International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Longitudinal Study of the Level of Male and Female Top Tennis Players' Performance Preconditions

Jiří Zháněl[1], Miroslav Černošek[2], Martin Zvonař[3], Jiří Nykodým[4]

[1, 2, 3, 4] Masaryk University, Faculty of Sports Studies,
Kamenice 753/5, Brno 625 00, Czech Republic

Abstract: ***In contemporary world tennis, there is a clear tendency towards conditionally demanding game, the most important motor preconditions being speed (reaction and action), strength (particularly start and explosive), strength endurance, and specific coordination abilities. The presented case study is based on the so-called retrospective theory. The research intent was longitudinal monitoring of the level of somatic and motor preconditions in top Czech tennis players (male player TB and female player PK). The research has a character of a longitudinal study, the research data was acquired with the test battery TENDIAG1 containing three somatic and six motor items. The results of both tested athletes clearly show that the total point score in the test battery was above the boundary of the average level of the population of male and female top Czech tennis players through the whole monitored period. The evaluation of intersexual differences has proved a practical significantly higher level in most items of the test battery in the male player TB with the exception of testing the torso flexibility and the reaction speed of arms and legs. The female player PK has shown a higher level in the test of flexibility in shoulder joints. The results provide interesting insights and suggestions for training practice because they come from long-time research of elite tennis players.***

Keywords: condition, case study, tennis, test battery

1. Introduction

The research in various sports deals with the influence of individual factors and their mutual interactions on the final sport performance. (Dovalil et al., 2009; Ferrauti et. al., 2006; Hohmann et al. 2010; Reid et al., 2003; Schönborn, 2008; Weineck, 2007; Wohlmann, 1996). As Schönborn (2008) says the long-term comprehensive sport performance is a necessary precondition for the later successful sport career. In the presented contribution, we look into the aspects of the performance level of two top athletes (a male and a female tennis player) during longitudinal monitoring of their somatic and motor preconditions. The study follows up similar studies realized with male and female tennis players (Černošek et al., 2012; Zháněl et al., 2008).

From the systemic viewpoint, the diagnostics in sport is understood as an integral part of the diagnostic process enabling the application of found knowledge when planning, regulating, and managing sport training, and enabling also the necessary feedback for athletes and coaches (Blahuš, 1996; Dovalil et al., 2009; Zháněl, 2005). According to Hohmann et al. (2010), the diagnostics of sport performance has two main practical goals: 1. identifying athlete's strengths and weaknesses by comparing the achieved (*the found state*) and required (*state diagnostics*) values; 2. checking the training success rate by comparing the existing values or existing and required values (*process diagnostics*). Diagnostics is focused on establishing the level of basic factors of sport performance (somatic, mental, technical, tactical, conditioning ones and the factor of external conditions) called performance preconditions (Dovalil et al., 2009; Hohmann et al., 2010; Schnabel et al., 2003). A number of authors emphasize that it is important to pursue such factors of sport performance that are significantly determining, or influencing it (Dovalil et al., 2009; Hohmann et al., 2010; Schnabel et al., 2003; Schönborn, 2008; Wohlmann, 1996). The methods used to identify their level are especially the anthropometrical, biomechanical, biochemical, physiological, and psychological ones, or the methods of observing and testing (Schnabela et al., 2003). The analysis of research data acquired by means of relevant diagnostic methods enables determining the topical diagnosis of the performance level and can also be a means of sport performance prognosis. However, the more complex the sport performance, the more problematic the prognosis (e.g. compare the sport performance structure in 100 meter sprint and in ice hockey).

The structure of playing performance in tennis has been being analyzed from the viewpoint of time, space, physiological and motor characteristics of tennis and their importance for tennis in the long term (Ferauti et al., 2006; Reid et al., 2003; Schönborn, 2008; Wohlmann, 1996; Zháněl et al., 2000). A generally accepted and recognized concept is that presented by Schönborn (2008), dividing the factors from the viewpoint of their importance for tennis to factors *limiting* performance (very important and hardly compensable), or *influencing* performance (important, however, to a certain extent compensable by other factors). When diagnosing the performance level in tennis, it is necessary to come out from the comprehensive analysis of the tennis game while using such diagnostic methods that cover the preconditions specific for tennis (Ferrauti et al., 2006; Schönborn, 2008; Wohlmann, 1996; Zháněl, 2005). The fitness level is an important precondition for sport performance (not only) in tennis; the development of contemporary tennis tends to a physically more demanding game. The most important motor preconditions for contemporary, increasingly aggressive, strength applying, and faster tennis are speed (reaction and action, especially running speed), strength (particularly start and explosive strength), strength endurance, and specific coordination abilities. Respected authors estimate the share of fitness in sport performance in tennis around 40 % (Crespo & Miley, 2003; Ferrauti, et al., 2006; Roetert & Ellenbecker, 2003; Schönborn, 2008; Zháněl et al., 2008).

Licensed Under Creative Commons Attribution CC BY

The diagnostics of the performance preconditions level in tennis often uses test batteries, the use of which has had more than seventy years of tradition (Wohlmann, 1996). The project of the Czech Tennis Federation called "The Comprehensive Diagnostics in Tennis" has been using the test battery TENDIAG1 in the long term (Zháněl et al., 2000), which has been developed in cooperation with tennis experts on the basis of the analysis of the contents and structure of the test batteries used so far. The results obtained by the test battery TENDIAG1 make possible particularly: 1. assessing of the *topical level* of performance preconditions (applicable in regulation and managing of the training process); 2. *long-term (longitudinal) monitoring of the level* of performance preconditions (applicable in planning of the training process). The theory of the so-called retrospective approach presumes that the athletes successful in their adult age were endowed with a high level of certain performance preconditions already in their youth that made it possible for them to achieve the top performance level later (Hohmann et al., 2010). With respect to this theory, we deal in the presented contribution with an analysis of the results of longitudinal monitoring of the performance preconditions level of one male and one female tennis player who belong to the contemporary world tennis elite.

2. Research Intent and Goal

Sport performance in tennis is understood as a multi-factor phenomenon that requires achieving of an optimum level and interaction of performance preconditions as a necessary (however not the only) condition for achieving high sport performance in the adult age. The research intent was to execute, within the framework of longitudinal monitoring of a male and a female top player, an assessment of the somatic and motor preconditions level, their comparison with the results of a population of male and female tennis players, and also an assessment of development trends and intersexual differences.

Research question

How is it possible to assess the level of somatic and motor preconditions of the monitored male and female player who achieved high international level of performance in their adult age?

Research goals:

1. comparing the level of somatic and motor performance preconditions of the monitored male and female player with a population of male and female tennis players;
2. assessing the development trends of the overall performance preconditions level of the monitored male and female player;
3. assessing intersexual differences in the performance preconditions level of the monitored male and female player.

3. Research Methods

3.1 Research Methodology

From the viewpoint of research methodology (Hendl & Blahuš, 2005), it is the research of the type of "case study" and "development study" focused on the development and changes in somatic and motor performance preconditions of young male and female tennis players utilizing the research of the type of "trends analysis" including their interpretation. The theoretical framework of the research is based on the theory of measuring and testing, the theory of motor activity constructs (Blahuš, 1996; Dovalil et al., 2009; Hohmann, et al., 2010; Měkota & Novosad, 2005; Weineck, 2007), and the theory of factor structure of sport performance in sport and its application in tennis (Ferrauti, et al., 2006; Reid et al., 2003; Zháněl, Vaverka, & Černošek, 2000; Zháněl, 2005).

3.2 Research population

From the methodological viewpoint, it is an intentional selection of a male and a female player who achieved a high international level in their adult age (the male player TB and the female player PK). The player TB has been in TOP 20 in ATP rankings since 2009, has been the player of the TOP 10 since 2010, and achieved his highest ranking so far in 2012 (6.). The female player PK entered professional tennis in the age of 16 (2006), in 2008, she was around the 50th place in the WTA rankings and achieved her highest ranking so far in 2011 (2.). The results achieved in the test battery of the male player TB were obtained in his age of 15.6 - 19.2 (total of 6 testing sessions); the female player PK was tested in the age of 15.7 - 19.8 (also 6 testing sessions). Both sets of results are shown in Table 1.

3.3 Measuring procedures and methods of data collection

The research data was obtained using the test battery TENDIAG1 (Zháněl, et al., 2000) containing a total of 9 items: measuring of somatic characteristics (bodily height, weight, flexibility in shoulder joints), tests of the level of conditioning (strength of the playing arm, action speed, medium-term endurance) and coordination performance preconditions (speed of arms and legs reaction, torso flexibility). The diagnostics was done by instructed and trained persons following a united methodology, the research data were collected in indoor tennis arenas with hard courts in 2000-2010, always twice a year in periods March/April and October/November as the players' schedules allowed (this is the reason why it was not always possible to observe the half-year testing cycle). The found somatic features have only an informational character, they are not valued by points, the items from the areas of fitness and coordination tests are rated on the scale of 0-2 points (i.e. from six test, 0-12 points can be achieved). Evaluation of results was executed on the base of three-stage performance norms for individual test items and age categories developed using the basic statistical characteristics from the results of testing an extensive population of male tennis players (n=619) and female ones (n=516), (Černošek, 2012; Zháněl, 2005). The calculations were executed by computer programs Microsoft Excel and Statistica.

4. Results and Discussion

Owing to the limited length of the contribution, it is not possible to present graphically the development trends of

Licensed Under Creative Commons Attribution CC BY

individual performance preconditions of the male player TB and the female player PK in detail. Therefore, we limit ourselves only to a graphical representation of the overall point scores of the male player TB and the female player PK. Their results achieved in the monitored period are presented in Table 1. However, on the basis of the results analysis and their comparison with the population of male or female tennis players, it is possible to say that in the monitored period, the male player TB and the female player PK were above average in bodily height and weight, they achieved mostly above-average results in the tests of playing arm strength, their running speed was around the average in both players, their endurance was below average (in a controlled interview, both players said that they do not consider this type of endurance important for tennis). Both of them were achieving significantly above-average results in the tests of arm reaction and particularly leg reaction, the level of torso flexibility was above average in the player TB and mostly below average in the player PK.

Table 1: The results of the male player TB and the female player PK

The male player TB												
T	Age	Height	W	BMI	ISF	PAS	RS	E	SAR	SLR	TF	Points
1	15,6	193	84,0	22,6	2,8	48,1	12,4	140,1	0,40	0,37	42	9
2	16,0	193	87,2	23,4	2,6	53,4	12,8	142,5	0,44	0,37	45	7
3	16,6	195	90,0	23,7	2,4	53,0	12,2	148,3	0,40	0,35	44	8
4	17,7	194	92,0	24,4	2,8	61,5	13,4	146,2	0,42	0,30	44	8
5	18,5	195	92,8	24,4	2,6	51,5	13,5	144,1	0,41	0,32	42	6
6	19,2	196	90,8	23,5	2,9	51,1	12,9	146,6	0,42	0,32	44	7
The female player PK												
1	15,7	178	58,2	18,4	2,0	28,9	14,5	151,4	0,44	0,37	43	7
2	17,1	179	69,4	21,7	2,6	38,6	14,0	152,2	0,45	0,32	39	9
3	17,6	181	71,0	21,7	2,6	35,4	14,0	155,7	0,47	0,33	38	7
4	18,8	181	71,8	22,2	2,2	37,2	14,2	151,4	0,45	0,35	42	10
5	19,2	181	74,8	22,8	2,6	41,7	14,0	154,7	0,43	0,30	36	9
6	19,8	182	70,0	21,1	2,3	49,1	13,9	159,5	0,41	0,33	42	9

Notes:

T… testing sequence	W… weight
ISF… index of shoulder joints flexibility	BMI… body mass index
PAS… playing arm strength	SAR… speed of arms reaction
RS… running speed	SLR… speed of legs reaction
E… endurance	TF… torso flexibility

Figure 1 shows the level of the overall point scores of the male player TB and the female player PK in the monitored period in comparison with the average level of the population of male and female tennis players (6 points); the development trends in both athletes are presented by means of time series.

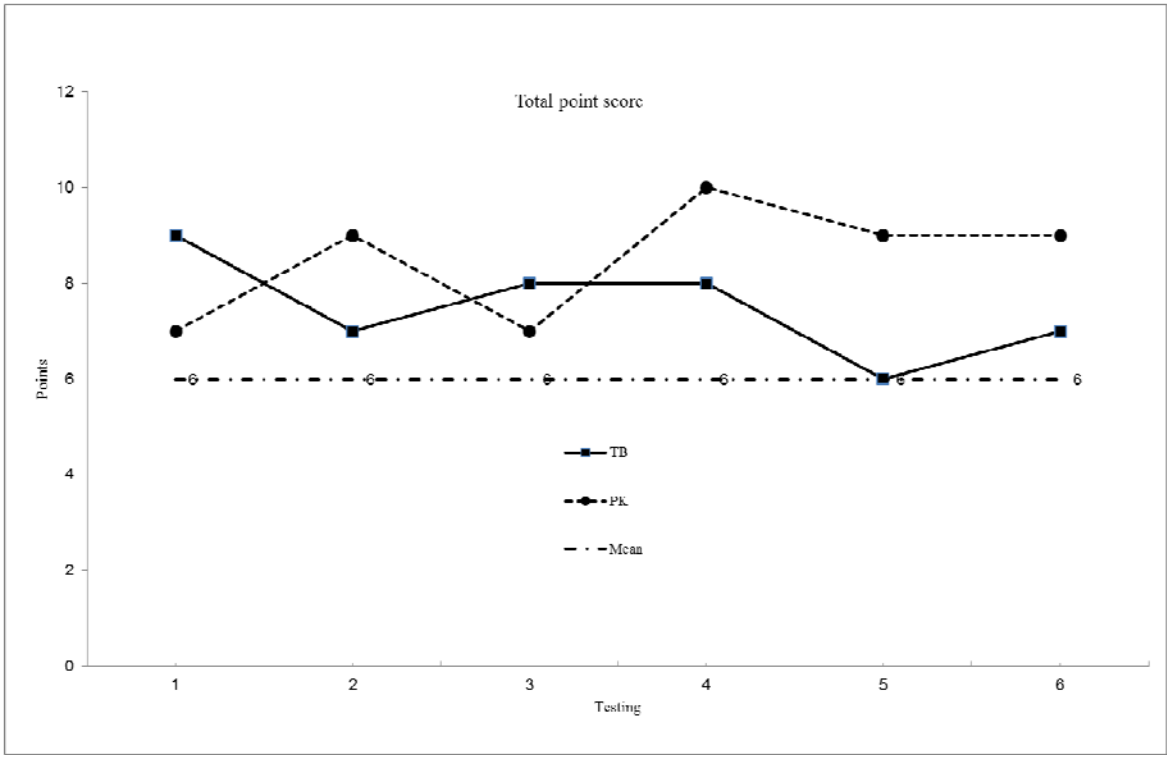

Figure 1: Development trends in the overall point scores of the male player TB and the female player PK in the test battery TENDIAG1

The player TB attended a total of six testing sessions in the age of 15.6 – 19.2, where the overall level of his motor performance preconditions was medium to high (6 to 10 points); he achieved his best point score (10 points) in the age of 15.6 years. In the monitored period, the median value of his results was at the level of 8 points ($\bar{x}$ = 8, median = 8). The player PK attended a total of six testing sessions in the age of 15.7 – 19.8, where the overall level of her motor performance preconditions was medium to high (7 to 10 points); she achieved her best point score (10 points) in the age of 18.8 years (it should be noted that she started her systematic conditioning preparation only around her 16th year of age). In the monitored period, the median value of her results was at the level of 9 points ($\bar{x}$ = 9, median = 9).

Licensed Under Creative Commons Attribution CC BY

Intersexual differences between the results of the male player TB and the female player PK in the last testing session (the age of 19.2 and 19.8 respectively) are shown in Table 2. The assessment of the significance of differences was made by the so-called critical difference calculated for individual tests from the values of coefficients of reliability and standard deviation (Měkota & Blahuš, 1983; Zháněl, 2005). The results show that in somatic parameters of the female tennis player PK, a significantly lower level of height (92.9%), weight (77.1%), and BMI (89.8%) was found as expected, which is in agreement with general knowledge. A surprisingly small and insignificant difference was found in the test of the playing arm strength (96.1%) in spite of the fact that the level of strength in the player TB is above average. This fact testifies to a high level of strength preparedness of the player PK, which shows in the force of her strokes. The differences in the tests of speed (92.8%) and endurance (91.9%) correspond to the published data and they are significant. The player PK proved a considerably higher level in the test of shoulder joint flexibility, which again confirms a known fact of women's higher flexibility. The differences in the tests of torso flexibility (2), the speed of arms and legs (0.1 sec.) are not significant.

Table 2: Intersexual differences in the results of the players TB and PK

Item/player	TB	PK	Difference	%	Critical difference
Height	196	182	-14	92,9	1,8*
Weight	90,8	70,0	-20,8	77,1	2,5*
BMI	23,5	21,1	-2,4	89,8	0,6*
ISF	2,9	2,3	+0,6	126,0	0,4*
PAS	51,1	49,1	-2,0	96,1	2,3
RS	12,9	13,9	-1,0	92,8	0,3*
E	146,6	159,5	-12,9	91,9	6,4*
SAR	0,42	0,41	+0,01	102,4	0,04
SLR	0,32	0,33	-0,01	97,0	0,04
TF	44	42	-2	95,5	3,8

Notes: see Table 1
* ..... a significant intersexual difference

5. Conclusions

In the monitored period (15.6 – 19.2 years), the player TB showed a medium to high level of motor performance preconditions (6 to 10 points) in comparison with the population of male tennis players; he achieved the best result (10 points) in the age of 15.6 years. The player PK showed a medium to high level of motor performance preconditions (7 to 10 points) in comparison with the population of female tennis players in the monitored period (15.7 – 19.8 years); she achieved the best result (10 points) in the age of 18.8 years. It is possible to say that the male tennis player TB as well as the female tennis player PK proved an above-average level of motor performance preconditions in the whole monitored period, in the junior as well as adult ages. The development trends showed a stabilized state of the motor preconditions level. The found intersexual differences are significant in favor of the player TB with the exception of the tests of torso flexibility and speed of arms and legs reaction. The female player PK proved a higher level in the test of shoulder joints flexibility.

The contribution has been prepared within the project of the Czech Tennis Federation called "The Comprehensive Diagnostics in Tennis".

References

[1] Blahuš, P. (1996). *K systémovému pojetí statistických metod v metodologii empirického výzkumu chování.* Praha: Karolinum.
[2] Crespo, M., & Miley, D. (2003). *Tenisový trenérský manuál 2. stupně (pro vrcholové trenéry).* (F. Zlesák, J. Zlesák, I. Dušek, J. Zháněl, J. Čermák, Trans.) Olomouc: Univerzita Palackého.
[3] Černošek, M. (2012). *Analýza vybraných faktorů ovlivňujících sportovní výkon v tenisu.* Disertační práce, Brno: Masarykova Univerzita, Fakulta sportovních studií.
[4] Černošek, M., Zháněl, J., Psalman, V. & Zvonař, M. (2012). Age effect v juniorskem tenise. *Studia Sportiva (in print).*
[5] Dovalil, J., Choutka, M., Svoboda, B., Hošek, V., Perič, T., Potměšil, J., Vránová, J., & Bunc, V. (2009). *Výkon a trénink ve sportu.* Praha: Olympia.
[6] Ferrauti, A., Maier, P., & Weber, K. (2006). *Tennistraining.* Aachen: Meyer & Meyer.
[7] Hendl, J. & Blahuš, P. (2005). *Závěrečná práce (proces a produkt). Jak na to?* Retrieved 15. 3. 2006 from the World Wide Web: http://www.ftvs.cuni.cz/hendl/index1.htm
[8] Hohmann, A., Lames, M., & Letzelter, M. (2010). *Úvod do sportovního tréninku.* (T. Studený, Trans.). Prostějov: Sport a věda. (Originál vydán 2007).
[9] Měkota, K., & Blahuš, P. (1983). *Motorické testy v tělesné výchově.* Praha: Státní pedagogické nakladatelství.
[10] Měkota, K., & Novosad, J. (2005). *Motorické schopnosti.* Olomouc: Univerzita Palackého, Fakulta tělesné kultury.
[11] Reid, M., Crespo, M., Quinn, A., & Miley, D. (2003). Modern strength and conditioning for tennis. In S. Miller (Ed.), *Tenis Science & Technology 2* (pp. 227-235). London: International Tennis Federation.
[12] Roetert, E. P., & Ellenbecker, T. S. (2003). The tennis player of the new millenium. In S. Miller (Ed.), *Tenis Science & Technology 2* (pp. 163-169). London: International Tennis Federation.
[13] Schnabel, G., Harre, D., Krug, J., & Borde, A. (Eds.). (2003). *Trainingswissenschaft.* Berlin: Sportverlag.
[14] Schönborn, R. (2008). *Optimální tenisový trénink.* (T. Studený, Trans.). Olomouc: doc. RNDr. Jiří Zháněl, Dr. (Originál vydán 2006).
[15] Weineck, J. (2007). *Optimales Training: Leistungsphysiologische Trainingslehre unter besonderer Berücksichtigung des Kinder- und Jugendtrainings.* Balingen: Spitta.
[16] Wohlmann, R. (1996). *Leistungsdiagnostik im Tennis.* Ahrensburg: Czwalina.
[17] Zháněl, J. (2005). *Diagnostika výkonnostních předpokladů ve sportu a její aplikace v tenise.* Habilitační práce, Univerzita Palackého, Fakulta tělesné kultury, Olomouc.

Licensed Under Creative Commons Attribution CC BY

[18] Zháněl, J., Balaš, J., Trčka, D., & Shejbal, J. (2000). Diagnostika výkonnostních předpokladů v tenise. *Tenis, 11(3),* 18-19.
[19] Zháněl, J., Černošek, M., Martinovský, L., & Agricola, A. (2008). Identifikace sportovních talentů v tenise – od talentu ke světové úrovni. In *Identifikace sportovních talentů* (pp. 16-20). Praha: Fakulta Tělesné výchovy a sportu Univerzity Karlovy.
[20] Zháněl, J., Vaverka, F., & Černošek, M. (2000). Longitudinal observation of physical and motor preconditions in tennis. In S. J. Haake & A. Coe (Eds.), *Tennis Science & Technology* (pp. 441-448). London: Blackwell Science Ltd.

Author Profile

Jiri Zhanel is working as Lecturer subjects Anthropomotorics, Methodology and Statistics. The President of the Czechoslovak section Lecturer Anthropomotorics, Vice-chief Czech kinanthropology society. Research interests: diagnostics of performance expected in the Sport.

Jiri Cernosek is working as sport manager, lecturer of sport management subject. Research interests: diagnostics of sport predisposition in youth players.

Martin Zvonar is working as Lecturer subjects Anthropomotorics, Diagnostics of performance and Kinesiology. Research interests: diagnostics of sport performance, biomechanical analysys of human movement.

Jiri Nykodym is working as Lecturer subject Sport games. Research interests: diagnostics of physical fitness.

Licensed Under Creative Commons Attribution CC BY