been observed that this information can generally be obtained from the limited amount of information published by official organizations such as national federations and the ITF.

Figure 1. *Key words in adult tennis research.*

Countries worldwide are developing and implementing various projects to increase women's tennis participation under the ITF's leadership. It is thought that women's participation is increasing daily thanks to the work carried out within the scope of these projects. Thanks to the advancement of technology, the introduction of artificial intelligence, the elimination of language and communication problems, and the positive use of social media in areas such as promotion, information, education, etc., people can now access global information more easily, and this is thought to have a positive effect on the increase in participation. All these developments are also used by individuals in Turkiye who are interested in tennis or who have been introduced to tennis in some way.

It is seen that the studies conducted on tennis and women are generally on topics such as the performance of players, coaches, and gender equality (Ancalmo et al., 2023; Masunga & Ancalmo, 2024; Orban-Sebestyen & Gal, 2024). However, the most important issue reflected and drawing attention to tournaments is the top players in the rankings and the competition between them. As usual, at the end of the tournaments, the tennis players who come first and their successes are conveyed as a popular topic. However, if the subject of the study, "participation", did not exist, there would never be situations where we would focus on the result. Therefore, participation and the increase in participation in women's tennis are the focus of this research. It isn't easy to reach participants or their information outside of popular tournaments today. It is possible to follow specific and up-to-date statistical information on the number of women masters tennis players by country worldwide from a single data source only thanks to ITF databases. However, the data in this area is generally limited, and a detailed distribution cannot be seen at the national level or obtained by accessing the data of the relevant national federations. Based on this, the purpose of this research is to examine the participation numbers of women players in Turkiye participating in masters tennis tournaments over the last ten years.

METHOD

Sample

For the analysis of women's participation in Masters in Turkiye, data was obtained by examining the 52-week Turkish Tennis Federation (TTF) singles ranking status that is publicly displayed. The data provided by I-Court was organized in accordance with the purpose of the research. Women tennis players who participated in at least one competition were included in the study. A total of 53.016 data were used to obtain new data. These data are classified separately according to age categories, years, national and international participation, and city variables. A total of nine years between 2016 and 2024 were included in the research. Since the data from 2015 was not available in the relevant open-access source, it could not be added to the research. Age categories were included in the study according to the classification determined by the ITF. A total of 10 age categories were examined between 35+ and 80+ age categories. The participation status in national and international competitions was obtained from the ranking scores. The 124 clubs to which the licenses of women masters tennis players are affiliated were examined and the city variable was obtained. For 3163 individual licensed participants, the city where tennis was played could not be determined. These data, which were organized and classified, were transferred to the analysis program. The data were examined on 6627 participation cases.

Table 1
Descriptive information of women participants (2016-2024)..

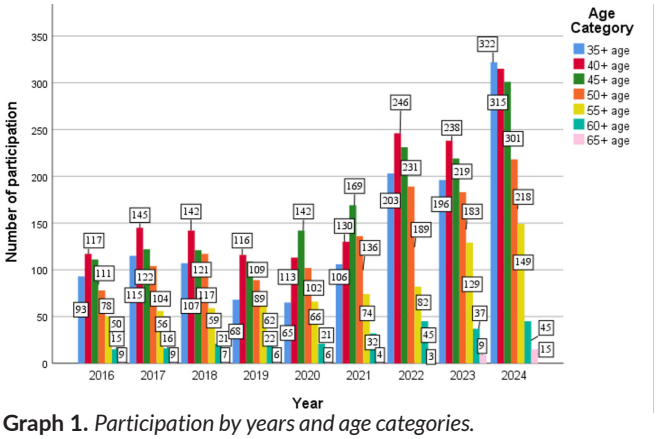
	N	Minimum	Maximum
Years of participation	6627	2016	2024
Age category	6627	35	65
Year of birth	6627	1942	1994
35+ years old	1275		
40+ years old	1562		
45+ years old	1525		
50+ years old	1216		
55+ years old	727		
60+ years old	254		
65+ years old	68		
Total	6627		

Analysis

The descriptive analysis method was used in the research. The data processed in the analysis program were visualized using basic graphics. Separate findings were obtained according to the years, age categories, and national, international, and city participation status of women masters participants.

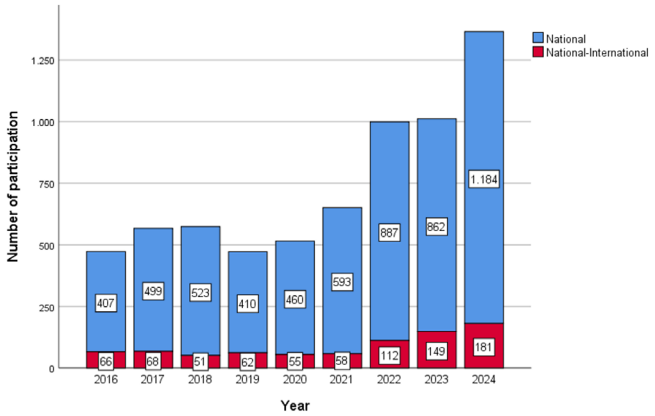
RESULTS

In the study, it was determined that there were 6627 participants in total according to age categories in the nine years between 2016-2024: 35+ 1275, 40+ 1562, 45+ 1525, 50+ 1216, 55+ 727, 60+ 254, 65+ 68. In addition, according to the latest information on the ITF Word Tennis Masters Tour rankings as of January 27, 2025, two women tennis players were in the 70+ category. No participation in national and international masters tennis tournaments was observed in the 75+, 80+, 85+, and 90+ age categories.



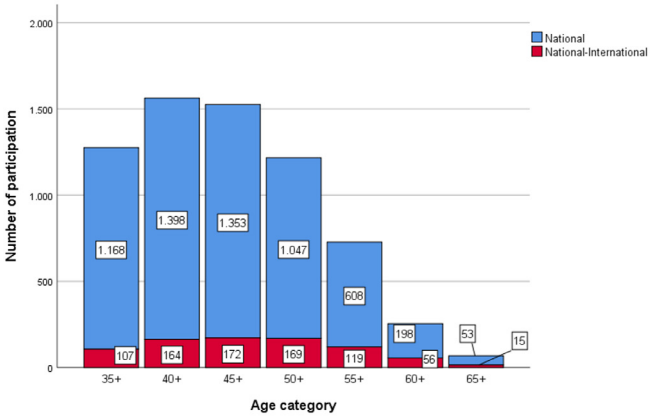
Graph 1. *Participation by years and age categories.*

It has been found that there has been a significant increase in women's participation in Masters tennis tournaments by age category in the last three years. It was determined that the total participation, which was 473 in 2016, would be 1365 in 2024. It is noteworthy that this noticeable increase in age categories over the years is relatively low in the 65+ age category. It has been seen that there was a total of 68 participants in the 65+ age category in the nine years.



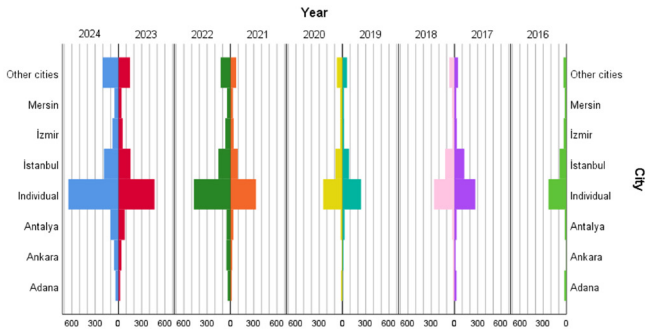
Graph 2. *Total participation by years.*

It has been found that there has been a significant increase in participation in national and international masters tennis tournaments in the last three years.



Graph 3. *National/International total participation by age categories.*

It was found that the women masters tennis players who participated most in national and international masters tennis tournaments between 2016 and 2024 were in the 40+ and 45+ age categories.



Graph 4. *Total participation by city and year.*

Between 2016 and 2024, there was participation in masters tennis tournaments from 36 cities. It was determined that masters women who participated in the competitions on behalf of the club had licenses in 124 different clubs. It was found that the highest participation was from Istanbul (36 clubs, n=1108), Antalya (7 clubs, n=403), Izmir (11 clubs, n=379) and Mersin (4 clubs, n=293). Similarly, it was observed that the highest participation in international (ITF) masters tournaments was from the same cities. It could not be determined from which cities and clubs individual masters tennis players (n=3163) participated in the tournaments.

DISCUSSION

In the research, numerical data belonging to women participants participating in masters tennis competitions in Turkiye were examined in four main areas. The results obtained according to the research results are summarized below according to subheadings.

The total number of participants has increased over the years

According to the data obtained in 2016, the number of participants, which was 7.1%, increased to 20.6% in 2024. However, considering that there are an average of 21 million women between the ages of 35-90 in the country according to Turkish Statistical Institute (TSI, 2023) data for 2023, it should not be forgotten that the participation of a total of 1011 women in masters tennis tournaments in 2023 is almost non-existent and a saddening situation. According to the latest data shared by the ITF, it has been reported that there are 35,380 registered masters players (ITF, 2025). It is thought that the decrease in participant numbers, which was 7.1% in 2019 and 7.8% in 2020, is due to the grave situation affecting the whole world due to the Covid 19 pandemic. A very significant increase in participation in 2022 and afterwards is remarkable. This situation can be interpreted as individuals who have emerged from the pandemic due to the epidemic prioritizing sports preferences for a healthy life. In addition, it is thought that the projects of high-level institutions and organizations around the world to direct more people to sports for a healthy life are also effective. Thanks to these projects, the creation of opportunities and the organization of more sports events make the increase in participation numbers obvious. For example, the increase in the number of Masters Tours organized by the ITF (552 tournaments) and the addition of new ones to the venues where the competitions are held (69 national hosting events) have removed the players from having to go to certain places and increased their participation by choosing the areas that are suitable for them. The increase in Masters Tours organized in Turkiye is also considered an essential factor in women involvement in Masters in the last decade.

Total participation by age category has increased

A significant increase in women's participation in masters tennis tournaments in Turkiye has been found between 2016 and 2024 according to age categories. In general, increases were observed in the 35+ to 55+ age categories, with the highest participation being in the 40+ (23.6%) and 45+ (%23) age categories. This situation decreases after the 60+ age category. However, there is still an increase in the 60+ and 65+ categories. As the number of women playing tennis in the lower age categories increases, it is thought that participation in masters tennis tournaments in the older age categories will increase in the next decade. However, according to I-Court

data, there are no women masters tennis participants in the 70+, 80+, 85+, and 90+ age categories. However, according to the ITF World Tennis Masters Tour Women's ranking data of January 27, 2025 (ITF Ranking, 2025), it was determined that there were 75+ 130, 80+ 71, 85+ 34, and 90+5 women participants in these age categories from the USA, Great Britain, Australia, and France. Considering the tennis history of these countries, it is thought that women tennis players playing in these age categories were introduced to tennis at an earlier age, continued to play as a culture, and the importance of the country's policy are major factors. As the tennis-playing culture develops in Turkiye and this increasing graph in women's participation is considered, the representation of women in each age category will increase. In addition, it is thought that this situation can be improved by increasing awareness of healthy aging, spending time in activity and doing sports, and providing opportunities to play tennis for older age groups. Activities that will enable these age groups to play tennis should be increased. The provision of tennis services and trainers for these age groups by local institutions and organizations in Turkiye can be implemented with projects to be developed.

The number of participants in national and international masters tennis tournaments has increased

The increase in general participation in masters tennis tournaments has also led to an increase in participation in national and international masters tennis tournaments. It was found that the women masters tennis players who participated the most in national and international masters tennis tournaments between 2016 and 2024 were in the 40+ and 45+ age categories. It can be interpreted that the fact that the ITF hosted the European and World Club Team Championships in Turkiye in some years had a positive effect on this increase in participation and attracted the attention of women masters participants. Because participating in these high-level competitions without going abroad is a very positive situation for women participants in these age categories. The fact that the women participant profiles in Turkiye who participate in masters tennis competitions do not do this job professionally is a situation that negatively affects the increase in participation. Because especially a large percentage of women participating in competitions between the age categories of 35+ and 55+ are women who continue their active working lives.

Number of participants by city

A total of 36 cities participated in masters tennis tournaments between 2016 and 2024. Considering that there are 81 cities in Turkiye, it can be said that this rate of close to 50% is still quite low. Because it has been determined that the number of cities with the highest participation varies between 9-10. According to this determination, Istanbul, Antalya, Izmir and Mersin are clearly the leaders in the number of participants every year. It is thought that this situation is because these cities are mega cities of Turkiye, their populations, number of clubs, tennis opportunities and the number of tennis tournaments organized. Similarly, the cities with the highest participation in national and international masters tournaments are also the same cities.

CONCLUSION

In this research conducted to examine the participation of women in masters tennis competitions in Turkiye in the last 10 years, the main finding was that the number of women participants has increased. However, since the results obtained in this study evaluated the participation of women masters tennis players in competitions with findings obtained from numerical data, it could only reveal the increase in participation. The data collection method used for the study was obtained through open-access resources. This situation also reveals the limitations of the study. Apart from the data sources used for this study, it is thought that there are more organizations, events, and competitions organized officially or specifically for masters tennis players. The fact that there is no gender discrimination in official competition organizations, and even the existence of mixed doubles categories, ensures that women and men participate in tournaments with equal rights. This is the best aspect of the egalitarian approach of the tennis branch. However, it can still be seen by looking at the participation numbers in tournaments that women's participation in individual masters tennis competitions in Turkiye is less than men's. Regardless of the purpose of doing sports, a deeper and more detailed examination of adult individuals participating in competitions through activities, especially women's participation, is recommended for future research.

Women's participation in the Masters Tennis tournaments is important because it focuses on promoting gender equality in sports (ITF, 2024), health/wellbeing benefits, challenging age and gender norms (Huggins and Randell, 2007), being role models for future generations (LTA, 2024), fostering community and camaraderie (Boyd, 2023), advancing competitive opportunities for women and economic growth in women's sports (ITF, 2023), making it a powerful tool to promote equality, health, and community while celebrating the enduring love of tennis across all ages.

Organizations and sports events have a significant impact on the spread of playing tennis. Because individuals try to do some things together by organizing, which they cannot do alone, it is thought that the increase in tennis-related activities by authorized institutions and federations will increase the participation of more individuals and, therefore, women in tennis.

CONFLICT OF INTEREST AND FUNDING

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REFERENCES

Ancalmo, C., Zuluaga, F., Miranda, M., Castro, P., & Kahn, D. (2023). Gender equality strategies at national association level. Examples of best practices in Central and South America. ITF Coaching & Sport Science Review, 31(90), 37-40. https://doi.org/10.52383/itfcoaching.v31i90.492

Boyd, M. (2023). Tennis BC showcasing opportunities in tennis with girls. Set. Match. Tennis Canada, News. August 23, 2023. (2025, January 27) https://www.tenniscanada.com/news/tennis-bc-showcasing-opportunities-in-tennis-with-girls-set-match/

Huggins, A., & Randell, S. (2007). The contribution of sports to gender equality and women's empowerment. International Conference on Gender Equity on Sports for Social Change, Kigali: Rwanda.

I-Court (2025). Ranking Points. Turkish Tennis Federation, (2025, January 28) https://www.ikort.com.tr/klasman-puanlari

IPIN (2025). The International Player Identification Number, ITF World Tennis Masters Tour IPIN FAQ, International Tennis Federation. (2025, January 12) https://www.itftennis.com/en/about-us/organisation/about-ipin/?type=masters

ITF (2023). Another significant step towards gender parity. International Tennis Federation, News & Media, April 3, 2023. (2025, January 28) https://www.itftennis.com/en/news-and-media/articles/another-significant-step-towards-gender-parity/

ITF (2024). Advantage all. Tennis is an equal advantage sport. ITF Gender Equality Strategy 2019-2024. International Tennis Federation. (2025, January 27) https://www.itftennis.com/en/about-us/governance/advantage-all/

ITF (2025). ITF World tennis masters tour. International Tennis Federation, (2025, January 15) https://www.itftennis.com/en/itf-tours/itf-world-tennis-masters-tour/

ITF Ranking (2025). Women's ranking, ITF World tennis masters tour. International Tennis Federation, 2025, 27 January. https://www.itftennis.com/en/rankings/world-tennis-masters-tour-rankings/

Joseph, A., Zimring, C., Harris-Kojetin, L., & Kiefer, K. (2006). Presence and Visibility of Outdoor and Indoor Physical Activity Features and Participation in Physical Activity Among Older Adults in Retirement Communities. Journal of Housing For the Elderly, 19(3-4), 141-165. https://doi.org/10.1300/J081v19n03_08

Lee, Y. J., & Hung, W. L. (2011) The relationship between exercise participation and well-being of the retired elderly. Aging Ment Health. 15(7), 873-881. https://doi.org/10.1080/13607863.2011.569486.

Legg, E., Wells, M., Newland, A., & Tanner, P. (2017). Exploring sense of community in adult recreational tennis. World Leisure Journal, 59(1), 39-53. https://doi.org/10.1080/16078055.2016.1277611

LTA (2024). More women and girls playing tennis than ever. Lawn Tennis Association News, 2024, August 3. https://www.lta.org.uk/news/more-women-and-girls-playing-tennis-than-ever-but-gender-equity-in-participation-still-a-way-off/

Masunga, T., & Ancalmo, C. (2024). Female coaches' initiatives that drive the ITF Gender Equality Advantage All Strategy. ITF Coaching & Sport Science Review, 32(93), 46-50. https://doi.org/10.52383/itfcoaching.v32i93.602

Orban-Sebestyen, K., & Gal, A. (2024). Female tennis coaches in Hungary: far from elite tennis. ITF Coaching & Sport Science Review, 32(93), 23-28. https://doi.org/10.52383/itfcoaching.v32i93.552

Sanchis-Moysi, J., Dorado, C., Vicente-Rodríguez, G., Milutinovic, L., Garces, G. L, & Calbet, J. A. L (2004). Inter-arm asymmetry in bone mineral content and bone area in postmenopausal recreational tennis players. Maturitas, 48(3), 289-298. https://doi.org/10.1016/j.maturitas.2004.03.008.

TSI (2023). Women in Statistics, 2023. Turkish Statistical Institute Newsletter, 6 March, 2024.

Vodak, P. A., Savin, W. M., Haskell, W. L., Wood, P. D. (1980). Physiological profile of middle-aged male and female tennis players. Medicine and science in sports and exercise, 12(3),159-63.

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Initial validation of the ITF World Tennis Number (WTN) on-court assessment

Rafael Martínez Gallego, Manrique Rodríguez-Campos & Ana Piquer-Piquer

Research Group on Sports Technique and Tactics, Universidad de Valencia (Spain).

ABSTRACT

This study validates an initial on-court assessment for the International Tennis Federation (ITF) World Tennis Number (WTN), designed for players without prior ratings. The research followed a multi-phase approach: (1) literature review, (2) ITN-WTN equivalence analysis, (3) evaluation of existing on-court tests, and (4) validation with 106 recreational players across six countries. Pearson's correlation and stepwise multiple regression identified ITN-based test as the strongest predictor of WTN ($r = -0.45$, $p < 0.05$), followed by serve ($r = -0.39$, $p < 0.05$) and volley ($r = -0.31$, $p < 0.05$). The final model ($\beta = -0.0464$, $p < 0.001$) explained 19.8% of WTN variance. These results confirm the ITN-based on-court test as a reliable tool for assigning initial WTN ratings. The implemented tests assessed serve, groundstrokes depth, groundstrokes accuracy, and volleys. Their strong correlation with WTN supports their validity in structured player classification. This assessment offers a standardized, accessible approach for players without match history, ensuring a fairer rating system.

Key words: rating, skill, level, competency, evaluation, technique

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Corresponding author: Manrique Rodríguez-Campos. manrocam@alumni.uv.es

INTRODUCTION

A player tennis rating is a numerical representation of a tennis player's skill level, designed to facilitate fair and competitive matchups. Systems such as the International Tennis Federation's World Tennis Number (WTN) and those used by several national tennis federations, provide a standardized measure of a player's abilities based on their performance in matches (ITF, 2025). These ratings consider various factors, including match outcomes, the strength of opponents, and the competitiveness of the matches. By offering a consistent and objective assessment, tennis ratings help players, coaches, and organizers to gauge skill levels accurately, ensuring that players compete against others of similar proficiency, which enhances the overall competitive experience. While rating systems typically rely on match data, such approaches may be impractical or inaccurate for players without a competition history. Alternative methods, such as self-assessment or coach-reported ratings, are susceptible to subjective bias and inconsistencies across contexts. In contrast, an on-court assessment offers a standardized and objective means to evaluate technical competencies, providing a more equitable entry point into the rating system. This is particularly crucial for newcomers or recreational players, for whom reliable competitive data may be unavailable.

The importance of an appropriate initial on-court test for tennis ratings cannot be overstated. Such assessments are crucial for establishing a reliable baseline rating for players who lack prior ratings, ensuring that their skill levels are accurately reflected from the outset. This initial evaluation usually focuses on technical competencies, such as serve, forehand, and backhand strokes, which are fundamental to

a player's performance (Strecker et al., 2011). In addition to traditional models like the ITN or NTRP, recent developments in performance rating systems have incorporated advanced computational methods to improve accuracy and applicability. Kyriakides et al. (2015) introduced AccuRATE, a hybrid approach that combines linear algebra models with machine learning to enhance prediction capabilities in football. Similarly, Ismail (2023) proposed the Estimated Performance Rating (PRe), a novel system designed to overcome the limitations of traditional Tournament Performance Ratings (TPR), particularly in cases of perfect or null scores, and applicable across tennis, football, and chess. These models highlight the ongoing evolution of rating systems toward more robust and adaptable frameworks.

Implementing a scientifically validated on-court test helps to maintain the integrity of the rating system, providing a fair and equitable starting point for all players. This approach

not only promotes fair competition but also aids in the development of tailored training programs that address individual strengths and weaknesses, ultimately contributing to the player's growth and progression in the sport (Šlosar et al., 2019).

The ITF continues to successfully roll out the ITF World Tennis Number (WTN) product with the aim to build a large, engaged community of global players in all nations of the world. The ITF World Tennis Number is a real-time skill level rating system designed for tennis enthusiasts of all levels (Santilli & Crespo, 2024). Like a golf handicap, the WTN provides a numerical representation of a player's ability, enabling them to find opponents who match their skill level anywhere in the world. This global rating system simplifies the process of identifying suitable playing opportunities, making tennis more accessible and enjoyable for everyone. It also serves as a tool to track the development of one's game over time. One of the largest and more accurate database of match records from close to nations is used to power both a singles and a doubles algorithm that updates globally on each Wednesday of each week. In 2023, the Intercollegiate Tennis Association (ITA) adopted ITF World Tennis Number as its exclusive rating. The WTN and is now seen on rosters and player profiles for all US College players (Santilli & Crespo, 2023).

Research has explored the validity and accuracy of the ITF WTN and has concluded that its accuracy levels are statistically greater than chance and is a valid measure of player skill based upon its ability to predict match outcomes (Im & Lee, 2023; Krall et al., 2024; Mayew & Mayew, 2023).

Following the ITF WTN current success and mirroring the steps taking for the implementation of the ITF WTN, it was suggested to create an on-court assessment to facilitate the delivery of this new rating system. The aim of the new on-court assessment was structured around various terms of reference. Initially, it would be geared towards individuals who had no ITF WTN rating. The assessment would not provide an indication of the player's tennis skill level but rather its equivalency to the ITF WTN. It would be intended as a one-off assessment to provide the initial ITF WTN rating and would not be used for periodic ratings, which would only be achieved through participation in competitions.

The development of the assessment would be evidence-based, following a scientific study conducted in the field, and would incorporate practical experience and knowledge from previous on-court rating assessments, such as the ITN. The assessment would be designed to be technically sound, focusing on the technical competency of the player. In principle, it would not consider tactical, physical, mental, or competitive competencies as variables to facilitate its practical implementation in a variety of tennis settings worldwide.

LITERATURE REVIEW

As part of this process, and in line with usual research processes, a literature review was deemed necessary. This section will cover previous assessments of tennis skill levels, including the ITN and other relevant tests. Key studies and methodologies will be discussed highlighting the skills measured in tennis and their correlation with performance levels.

Historically, research has explored the use of on-court tennis assessments to provide accurate player ratings (Broer & Miller, 1950; Digennaro, 1969; Dyer, 1935; Fox, 1953; Hewitt, 1965, 1966, 1968; Kemp & Vincent, 1968; Miller, 1953; Purcell, 1981). As an example, the National Tennis Rating Program (NTRP) has been used in the USA (Delaney, 1982) to rate the tennis ability of amateur players for a considerable number or years.

In 2003, the ITF launched the International Tennis Number (ITN) as an instrument to increase participation in the ITF's member nations. The ITN was structured in a 1-10 rating system which was very straightforward and simple for tennis players around the world to comprehend. The introduction of sub-categories for beginner players (ITN 10.3, ITN 10.2, and ITN 10.1) facilitated the inclusion of players of all skill levels to have an ITN (ITF, 2003a). It was also related with existing national rating systems in some nations (such as the NTRP in the USA, the "classement" system in France, and the British rating system) using an ITN Conversion Chart (ITF, 2003b) as well as a description of standards (ITF, 2003c). It was adopted by close to 40 nations worldwide. Furthermore, since its launch, the ITN has been used as an indicator of the skill level of tennis players in multiple research studies related to physical fitness (Olcucu & Vatansever, 2015), health benefits (Fernandez Fernandez et al., 2009), psychology (Cherappurath et al., 2020), or stroke classification (Wu et al., 2022) among others. Apart from research projects, the ITN was also used by sport organisations such as Special Olympics for the classification of the tennis players participating in their competitions (Special Olympics, 2025).

To emphasise the practical application of the ITN, an objective on-court assessment was developed. This tool was created specifically for the ITN and was an important instrument to facilitate the adoption of the rating. It was developed to engage recreational players who did not regularly participate in competitions. It served as an objective method for initially rating players at this level. While some limitations acknowledged as related to assessments non based on tennis match results (such as static feeding, assessing strokes in a closed situation, and only evaluating certain strokes), it was felt that the assessment could be used alongside the ITN. It not only provided an objective method for initially rating players without previous competition results but also served as an instrument that would assist in the promotion of the game and motivate players of all levels to have a more objective awareness of the level of their game (ITF, 2004).

The assessment measured certain key strokes on consistency, accuracy (1st bounce), power (2nd bounce) and measures mobility. Coaches were registered as official assessors to use the instrument to rate players for competition and training (Sharp, 2007). The ITN on-court assessment was also included in the syllabi of the ITF coach education courses as part of the content for the first certification levels.

Therefore, following the steps taken in the implementation of the ITN and the ITN on-court assessment, the goal of this article is to outline the development and validation of an initial on-court assessment for the ITF World Tennis Number (WTN). This assessment is designed for players without a prior WTN rating and focuses on their technical competencies. The assessment is evidence-based, drawing from scientific research and practical experience with previous on-court rating assessments, such as the ITN.

METHODOLOGY

Study design and implementation phases

The research was conducting following several implementation phases. The first one was the literature review which encompassed a comprehensive examination of existing studies on tennis skill assessments and their pertinence to the World Tennis Number (WTN) as shown previously. The second phase consisted in an initial search for equivalence between the ITN and WTN was explored, considering various tests. This exploration aimed to establish a foundational equivalency between the two rating systems.

Subsequently, the third phase involved the analysis of the most pertinent tests undertaken based on the literature. Notable examples of these tests included the Avery Richardson Tennis Serve Test (Avery et al., 1979, 1981; McGhee, 1981), the ITN on-court assessment, and the Dutch Technical-Tactical Tennis Test (D4T) (Kolman et al., 2017). These tests were chosen for their relevance and ability to accurately measure tennis skills. The initial conclusion of this phase was that the ITN on-court test seemed the most accurate and viable according to the goals of the study.

Finally, the fourth phase consisted in the establishment of an equivalency between the ITN-based on-court test and the WTN. This validation was conducted through practical on-court testing involving 106 players, who were later categorized into four distinct WTN level groups. Statistical analysis was employed to identify the sections of the ITN-based on-court test that most effectively predicted the players' WTN, ensuring the reliability and accuracy of the assessment process.

Sample

The sample included 106 recreational players, with a mean age of 18.62 ± 9.33 years and a WTN between 20 and 40, representing the national federations from the following nations: Argentina, Brazil, Colombia, Singapore, the United Kingdom, and the United States. The selection criteria for these nations included the degree of implementation of the ITF WTN, availability of test deliverers, availability of players, regional distribution, and recognition of their Coach Education System.

All players joined voluntarily to take part in the study, they were informed of the research procedure prior to commencement by the test deliverer, they all indicated that were healthy and injury free, were given the opportunity to ask any questions regarding the process and agreed to participate freely in the activity. Table 1 shows the geographical distribution of the players participating in the study.

Table 1
Geographical distribution of the players participating in the study.

Countries	Number of players
Argentina	17
Brazil	15
Colombia	20
Singapore	17
United Kingdom	16
United States	21
TOTAL	106

Instrument

As indicated, it was considered that the ITN was the on-court assessment test that would better adapt to the goals of the study. Furthermore, due to previous challenges in the implementation and measurement of the mobility section of the ITN test, it was agreed that the test would comprehensively cover all the basic tennis strokes — serve, groundstrokes depth, groundstrokes accuracy and volleys — ensuring that players were assessed across the full range of fundamental techniques. The decision to exclude physical components from the assessment was made deliberately to ensure broad applicability and ease of implementation across diverse tennis settings. While tactical decision-making and physical fitness are undoubtedly integral to overall tennis performance, their reliable measurement typically requires more complex testing protocols, greater assessor expertise, and specific equipment or match-play conditions. These constraints would hinder the scalability of the tool, particularly in developing contexts or grassroots programs. Therefore, prioritizing technical stroke execution allows for a valid and objective assessment that remains accessible, time-efficient, and consistent across settings, without compromising the purpose of initial classification. It was believed that this inclusion guarantees a holistic evaluation of a player's on-court capabilities as per stroke production. For a description of the main characteristics of the ITN on-court assessment test interested readers are directed to its guide (ITF, 2004). The ITN-based on-court assessment tests selected for this study are shown in Figure 1.

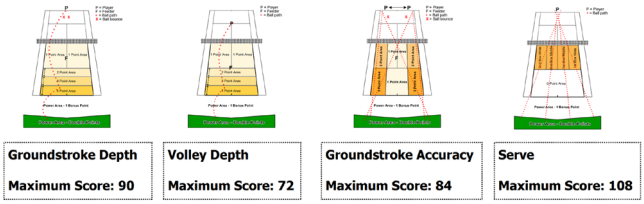

Figure 1. *ITN-based on-court assessment tests selected for this study.*

Data analysis

Descriptive statistics were calculated for all variables, expressed as means and standard deviations. The normality of the distribution was assessed using the Shapiro-Wilk test, revealing that all variables followed a normal distribution. Given these results, parametric tests were applied for normally distributed variables. A Pearson's correlation analysis was computed to assess the relationships between the variables. Correlations were classified as trivial (0–0.1), small (0.1–0.3), moderate (0.3–0.5), large (0.5–0.7), very large (0.7–0.9), nearly perfect (0.9), and perfect (1.0) Additionally, a stepwise multiple regression analysis was performed to determine the best predictors of WTN, retaining only the most relevant variables based on Akaike Information Criterion (AIC). The final predictive model was evaluated in terms of its explanatory power, using the adjusted R^2 value and the Root Mean Square Error (RMSE), obtained through cross-validation. Statistical significance was established at an alpha level of $p \leq 0.05$. All statistical analyses were performed using RStudio (Version 2024.04.1+748.)

RESULTS

Table 2 presents the descriptive statistics for each of the analysed variables. The results indicate that the mean serve score was 66.30 (SD = 16.23), ranging from 25 to 96. The average groundstrokes depth was 52.33 (SD = 12.28), with values between 20 and 80, while groundstrokes accuracy had a mean of 55.08 (SD = 14.65), ranging from 23 to 91. The mean volley score was 34.51 (SD = 10.62), with a minimum value of 14 and a maximum of 60.

Regarding rating systems, the International Tennis Number had a mean value of 211.86 (SD = 37.43), ranging from 118 to 305. The World Tennis Number showed an average of 27.81 (SD = 3.83), with a minimum of 20 and a maximum of 40.

Table 2
Descriptive statistics of performance and rating variables.

Variable	Mean (SD)	Min-Max
Serve	66.30 (16.23)	25-96
Groundstrokes depth	52.33 (12.28)	20-80
Groundstrokes accuracy	55.08 (14.65)	23-91
Volley	34.51 (10.62)	14-60
ITN-based on-court test	211.86 (37.43)	118-305
World Tennis Number	27.81 (3.83)	20-40

SD: Standard deviation; Min: Minimum; Max: Maximum; ITN: International Tennis Number.

The correlation coefficients between the variables are shown in Figure 2. The ITN-based test had the strongest negative correlation with WTN (r = -0.45, p < 0.05), followed by Serve (r = -0.39, p < 0.05) and Volley (r = -0.31, p < 0.05). Other variables (Groundstrokes depth and Groundstrokes accuracy) showed weaker correlations with WTN. These results indicate that higher ITN scores are associated with lower WTN scores, suggesting that ITN-based test is a critical factor in predicting WTN.

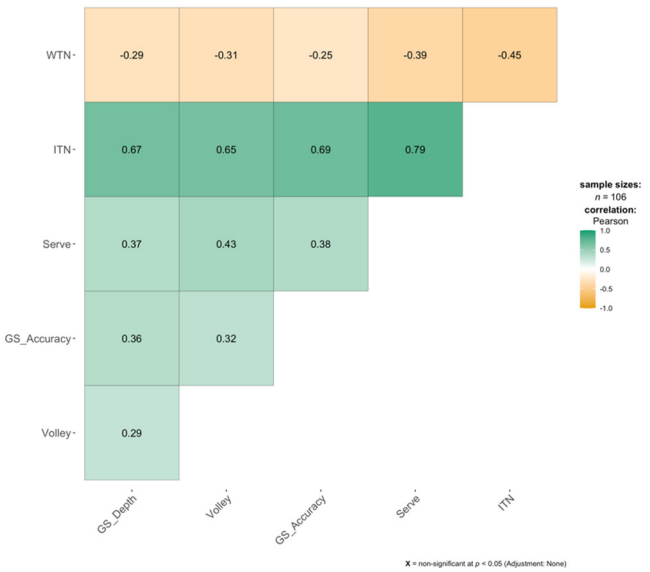

Figure 2. *Correlation between the tests of the ITN-based test with the WTN.*

Note: GS: Groundstrokes

As shown in Table 3, the stepwise multiple regression analysis retained ITN as the only significant predictor of WTN, removing groundstrokes depth, Volley, groundstrokes accuracy, and serve due to their lack of statistical significance. The final regression equation was: WTN=37.64−0.0464×ITN-based.

Table 3
Stepwise regression model results.

Predictor	Estimate	Std. Error	t-value	p-value	AIC
Intercept	37.6429	1.9229	19.577	<0.001	263.17
ITN-based test	-0.0464	0.0089	-5.194	<0.001	

The model was statistically significant (F (1, 104) = 26.98, p < 0.001), indicating a meaningful relationship between ITN-based test and WTN. The adjusted R^2 value was 0.198, suggesting that ITN explains approximately 19.8% of the variance in WTN. The negative coefficient for ITN (-0.0464, p < 0.001) confirms that as ITN-based test increases, WTN decreases. The residual standard error of the model was 3.428, and the Root Mean Square Error (RMSE) on the test dataset was 3.54, indicating moderate predictive accuracy.

DISCUSSION

The findings of this study provide strong support for the initial validation of the ITF World Tennis Number (WTN) on-court assessment as a reliable method for assigning initial player ratings. The observed correlations between WTN ratings and on-court performance indicators align with previous research validating rating systems such as the ITN and UTR (Im & Lee, 2023; Krall et al., 2024). This reinforces the legitimacy of using standardized assessment methods to determine player skill levels, particularly for those without prior match results.

A key implication of our results is that the assessment offers a practical and scientifically grounded solution for assigning initial WTN ratings. Prior to this, rating systems like the WTN relied primarily on competitive match data (Santilli & Crespo, 2023). However, this approach posed challenges for new players, as they required match history to receive an accurate rating. The introduction of an on-court assessment addresses this gap, ensuring that all players, regardless of competition history, receive an initial rating that reflects their technical abilities.

Our findings are in line with previous research highlighting the importance of objective skill assessments in tennis. For example, standardized rating scales such as the ITN have been successfully utilized in junior player evaluations, demonstrating high validity and reliability (Ngatman et al., 2023). Similarly, studies on tennis ratings have shown that structured assessment methodologies contribute to improved match predictability (Im & Lee, 2023; Krall et al., 2024). The results of our study further confirm that structured on-court assessments can serve as effective tools for categorizing player skill levels in a manner consistent with broader rating frameworks. While the predictive accuracy of the WTN system has been affirmed in prior studies (Im & Lee, 2023; Mayew & Mayew, 2023), questions remain regarding the impact of algorithm modifications on rating stability (Krall et al., 2024). Future research should examine whether adjustments to the WTN algorithm, such as those

implemented in 2023, enhance the predictive capacity of the system or introduce new biases (Krall et al., 2024). Moreover, further investigations should explore the extent to which on-court assessments predict future match performance, especially among junior and recreational players.

Another important consideration is the potential integration of physical and tactical components into the on-court assessment. Although our study focused primarily on technical competencies, prior research suggests that physical attributes, such as agility and endurance, also correlate with player performance (Morais et al., 2024; Olcucu & Vatansever, 2015). However, the objective of this initial validation was to provide a test that is as simple as possible to apply, ensuring that coaches can implement it with ease. Objective and standardized measurement of these components typically requires either advanced monitoring equipment (e.g., wearable sensors or video analysis) or simulated match-play conditions, which may not be accessible in all implementation contexts. Moreover, such additions could increase administration time, reduce portability, and complicate scoring reliability. As such, while theoretically valuable, the practical integration of physical and tactical aspects must be carefully weighed against the assessment's intended simplicity and scalability.

In summary, our study demonstrates that the WTN on court assessment is a valid and practical method for establishing initial player ratings.

LIMITATIONS

Despite the promising findings, this study has some limitations. First, the sample size was limited, and further research with a larger and more diverse participant pool is needed to confirm the generalizability of the results. Second, the assessment strictly considers technical competencies, excluding physical, mental, and tactical aspects. While this is a limitation, it was intentionally designed this way to ensure a simple and easily applicable test for coaches. Third, external factors such as player motivation and environmental conditions were not considered, aligning with the study's focus on an objective, skill-based evaluation.

PRACTICAL APPLICATIONS

From a practical standpoint, the implementation of the WTN on court assessment offers a valuable tool for coaches and tennis organizations seeking to integrate a standardized and accessible rating system. The ease of administration makes it a practical solution for evaluating players who lack match history. Additionally, by providing an objective measure of technical ability, the WTN on court assessment can assist in training program design and player development strategies. By providing a standardized approach to rating assignment, the WTN on court assessment enhances the inclusivity and accessibility of the WTN system. Furthermore, organizing tournaments often presents challenges in accurately determining player levels, and this tool could help address that issue by offering a reliable initial classification. Future research should continue to refine the assessment methodology and investigate its long-term implications for player development and competitive fairness.

CONCLUSIONS

The decision to implement the on-court test for ITN-based test has proven to be appropriate, providing a highly accurate correlation between on-court performance and WTN classification. The developed formula allows for consistent and objective calculation of a player's WTN rating based on their on-court performance. This on-court assessment provides a highly accurate correlation between on-court performance and the classification within the ITF World Tennis Number, ensuring that players are rated reliably based on their skills and abilities displayed during actual play.

It was also concluded that the ITN on-court test does not need to be conducted in its entirety. The final physical test segment has been eliminated, as it was found to be unnecessary for predicting WTN ratings. The streamlined test structure focuses on essential components while maintaining the accuracy and validity of the results, ensuring a holistic evaluation of players' capabilities. By focusing solely on the most critical performance components, the revised structure ensures a comprehensive yet practical assessment, making it more accessible for a broader range of players and evaluators.

The WTN On-Court Assessment could transform the landscape of tennis, particularly for recreational players, over the next few years. Through the WTN On-Court Assessment, there would be opportunities not only to attract new individuals to the sport but also to retain and motivate both new and existing players to engage more with tennis. It is anticipated that, in a short time, most tennis players worldwide would hold a WTN On-Court Assessment, which would be recognized as the most objective procedure to access the ITF WTN, thus incorporating this crucial rating language in the tennis community.

As the ITF World Tennis Number continues to evolve, it is suggested that its on-court assessment will have to be committed to refining and expanding to be used by as many interested parties as possible. Future research should explore additional variables that may enhance the predictive accuracy of WTN ratings while ensuring the system remains adaptable to diverse playing conditions and competitive levels. Moreover, continuous feedback from players, coaches, and tennis organizations will be crucial in optimizing the assessment protocol, ensuring it meets the needs of a growing and diverse tennis-playing population. By embracing these developments, the WTN On-Court Assessment has the potential to become a cornerstone of modern tennis evaluation, supporting data-driven player progression at all levels of the sport.

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CONFLICT OF INTEREST AND DECLARATION OF FUNDING

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REFERENCES

Avery, C. A., Richardson, P. A., & Jackson, A. W. (1979). A practical tennis serve test: measurement of skill under simulated game conditions. Research Quarterly for Exercise and Sport, 4(50), 554–564.

Avery, C. A., Richardson, P. A., & Jackson, A. W. (1981). Response to McGehee's Discussion. Research Quarterly for Exercise and Sport, 52, 296–297.

Broer, M. R., & Miller, D. M. (1950). Achievement tests for beginning and intermediate tennis. Research Quarterly for Exercise and Sport, 3(21), 303–321.

Cherappurath, N., Elayaraja, M., Kabeer, D. A., Anjum, A., Vogazianos, P., & Antoniades, A. (2020). PETTLEP imagery and tennis service performance: an applied investigation. Journal of Imagery Research in Sport and Physical Activity, 15(1). https://doi.org/10.1515/jirspa-2019-0013

Delaney, B. (1982). The National Tennis Rating Program. Journal of Physical Education, Recreation & Dance, 53(6), 27–27. https://doi.org/10.1080/07303084.1982.10629422

Digennaro, J. (1969). Construction of Forehand Drive, Backhand Drive, and Service Tennis Tests. Research Quarterly. American Association for Health, Physical Education and Recreation, 40(3), 496–501. https://doi.org/10.1080/10671188.1969.10614868

Dyer, J. T. (1935). The backboard test of tennis ability. Research Quarterly for Exercise and Sport, sup 1(6), 63–74.

Fernandez Fernandez, J., Sanz, D., Sanchez, C., Pluim, B., Tiemessen, I., Ruiz Cotorro, A., Estruch, A., & Mendez Villanueva, A. (2009). Health benefits of tennis in adult population. ITF Coaching & Sport Science Review, 16(47), 13–16.

Fox, K. (1953). A study of the validity of the Dyer backboard test and the Miller forehand-backhand test for beginning tennis players. Research Quarterly for Exercise and Sport, 1(24), 1–7.

Hewitt, J. E. (1965). Revision of the Dyer backboard tennis test. Research Quarterly for Exercise and Sport, 2(36), 153–157.

Hewitt, J. E. (1966). Hewitt's tennis achievement test. Research Quarterly for Exercise and Sport, 37, 231–240.

Hewitt, J. E. (1968). Classification tests in tennis. Research Quarterly for Exercise and Sport, 39(3), 552–555.

Im, S., & Lee, C.-H. (2023). World Tennis Number. The new gold standard, or a failure. ITF Coaching & Sport Science Review, 30(91), 6–12.

Ismail, M. S. (2023). Performance rating in chess, tennis, and other contexts. arXiv preprint. https://arxiv.org/abs/2312.12700

ITF. (2003a). How the ITN Works. ITF Coaching & Sport Science Review, 11(29), 6.

ITF. (2003b). ITN comparison chart. ITF Coaching & Sport Science Review, 11(29), 7.

ITF. (2003c). ITN description of standard. ITF Coaching & Sport Science Review, 11(29), 4–5.

ITF. (2004). ITN On Court Assessment Guide. www.internationaltennisnumber.com

ITF. (2025, March 5). ITF World Tennis Number. Https://Worldtennisnumber.Com

Kemp, J., & Vincent, M. F. (1968). Kemp-Vincent rally test of tennis skill. Research Quarterly for Exercise and Sport, 4(39), 1000–1004.

Kyriakides, G., Talattinis, K., & Stephanides, G. (2015).
A hybrid approach to predicting sports results and an AccuRATE rating system. International Journal of Applied and Computational Mathematics, 3(2), 239–254. https://doi.org/10.1007/s40819-015-0103-1

Kolman, N., Huijgen, B., Kramer, T., Elferink-Gemser, M., & Visscher, C. (2017). The Dutch Technical-Tactical Tennis Test (D4T) for Talent Identification and Development: Psychometric Characteristics. Journal of Human Kinetics, 55(1), 127–138. https://doi.org/10.1515/hukin-2017-0012

Krall, N., Maroulis, N., Mayew, R. L., & Mayew, W. J. (2024). Initial evidence on the impact of the 2023 World Tennis Number algorithm change for predicting match outcomes. ITF Coaching & Sport Science Review, 32(94), 52–58. https://doi.org/10.52383/itfcoaching.v32i94.559

Mayew, R. L., & Mayew, W. J. (2023). Which global tennis rating better measures player skill? Evidence from the 2022 USTA Junior National Championships. The Sport Journal, 27, 1–26. https://ssrn.com/abstract=4547112

McGhee, R. V. (1981). Discussion of "A Practical Tennis Serve Test: Measurement of Skill under Simulated Game Conditions." Research Quarterly for Exercise and Sport, 52, 294–295.

Miller, W. K. (1953). Achievement Levels in Tennis Knowledge and Skill for Women Physical Education Major Students. Research Quarterly. American Association for Health, Physical Education and Recreation, 24(1), 81–90. https://doi.org/10.1080/10671188.1953.10624898

Morais, J. E., Kilit, B., Arslan, E., Soylu, Y., & Neiva, H. P. (2024). Effects of a 6-week on-court training program on the International Tennis Number (ITN) and a range of physical fitness characteristics in young tennis players. Frontiers in Sports and Active Living, 6, 1304073. https://doi.org/10.3389/fspor.2024.1304073

Ngatman, N., Guntur, G., & Broto, D. P. (2023). Test of validity, reliability and relevance of the ITN 10.3 ITF test. Proceedings of the 6th Yogyakarta International Seminar on Health, Physical Education, and Sports Science, 73, 49-60. https://doi.org/10.2991/978-94-6463-356-6_6

Olcucu, B., & Vatansever, S. (2015). Correlation Between Physical Fitness and International Tennis Number (ITN) Levels Among Children Tennis Players. Anthropologist, 21, 137–142.

Purcell, K. (1981). A tennis forehand-backhand drive skill test which measures ball control and stroke firmness. Research Quarterly for Exercise and Sport, 2(52), 238–245.

Santilli, L., & Crespo, M. (2023). Editorial. ITF Coaching & Sport Science Review, 30(91), 2–5.

Santilli, L., & Crespo, M. (2024). Editorial. ITF Coaching & Sport Science Review, 32(94), 1–3.

Sharp, B. (2007). "Discovery" Match Tennis is a Sport for All-ITN. ITF Coaching & Sport Science Review, 15(42), 8–9. www.itftennis.com/itn

Šlosar, L., Šimunič, B., Pišot, R., & Marusic, U. (2019). Validation of a Tennis Rating Score to evaluate the technical level of children tennis players. Journal of Sports Sciences, 37(1), 100–107. https://doi.org/10.1080/02640414.2018.1483184

Special Olympics. (2025). Tennis - ITN on-court assessment. Https://Resources.Specialolympics.Org/Sports-Essentials/Sports-and-Coaching/Tennis/Itn-on-Court-Assessment-Level-4-and-Level-5

Strecker, E., Foster, E. B., & Pascoe, D. D. (2011). Test-retest reliability for hitting accuracy tennis test. Journal of Strength and Conditioning Research, 25(12), 3501–3505. https://doi.org/10.1519/JSC.0b013e318215fde6

Wu, M., Fan, M., Hu, Y., Wang, R., Wang, Y., Li, Y., Wu, S., & Xia, G. (2022). A real-time tennis level evaluation and strokes classification system based on the Internet of Things. Internet of Things (Netherlands), 17. https://doi.org/10.1016/j.iot.2021.100494

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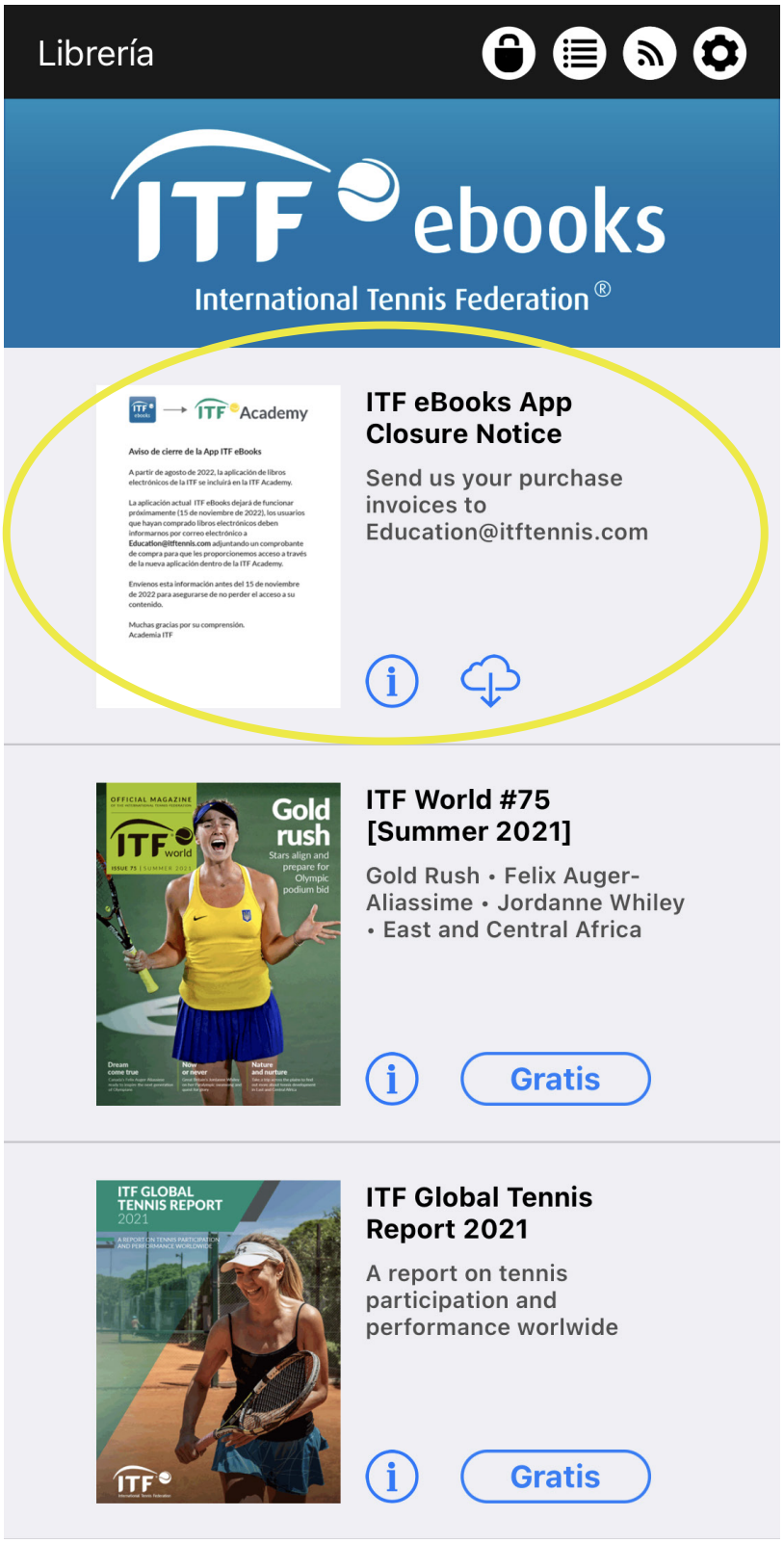

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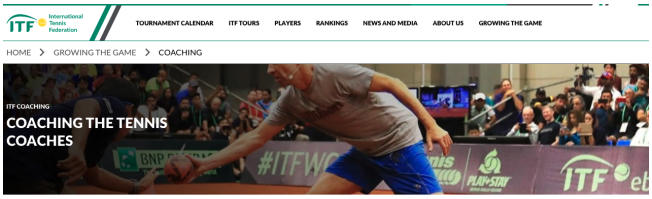

Top quality tennis coaching is vital to develop players to the best of their abilities at every level. The ITF is focused on coaching the coaches, and providing support to National Associations (and individual tennis coaches) through courses, conferences, online learning and various publications

Worldwide Coach Education

Every year, the ITF Coach Education programme works with an average of 68 countries to help develop and deliver ever higher standards of tennis coaching. We also develop programmes for our member nations who don't currently have a system for certifying coaches. We provide qualified experts to deliver the tennis coaching courses, along with course resources in English, French and Spanish, and selected documents in four other languages

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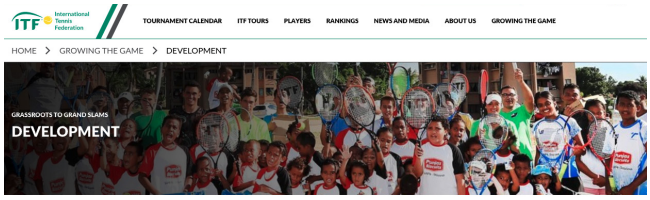

The ITF is here to develop and grow tennis around the globe, working with Regional and National Associations to identify rising talent and build new and better facilities. And we're here to support players on every step of their development, from playground to podium

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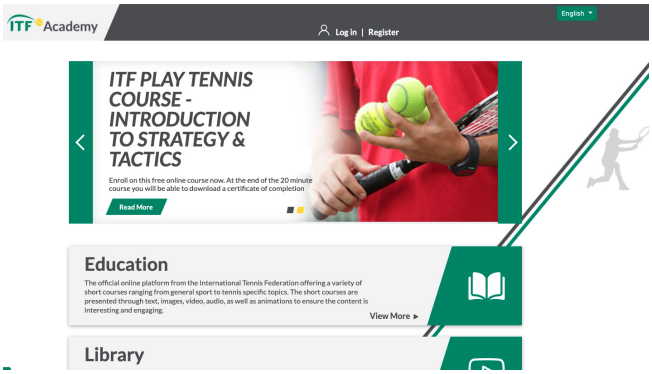

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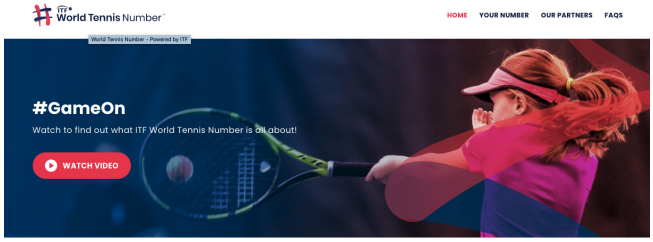

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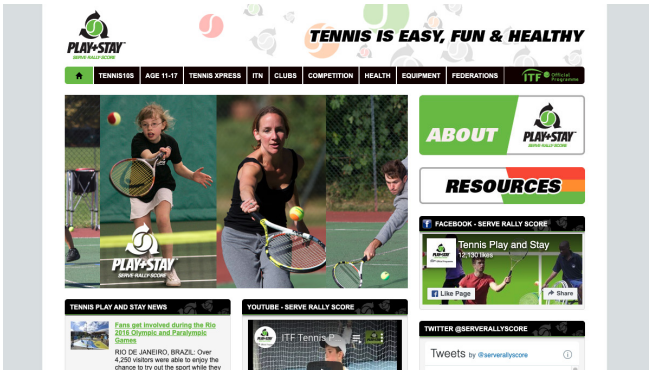

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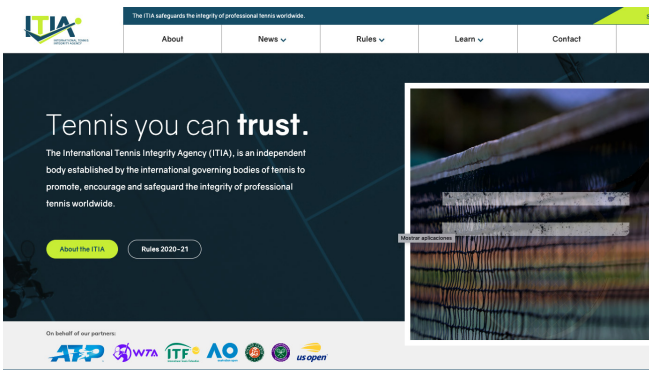

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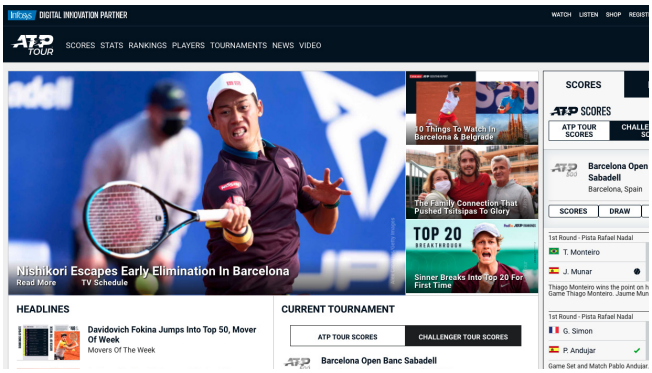

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