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Anthropometric and Physical Performance Determinants of Young Tennis Players Progressing through a Talent Identification and Development Programme

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Abstract

This study examined the influence of both anthropometric and physical performance determinants on the likelihood to be selected to progress through a talent identification and development programme (TID) in young tennis. Data were collected in 538 young tennis players (323 males and 215 females) from six age categories (U8-U13). A principal component analysis was used to generate 1 anthropomaetric determinant (based on body height, body weight and maturity offset) and 4 physical performance determinants: speed and agility (based on 5 m sprint, 20 m sprint and 505 change of direction test); jumping power (based on standing broad jump and standing broad jump in series); motor coordination (based on balancing backwards and jumping sideways) and tennis ball control (based on a throw and catch test and hold tennis ball up test). For all determinants, tertiles were generated for every age category and both sexes separately. Univariate binary logistic regressions were performed to examine the influence of each determinant on the chances to be selected to progress in the TID programme. Significant odds ratios were found for all included anthropometric and physical performance determinants ($p<0.05$), ranging from 0.26 to 7.50 in the male young tennis players and from 0.18 to 6.87 in the female young tennis players. The included determinants influenced selection chances mostly in the early age categories (U8-U10) as opposed to the later age categories (U11-U13). Future research should examine the influence of additional determinants (such as tennis (match-play) performance) on the selection chances to progress through a TID programme.

Keywords: talent selection, talent identification, racket sports, youth sports, monitoring

Introduction

Early talent identification in sports is advantageous since promising players can benefit from qualitative training opportunities and gain competitive experience over a long(er) period of time.[1] An early identification of talented athletes also benefits in the process of technical skill acquisition. Indeed, there are sensitive learning phases (especially before the onset of puberty) during which motor learning should be prioritized.[2, 3] Specifically for tennis, which requires a high technical skill level to be developed early on, players preferably start their sports career at a young age in order to reach an elite level.[4, 5] Besides the mastery of specific technical skills, talent identification of potentially successful tennis players is influenced by several other determinants.[6, 7] Previous studies have already examined the importance of both anthropometric and physical performance determinants on talent identification and tennis performance (based on players' national tennis ranking).[6-11] In relation to anthropometric characteristics, for example, it has been demonstrated that young tennis players who are taller, have a higher body weight and an advanced biological maturation are more likely to be identified as talented.[8] In the study performed by Meckel et al. (2015), both body height and weight were also found to be positively related to tennis performance in competitive young (U16) male tennis players.[9] Regarding the physical performance aspect, speed, agility, upper extremity power, jumping power, motor coordination and tennis ball control have been reported to be important determinants of tennis performance among male and female (young) tennis players.[6, 7, 10-13]

Young tennis players, who are esteemed to have the potential to perform successfully at an elite level, are often selected on an individual basis to take part in talent identification and development (TID) programmes.[14-16] In the case of tennis, two models for TID can be identified. The first model is based on natural selection. In this model, players develop their skills through practice and gradually compete in higher-level events up until the professional level. The second model uses a scientific-based approach. In this model, the emphasis generally lies on specific sport science areas such as human biometry, exercise physiology and physical performance.[17, 18] Although historically these two models have been considered as opposites, it is suggested that combining both works best for the identification and development of talented players towards elite sports success. The TID programme of tennis Australia, for instance, is characterised by an identification process where (potential) players are tested regularly with regards to speed, agility, jumping and throwing abilities.[19] Similarly, the most promising German young tennis players are tested regularly (i.e., every six months) so that an individual player profile entailing an overview of their strengths and weaknesses can be made.[20]

When being part of a TID programme, players are generally divided into subsequent age categories based on their chronological age (e.g., U8 for players under 8 years of age, U9 for players under 9 years of age, and so on). In view of a TID programme and the progress from one age category to the next age category, a player can either be selected to progress (e.g., from U9 to U10), can be de-selected, or can be newly selected and thus added to a certain age category in entering the programme.[17] Besides aiming to identify talented players as early as possible, a TID programme is designed to provide them with the opportunity to further develop their performance upon their selection.[18] An important part of TID programmes is the use of anthropometric measures and physical performance tests to monitor players' growth/development and to follow the progress in their performances over a certain time period.[21] However, little is known about the determining role of both anthropometric (e.g., height and weight) and physical performance (e.g., speed, power and motor coordination) measures on young tennis players' chance to be selected to progress to the next age category of a TID programme.[10] In this respect, more insights could be gained in favour of talent identification and development in tennis. Therefore, the present study aims to examine the influence of anthropometric as well as physical performance determinants on the likelihood to be selected to progress through a TID programme in youth tennis.

Methods

Participants and procedures

This study included 538 unique young tennis players (323 males and 215 females, aged between 7 and 12 years). All included players were part of the TID programme of the Flemish tennis federation between 2012 and 2021. At the time of measurement, the included players were required to compete in the Belgian youth circuit (i.e., the highest national youth tournament level) in their respective age categories. Based on their chronological age at the time of measurement, players were grouped into six different age categories (i.e., U8, U9, U10, U11, U12 and U13). In Figure 1, a clear overview is provided of the number of male and female young tennis players, who were selected to progress, de-selected or newly selected for the TID programme in each age category. This (cohort) study was conducted in accordance with the recognised ethical standards and was approved by the local ethical committee (B.U.N. 14320200000143).

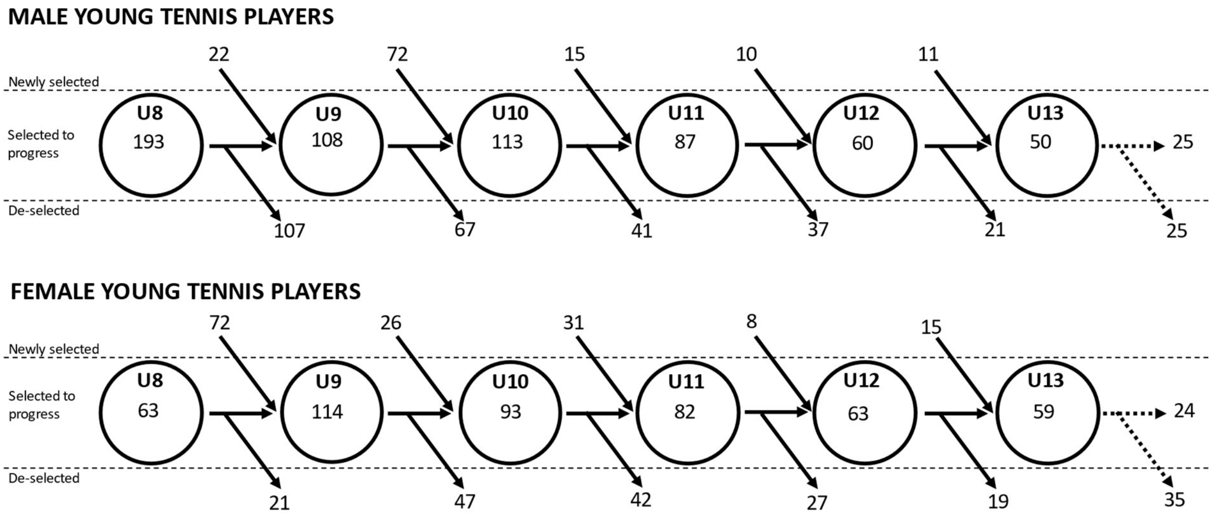

Figure 1. Overview of the number of male (n=323) and female (n=215) young tennis players who are selected to progress de-selected or newly selected for the talent identification and development (TID) programme in each age category.

As part of the TID programme of the Flemish Tennis Federation, anthropometric and physical performance measurements were performed yearly during the first week of May. The anthropometric measurements were conducted in a medical office with the players being barefoot and in minimal sports clothing, whereas the physical performance test battery took place on an indoor hard court tennis court with the players wearing their normal tennis outfit. The anthropometric measures were determined in accordance with the International Society for the Advancement of Kinanthropometry (ISAK) guidelines.[22] The examined physical performance tests were chosen by the physical staff of the Flemish tennis federation because these determinants were reported to be important for tennis performance.[6, 7] Every player was given three attempts for every single test, except when stated otherwise. The best test result was subsequently used for analysis. The players received 60 seconds of rest between their attempts and around 3 minutes of rest between the different tests. For every physical performance test, the intraclass correlation coefficient (ICC) was calculated using a subsample of the included participants. This subsample was comprised of 10 young tennis players (i.e., 6 male and 4 female young tennis players (10.2 ± 1.5 years)), who performed every physical performance test three times.[23]

Anthropometry

The young tennis players' body height (Seca 217, Seca, Hamburg, Germany), sitting height (Harpenden sitting height table, Holtain, UK) and body weight (Radwag WLT 60/120/X/L3, All scales Europe, Veen, The Netherlands) were measured to the nearest 0.1 cm and 200 g, respectively. Based on these measures in combination with their chronological age, players' maturity offset (i.e., the number of years from peak height velocity) was estimated using the sex-specific prediction equations of Mirwald et al. (2002).[24]

Speed and agility

The players performed a 5 m and 20 m sprint from a stationary start. The time needed to complete these distances was measured to the nearest 0.001 second using electronic timing gates (Witty Wireless Training Timer, Microgate, Bolzano, Italy).[25, 26] In addition, the time needed to complete the 505 change of direction test was also determined to the nearest 0.001 second using the same electronic timing gates. The 505 change of direction test consisted of a 5 m sprint, followed by a 180° turn and a 5 m sprint back to the starting line. The players completed the 505 change of direction test (also from a stationary start) for a total of six times (i.e., three times using a left turn and three times using a right turn) but only their overall fastest time out of these six attempts was retained for analysis.[27] The ICC of the 5 m sprint, 20 m sprint and 505 change of direction test was 0.94, 0.95 and 0.93, respectively.

Jumping power

To examine their (horizontal) jumping power, players performed the standing broad jump as well as the standing broad jump in series using both feet during take-off and landing. The single standing broad jump was executed as described in the Eurofit test battery's manual.[28] The standing broad jump in series consisted of 5 consecutive jumps without rest or an intermediate jump. The players needed to keep their balance after landing, otherwise an additional attempt was given. For both executions of the standing broad jump tests, the distance from the starting line to the closest heel of the player was measured to the nearest 1 cm using a measuring tape. The ICC of the single standing broad jump was 0.95, whilst the ICC of the standing broad jump in series was 0.92.

Motor coordination

The players' motor coordination was examined using the balancing backwards and jumping sideways tests from the Körperkoordinationstest für Kinder (KTK).[29-31] The balancing backwards test required the players to step backwards while maintaining their balance on three progressively smaller beams (i.e., 6 cm, 4.5 cm and 3 cm wide) with a length of 3 m each. The test consisted of three trials on every beam (i.e., nine trials in total). Every backward step on each beam was awarded one point, with a maximal of eight steps per trial per beam. The total result was obtained by adding the number of steps across trials and beams, with a maximum score of 72. The jumping sideways test consisted of jumping back and forth over a wooden slat in a sideway manner with both feet together as many times as possible in 15 seconds. Each cycle (i.e., jumping over the slat and back) was awarded one point. The players performed the jumping test twice and the overall result was calculated by taking the sum of both trials. The ICC of the balancing backwards and jumping sideways tests was 0.95 and 0.94, respectively.

Tennis ball control

During the throw and catch test the players were standing in a marked square (1.5 m x 1.5 m) at 1.5 m from a wall and had to throw a tennis ball in an underarm manner, alternately with their left and the right hand, diagonally towards the centre of a marked throwing zone (1.0 m x 1.0 m) at 1.0 m height on a wall.[4, 32] After throwing the ball with one hand, the players had to catch the ball directly (i.e., without letting it bounce on the floor) with their other hand. The players received one point for every successful throw into the throwing zone and one point for every successful catch. The aim of the throw and catch test was to score as many points as possible in 30 seconds. If the player was unable to catch the tennis ball, the examiner immediately handed over a new ball. For the hold tennis ball up test, the player had to bounce a tennis ball up using a basketball for as many times as possible during 30 seconds whilst staying within the service box of a tennis court. The player received one point every time the tennis ball was bounced up by the basketball in the set time frame. Time continued running even if the tennis ball was lost by the player, who then had to retrieve the ball as quickly as possible. The ICC of the throw and catch test was 0.95, whereas the ICC for the hold tennis ball up test was 0.91.

Statistical analyses

R-studio version 1.5.5001 (Rstudio, Boston, Massachusetts, USA) was used for the statistical analyses. In accordance with the Field method, a principal component analysis was conducted first in order to examine whether tests examining the same aspect could be grouped together.[10] As a result, the anthropometric outcome measures could be grouped into one single determinant (i.e., anthropometry) whilst the physical performance measures could be grouped into 4 determinants (i.e., speed and agility, jumping power, motor coordination, tennis ball control). The factor loadings used to generate the five determinants are displayed in figure 2. To handle skewed data and to increase clarity and comprehensibility, tertiles were made (i.e., T1, T2 and T3) for each of these 5 determinant according to players' sex and age category.[33] The first tertile (T1) was defined as the highest or best performing tertile, the middle tertile (T2) was defined as the reference tertile, whereas the third tertile (T3) was defined as the lowest or least performing tertile. To examine the influence of each determinant on the players' likelihood to be selected to progress to the next age category as the main binary outcome, univariate binary logistic regressions were performed with the computation of odds ratios (together with their 95 % Wald confidence interval (95 % CI)).[34] The level of statistical significance was set at alpha = 0.05.

Anthropometry = 0.873 * body height (cm) + 0.836 * body weight (kg) + 0.820 * maturity offset (years)
Speed and agility = 0.912 * 5 m sprint time (s) + 0.865 * 20 m sprint time (s) + 0.833 * 505 change of direction time (s)
Jumping power = 0.792 * standing broad jump (m) + 0.754 * standing broad jump in series (m)
Motor coordination = 0.841 * balancing backward (steps) + 0.821 * jumping sideways (reps)
Tennis ball control = 0.815 * throw and catch test (reps) + 0.807 * hold tennis ball up test (reps)

Figure 2. Factor loading to generate each determinant (n=5).

Results

The overall scores for every anthropometric and physical performance outcome measure can be found in Table 1, displayed for the male and female young tennis players participating in this study in function of their age category. The odds ratios (as well as their 95 % CI), indicating the likelihood to progress through the TID programme, in view of every single determinant and according to sex and age category can be found in Table 2.

Table 1. Overall scores of the anthropometric and physical performance measures for the male (n=323) and female (n=215) young tennis players according to age category.

	U8	U9	U10	U11	U12	U13
MALE YOUNG TENNIS PLAYERS						
Anthropometry						
Body height (cm)	122.8 ± 4.9	129.1 ± 11.8	136.3 ± 5.7	142.0 ± 5.7	148.5 ± 6.0	154.5 ± 6.5
Body weight (kg)	23.2 ± 2.5	26.3 ± 3.3	29.6 ± 4.0	33.1 ± 5.4	36.9 ± 5.4	42.3 ± 7.2
Maturity offset (years)	-5.1 ± 0.3	-4.2 ± 0.4	-3.7 ± 0.4	-3.0 ± 0.5	-2.3 ± 0.4	-1.6 ± 0.4
Speed and agility						
5 m sprint (sec)	1.396 ± 0.078	1.365 ± 0.084	1.331 ± 0.088	1.262 ± 0.066	1.246 ± 0.083	1.234 ± 0.076
20 m sprint (sec)	4.317 ± 0.372	4.144 ± 0.313	3.969 ± 0.193	3.782 ± 0.165	3.682 ± 0.175	3.636 ± 0.159
505 change of direction (sec)	3.048 ± 0.160	2.953 ± 0.142	2.778 ± 0.121	2.664 ± 0.103	2.612 ± 0.087	2.568 ± 0.095
Jumping power						
Standing broad jump (cm)	129 ± 14	138 ± 14	152 ± 15	166 ± 14	207 ± 27	182 ± 14
Standing broad jump in series (cm)	673 ± 73	732 ± 69	789 ± 86	862 ± 65	909 ± 71	946 ± 67
Motor coordination						
Balancing backward (steps)	34 ± 12	44 ± 13	52 ± 13	56 ± 13	60 ± 12	69 ± 4
Jumping sideways (reps)	84 ± 10	95 ± 12	101 ± 15	110 ± 12	115 ± 14	114 ± 26
Tennis ball control						
Throw and catch test (reps)	16 ± 7	22 ± 7	28 ± 6	33 ± 4	35 ± 4	36 ± 4
Hold tennis ball up test (reps)	19 ± 7	28 ± 8	37 ± 13	47 ± 13	56 ± 12	69 ± 10
FEMALE YOUNG TENNIS PLAYERS						
Anthropometry						
Body height (cm)	122.8 ± 5.8	129.5 ± 5.5	135.9 ± 5.9	141.4 ± 5.9	148.1 ± 6.5	154.0 ± 7.6
Body weight (kg)	23.3 ± 3.7	26.7 ± 3.9	30.2 ± 4.2	33.9 ± 6.6	36.6 ± 5.0	41.7 ± 7.3
Maturity offset (years)	-4.1 ± 0.4	-3.3 ± 0.4	-2.5 ± 0.4	-1.8 ± 0.6	-0.9 ± 0.4	0.0 ± 0.6
Speed and agility						
5 m sprint (sec)	1.408 ± 0.077	1.372 ± 0.090	1.339 ± 0.092	1.271 ± 0.073	1.252 ± 0.072	1.248 ± 0.078
20 m sprint (sec)	4.420 ± 0.234	4.190 ± 0.240	4.036 ± 0.197	3.831 ± 0.161	3.758 ± 0.134	3.704 ± 0.177
505 change of direction (sec)	3.103 ± 0.148	2.967 ± 0.182	2.835 ± 0.102	2.726 ± 0.105	2.648 ± 0.074	2.613 ± 0.087
Jumping power						
Standing broad jump (cm)	125 ± 14	136 ± 16	143 ± 15	188 ± 26	172 ± 12	176 ± 13
Standing broad jump in series (cm)	644 ± 58.3	689 ± 51	776 ± 65	830 ± 70	877 ± 112	904 ± 63
Motor coordination						
Balancing backward (steps)	41 ± 14	49 ± 13	60 ± 11	62 ± 10	65 ± 9	61 ± 8
Jumping sideways (reps)	86 ± 10	93 ± 13	102 ± 16	106 ± 12	115 ± 12	117 ± 16
Tennis ball control						
Throw and catch test (reps)	10 ± 4	16 ± 7	25 ± 8	29 ± 7	34 ± 4	36 ± 4
Hold tennis ball up test (reps)	17 ± 4	22 ± 7	32 ± 10	41 ± 13	52 ± 13	59 ± 17

Note: All data are presented as mean ± standard deviation; U = under; reps = number of repetitions.

Table 2. Odds ratios, together with their 95% confidence intervals, indicating the likelihood for the male (n=323) and female (n=215) young tennis players to progress through the talent identification and development programme for every anthropometric and physical performance determinant according to age category.

		U8	U9	U10	U11	U12	U13
MALE YOUNG TENNIS PLAYERS							
Anthropometry	T1	1.46 (0.89;2.43)	1.31 (0.47-3.73)	0.62 (0.23;1.62)	1.23 (0.45;3.35)	1.74 (0.53;6.11)	1.50 (0.36;6.45)
	T3	**0.29 (0.14;0.59)**	0.44 (0.16;1.19)	1.00 (0.40;2.52)	0.87 (0.31;2.43)	2.97 (0.91;10.4)	1.71 (0.41;7.59)
Speed and agility	T1	**2.07 (1.01;4.35)**	**4.30(1.46;13.60)**	**4.56 (1.38;12.21)**	1.25 (0.26;2.47)	1.58 (0.42;6;17	**7.50 (1.49;17.54)**
	T3	0.52 (0.26;1.04)	1.26 (0.48;5.62)	0.53 (0.09;1.19)	0.99 (0.32;3.08)	0.46 (0.12;1.72)	0.45 (0.06;1.81)
Jumping power	T1	**3.02 (1.40;6.75)**	1.31 (0.47;3.68)	2.11 (0.85;5.39)	2.65 (0.86;8.70)	1.22 (0.35;4.26)	0.26 (0.04;1.11)
	T3	0.91 (0.40;2.10)	**0.34 (0.13;0.89)**	0.42 (0.13;1.24)	1.51 (0.47;5.07)	1.63 (0.47;5.78)	0.27 (0.06;1.31)
Motor coordination	T1	1.73 (0.77;3.90)	1.02 (0.29;3.49)	1.18 (0.37;3.82)	3.63 (0.95;16.14)	0.64 (0.14;2.93)	2.51 (0.02;6.56)
	T3	0.54 (0.23;1.23)	**0.31 (0.09;0.96)**	0.67 (0.19;2.30)	1.33 (0.30;6.30)	0.38 (0.07;1.83)	1.32 (0.76;1.83)
Tennis ball control	T1	**1.99 (1.01;4.03)**	**4.41 (1.30;17.95)**	2.40 (0.87;6.94)	2.30 (0.74;7.52)	2.55 (0.72;9.73)	0.73 (0.15;3.45)
	T3	0.53 (0.25;1.13)	0.66 (0.30;1.85)	**0.26 (0.05;0.98)**	1.00 (0.31;3.32)	0.63 (0.16;2.38)	0.86 (0.17;4.18)
FEMALE YOUNG TENNIS PLAYERS							
Anthropometry	T1	1.00 (0.26;3.79)	2.31 (0.90;6.01)	**3.83 (1.43;10.83)**	2.33 (0.82;6.93)	0.65 (0.17;1.46)	0.77 (0.18;3.21)
	T3	0.79 (0.20;3.05)	0.39 (0.12;1.08)	0.75 (0.26;2.14)	1.35 (0.46;4.04)	0.51 (0.13;1.89)	0.31 (0.07;1.19)
Speed and agility	T1	1.33 (0.32;5.75)	2.02 (0.93;5.12)	**3.46 (1.11;13.89)**	2.86 (0.82;11.11)	1.10 (0.26;4.83)	1.52 (0.35;6.67)
	T3	1.14 (0.28;5.29)	0.60 (0.22;1.61)	0.46 (0.16;1.29)	0.38 (0.12;1.16)	0.54 (0.11;2.51)	0.53 (0.10;2.56)
Jumping power	T1	0.77 (0.18;3.23)	2.19 (0.80;6.19)	0.70 (0.27;1.82)	**3.02 (1.01;9.71)**	0.31 (0.05;1.39)	**6.00 (1.27;35.63)**
	T3	0.66 (0.15;2.83)	0.40 (0.12;1.22)	**0.12 (0.03;0.37)**	0.70 (0.21;2.27)	0.86 (0.21;3.50)	1.50 (0.34;6.77)
Motor coordination	T1	**6.87 (1.46;39.72)**	2.33 (0.74;7.67)	2.47 (0.72;9.12)	1.33 (0.40;4.52)	1.50 (0.25;5.03)	1.24 (0.41;6.02)
	T3	1.39 (0.28;7.28)	**0.18 (0.04;0.66)**	0.62 (0.15;2.41)	0.67 (0.19;2.33)	0.60 (0.06;4.43)	1.17 (0.28;5.16)
Tennis ball control	T1	**3.62 (1.12;14.26)**	**3.21 (1.17;9.28)**	**6.33 (2.06;21.58)**	0.73 (0.24;2.19)	0.76 (0.17;3.24)	0.61 (0.13;2.72)
	T3	1.06 (0.25;4.57)	0.43 (0.14;1.25)	1.05 (0.31;3.59)	0.53 (0.17;1.60)	0.83 (0.19;3.58)	**0.20 (0.04;0.86)**

Note: Significant odds ratios (p<0.05) are highlighted in bold; The first tertile (T1) was defined as the highest or best performing tertile, whereas the third tertile (T3) was defined as the lowest or least performing tertile; U = under.

Male young tennis players

For players within the U8 age category, being in T1 for speed and agility, jumping power and tennis ball control significantly increased the likelihood to be selected to progress to the U9 by 107 % (95 % CI=1-335 %; p=0.016), 202 % (95 % CI=40-575 %; p=0.005) and 99 % (95 % CI=1-303 %; p=0.038) respectively, whilst being part of T3 for anthropometry significantly decreased their selection chances by 71 % (95 % CI=41-86 %; p<0.001). For players within the U9 age category, being in T1 significantly increased the selection chances to progress to the U10 by 330 % (95 % CI=46-1260 %; p<0.001) for speed and agility and by 341 % (95 % CI=30-1695 %; p=0.024) for tennis ball control. Being part of T3 in the U9 age category significantly decreased players' selection chances to progress to the U10 by 66 % (95 % CI=11-87 %; p=0.031) for jumping power and by 69 % (95 % CI=4-91 %; p=0.028) for motor coordination. For players within the U10 age category, being part of T1 for speed and agility significantly increased the selection chances to progress to the U11 by 356 % (95 % CI=38-1121 %; p=0.009), whilst being part of T3 for tennis ball control significantly decreased the selection chances to progress by 74 % (95 % CI=2-95 %; p=0.038). Regarding the U13 age category, being part of T1 for speed and agility significantly increased the likelihood of players to be selected to progress further through the TID programme by 650 % (95 % CI=49-1654 %; p=0.024).

Female young tennis players

For players within the U8 age category, being part of T1 significantly increased the likelihood to be selected to progress to the U9 by 587 % (95 % CI=46-3872 %; p=0.020) for motor coordination and by 262 % (95 % CI=12-1326 %; p=0.017) for tennis ball control. For players within the U9 age category, being part of T1 for tennis ball control significantly increased the selection chances to progress to the U10 by 221 % (95 % CI=17-828 %; p=0.009), whilst being part of T3 for motor coordination significantly decreased the selection chances by 82 % (95 % CI=34-96 %; p=0.013). For players within the U10 category, being in T1 for anthropometry, speed and agility and tennis ball control significantly increased the selection chances to progress to the U11 by 283 % (95 % CI=43-983 %; p=0.009), 246 % (95 % CI=11-1289 %; p=0.047) and 533 % (95 % CI=106-2058 %; p=0.002), respectively, whilst being part of T3 for jumping power significantly decreased the likelihood to be selected by 88 % (95 % CI=63-97 %; p=0.001). Regarding the U11 age category, being part of T1 for jumping power significantly increased the selection chances of players to progress to the U12 by 202 % (95 % CI=1-871 %; p=0.041). As for the U13 age category, being part of T1 for jumping power significantly increased the likelihood of players to be selected to progress further through the TID programme by 500 % (95 % CI=27-3463 %; p=0.032), whilst being part of T3 for tennis ball control significantly decreased the chance to be selected to progress by 80 % (95 % CI=14-96 %; p=0.037).

A graphical representation of the reported significant anthropometric and physical performance determinants for the male and female young tennis players according to age category is displayed in Figure 3.

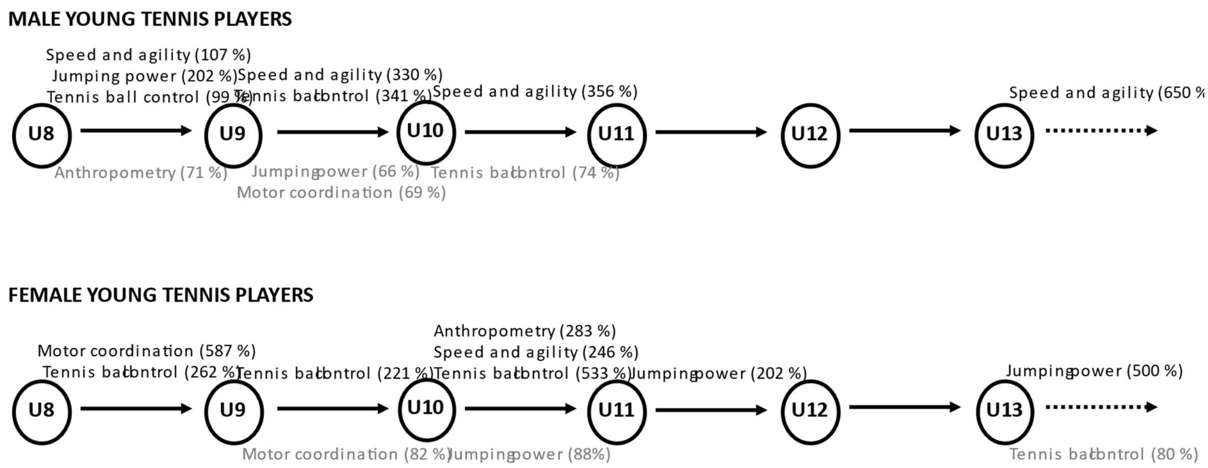

Figure 3. Graphical representation of the significant determinants of the male (n=323) and female (n=215) young tennis players progressing through a talent identification and development (TID) programme.

Discussion

This study aimed to gain better insights into meaningful anthropometric and physical performance measures in the context of talent identification in tennis. All the included anthropometric and physical performance determinants (i.e., speed and agility, jumping power, motor coordination and tennis ball control) showed to significantly influence the selection chances to progress as significant odds ratios ranging from 0.26 to 7.50 in the male young tennis players and from 0.18 to 6.87 in the female young tennis players were found.

It can be argued that the significant anthropometric and physical performance determinants influencing the selection chances of both male and female young tennis players were most commonly situated in the early age categories (i.e., U8, U9 and U10) as opposed to the later age categories (i.e., U11, U12 and U13). This is possibly due to the more homogenous population at the latter stages of the TID programme due to the yearly selections. Also, this observation is in line with the sliding population approach proposed by Règnier et al. (1993).[35]

This sliding population approach takes into consideration different stages of performance throughout a TID programme. This implies that, as the players grow older and reach a higher performance level due to their training regimens and yearly selections, different anthropometric and performance determinants become important.

The results of the present study revealed that young tennis players who have a small body height, low body weight and late maturity have a higher likelihood to be de-selected from the present TID programme. These results in relation to anthropometric and maturational characteristics are in agreement with the scientific literature as a higher body height, body weight and more advanced maturation have already been associated with an advantage for both tennis performance (taking players' national tennis ranking into account) and talent identification.[8, 9] For instance, it has been demonstrated that taller tennis players possess longer limbs and are able to generate higher tangential racquet head velocities at the point of ball contact.[36, 37] The present study also showed that players of the early age categories (i.e., U8-U10) have greater chances to progress to the next categories when they possess a better motor coordination and tennis ball control. These results are in line with previous studies reporting the influential role of both motor coordination and tennis ball control on tennis performance.[12, 13] As players progress through the TID programme, speed and agility as well as jumping power were demonstrated to become more influential. Once again, these results are in line with earlier research reporting that these physical performance measures are important determinants given that producing fast and powerful movements on court are reported to be beneficial for tennis performance.[6, 11, 38] Based on our study results, it is recommended to accentuate different characteristics in the successive test batteries at different age categories. For example, the test battery in the younger age categories (i.e., from

U8 to U10) could place a higher emphasis on tennis ball control and motor coordination whilst the test battery in the older age categories (i.e., from U11 to U13) could place a higher emphasis on speed, agility and jumping power. It is important to bear in mind that that other physical performance determinants, which were not specifically measured or monitored in the present study, could also influenced the yearly selections. For instance, physical performance determinants that are reported to be important for tennis performance, such as strength, flexibility and upper extremity power were not measured. It is possible that these 'latent' determinants could have a significant influence on the selection chances of the tennis players examined in the present study to progress (especially in the later age categories).[6, 7, 10, 20] Additionally, the motor coordination tests included in this study (i.e., balancing backwards and jumping sideways) were general motor coordination tests as opposed to tennis specific motor coordination tests. Therefore, and in line with the sliding population approach, future research should examine which determinants are particularly important for each age category separately.[35] In doing so, the yearly monitoring of influential anthropometric and physical performance determinants can be even more optimised in the context of a TID programme taking players' age at the selection moment into account.[20, 21]

Although this is the first study to examine the influence of anthropometric and physical performance determinants on the likelihood to be selected to progress in a TID programme in youth tennis, there are some limitations apparent. For instance, due to practical reasons, the order of the different physical performance tests per test session could not be standardised for each player over the years. Additionally, a possible learning effect of the players who were tested over several years (and thus completed the selection test battery multiple times) throughout the TID programme was not taken into account. Another important consideration is that the results of this study only pertain to the influence of anthropometric and physical performance determinants and the likelihood to be selected to progress in a TID programme in youth tennis. The influence of tennis (match play) performance or tennis ranking, which could have a significant influence on the players' progression chances, was not examined. Similarly, other (extra) determinants which could influence a player's selection chances to progress, such as physical (i.e., strength, flexibility and upper extremity power), technical (i.e., related to the execution of the various tennis strokes), tactical, psychological and/or social determinants, were not taken into account in the present study.[10] On the same note, the reasons for de-selection were not examined as it might be possible that a player personally decided to drop-out of the TID programme by choice even after being selected to progress. Finally, a univariate logistic regression model was applied to examine the influence of every determinant on the selection chances separately as opposed to a multivariate model (which examines the influence of all the determinants together). Future longitudinal research should examine the influence on the selection chances of other and thus additional determinants (especially in the older age categories towards adolescence) with the inclusion of (extra) physical, tennis (match-play) performance, tennis ranking, technical, tactical, psychological and social determinants.[39]

To conclude, all the examined anthropometric and physical performance determinants significantly influenced the likelihood to be selected to progress through a TID programme as demonstrated by the odds ratios ranging from 0.26 to 7.50 in the male young tennis players and from 0.18 to 6.87 in the female young tennis players. The anthropometric and physical performance determinants that significantly influenced players' selection chances to progress were mostly situated in the early age categories (i.e., from U8 to U10) as opposed to the later age categories (i.e., from U11 to U13). This could be possibly explained by the fact that the same determinants were examined throughout the entire TID programme. Therefore, future longitudinal research should examine the long-term influence of other (extra) determinants on the likelihood to be selected to progress through a TID programme in youth tennis, especially in the older age categories.

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Conflicts of Interest

The authors declare no conflict of interest.

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