RELATION BETWEEN TWO AEROBIC CAPACITY TESTS AND COMPETITIVE SUCCESSFULNESS OF JUNIOR TENNIS PLAYERS

Aleš Filipčič[1]
Srečo Završki[2]

POVEZAVA MED DVEMA TESTOMA AEROBNIH KAPACITET IN TEKMOVALNO USPEŠNOSTJO MLADIH TENIŠKIH IGRALCEV

(Received: 18. 08. 1999 – Accepted: 18. 04. 2002)

Abstract

A sample of 42 tennis players, between 12 and 14 years of age, performed a laboratory test on a treadmill and a running test on an athletic track. Both were used to measure aerobic capacity of the subjects. Two predictive variables were chosen maximal O_2 consumption, running test on 2400 m and a criterion variable – competitive successfulness. The correlation between the predictive variables and competitive successfulness was analysed with the Pearson correlation coefficient. The results show that the correlation of competitive successfulness with running endurance and aerobic power is weak, but statistically significant.

Keywords: tennis, endurance, competitive successfulness, correlation

Izvleček

Na vzorcu 42 teniških igralcev, starih od 12 do 14 let, sta bila opravljena laboratorijski test na tekoči preprogi ter tekaški test na atletski stezi. Z obema smo želeli izmeriti aerobne kapacitete merjencev in ugotoviti kakšna je možnost napovedovanja tekmovalne uspešnosti ob pomoči obeh testov. Izbrali smo dve napovedni spremenljivki – maksimalna poraba kisika, tekaški test na 2400 m in eno kriterijsko spremenljivko (tekmovalna uspešnost). Povezanost med izbranima spremenljivkama in tekmovalno uspešnostjo v tenisu je bila analizirana s Pearsonovim korelacijskim koeficientom. Rezultati kažejo, da so povezave med tekmovalno uspešnostjo in tekaško vzdržljivostjo ter aerobno močjo šibko izražene, vendar statistično značilne. Nizka in statistično neznačilna povezanost se kaže med obema napovednima spremenljivkama.

Ključne besede: tenis, vzdržljivost, tekmovalna uspešnost, povezanost

Contact address
[1]Aleš Filipčič
University of Ljubljana – Faculty of Sport
Gortanova 22
SI-1000 Ljubljana
Slovenia
Phone: +386 1 520-77-00
Fax: + 386 1 520-77-50
E-mail: Ales.Filipcic@sp.uni-lj.si

[2](High School Jurij Vega, Idrija)

Introduction

Body movement during a tennis game is determined by the volume, intensity and player's tactics. The amount of work is determined by the length of a match, the number of performed shots, the number of played points, games and sets, and the total distance the player covers on the court during a match. The intensity depends primarily on playing surface and the velocity of the ball in flight – which affects the frequency of shots – and on the breaks between the individual points, games and sets. In the game, various modes of movement occur: running forward, backward, running sideways with stepping across and with forward paces, fast starts, various types of jumps and turning movements, as well as sliding and falling (Filipčič, 1990).

Measurements of metabolism in tennis point more to an anaerobic–alactate and lactate consumption of energy; however, it is necessary to emphasise that tennis matches can last several hours, which means that due to the limited processes, the mode of energy consumption during the game varies. A top tennis player must therefore have well developed both anaerobic and aerobic energy mechanisms. In the active part of the tennis game the energy processes are mainly anaerobic. The results obtained in the tests carried out by German experts have shown that the values of the measured lactates for tennis players during the game are in the range between 3 and 12 mmol/l (Weber, 1989). The values of lactate are slightly higher in playing on fast courts, where movements and activities of tennis players are of very high intensity and short duration.

The functional dimension occurring in a tennis match can be defined in terms of the distribution of time between play and breaks, and in the intensity of the activity itself. The measurements of time parameters have shown that the effective part of the game represents 20 – 30 % of the total duration of the tennis match on slow surfaces, while on faster surfaces the percentage of the play is even lower. A point on a clay court lasts on an average from 6 to 8 seconds, while on grass and fast surfaces the average duration of a point is from 4 to 6 seconds. Tennis players exchange the ball on an average 2.9 times in this time. The remaining time is used for changing sides, interruptions and for resting (Schönborn, 1999).

Maximal aerobic processes occur in a tennis match to a smaller extent. It is typical for these processes to take place in the presence of oxygen and be limited in time. Although maximal activation of aerobic processes in tennis is not necessary, these processes are very important for the development of the tennis contest and for the training process of tennis players, and above all, for younger tennis players, where the intensity of the tennis game is lower. Aerobic processes find full expression especially in very long – several hours – lasting matches. Known data on Dutch players, shows that the optimal value of VO_2max for top male adult players is between 63 and 67 ml/kg/min, and for female players between 53 and 57 ml/kg/min. Alongside these values, they also found that at this level, further development of aerobic capacities can reflect negatively on abilities, where speed is important (Pluim, 2000).

In the current study we were interested to assess the possibility of predicting competitive successfulness with a laboratory test on a treadmill and a 2400 m running test on an athletic track. Maximal aerobic power namely tells us about the capacity of the aerobic energy processes, while running endurance is a specific psychomotor ability. We namely wished to find out if the duration of a tennis match, which can last for quite a while, is correlated with the running endurance of a young tennis player. The existence of such a relation would namely lead to a conclusion that endurance in tennis can be improved with exercise, where running has a relatively large role. This interest was entirely practical, namely, which one of these two procedures to use for monitoring athletes' state of preparedness in the specified field.

Methods

Subjects

The sample of subjects consisted of 42 active tennis players in the category of boys, 12 to 14 years of age. The study covered only the players fulfilling the following conditions:

- that they were ranked on the scale of the Tennis Association of Slovenia in the category of boys up to the age of 14;
- that they were included in the process of regular training;
- that they completed the test relevant to the research.

General characteristics of the subject sample

	Minimum	Maximum	Mean	Std. Deviation
Age /years/	12	14	13.77	0.83
In training /years/	1	7	4.15	1.62
Height /cm/	139.9	184.5	159.829	9.942
Weight /kg/	32.0	70.6	47.456	9.505

Procedures

The measurements lasted two days. On the first day the subjects completed the treadmill test, on the second day the test at the track.

The functional test was carried out on a treadmill (Woodway) for analysing the cardio-respiratory, ergo-spirometric and metabolic parameters (Oxycon Beta).

Description of the test: The subject begins the run at a speed of 6 km/h. The first four minutes he runs at this speed. After running for four minutes, the speed is increased to 9 km/h. The subject then runs four minutes at this speed. After running for four minutes, the slope of the treadmill is increased by 5 degrees, and the speed decreases to 8 km/h. The speed of the treadmill increases in the continuation of the test by 1 km/h per minute. The measured subject perseveres in carrying out the test up to the level of his maximal abilities.

In setting up the protocol of the tests, the standards recommended by American College of Sports Medicine (Lea & Febiger, 1986) have been observed.

The running test was performed on an athletic track. The subjects covered a 2400 m distance. They ran in groups of 10.

Variables

Two assessments of aerobic capacity were chosen. In the treadmill test we decided on the VO_2max – maximal O_2 consumption (ml/min), in the RT2400 (running test 2400 m) the result was the time (seconds) in which the subjects covered the 2400 m distance.

Criterion Variable

In defining the criterion variable we have taken into account all competitions of boys up to 14 years of age, which took place in the period of one competitive season (the last 52 weeks). The players had different numbers of tournaments, so we selected the most suitable criterion variable CS (competitive successfulness), which determines the relationship between the number of the collected points in tournaments and the number of tournaments played. Since certain departures from linearity were observed, we used the logarithm of the criterion to linearise the association between the predictors and the criterion.

Data analysis

The collected data was processed by means of the SPSS program package for Windows (Release 11.0). To establish the influence of predictor variables on competitive successfulness, descriptive statistics and Pearson product-moment correlation were used.

Results

Table 1: Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis	Kolmogorov-Smirnov Test	Sig.
VO_2max	1475	3885	2530.00	611.21	.328	-.424	.993	.135
RT 2400	532	868	640.61	68.10	1.331	2.971	.135	.993
CS	-3.51	3.18	-.6312	1.89765	.024	-1.203	.668	.668

Table 2: Correlations between predictor variables and criterion variable

		CS	VO_2max
CS	Pearson Correlation Sig. (2-tailed)		
VO_2max	Pearson Correlation Sig. (2-tailed)	.519 .000	
RT 2400	Pearson Correlation Sig. (2-tailed)	–.429 .000	–.104 .513

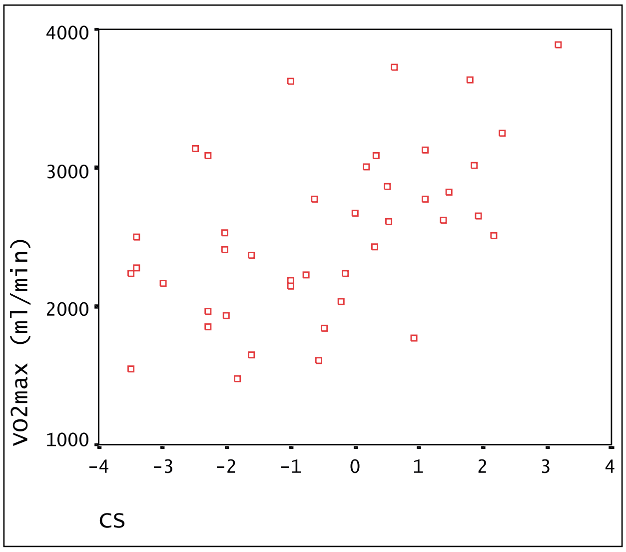

Fig. 1: Correlation between VO_2max and CS

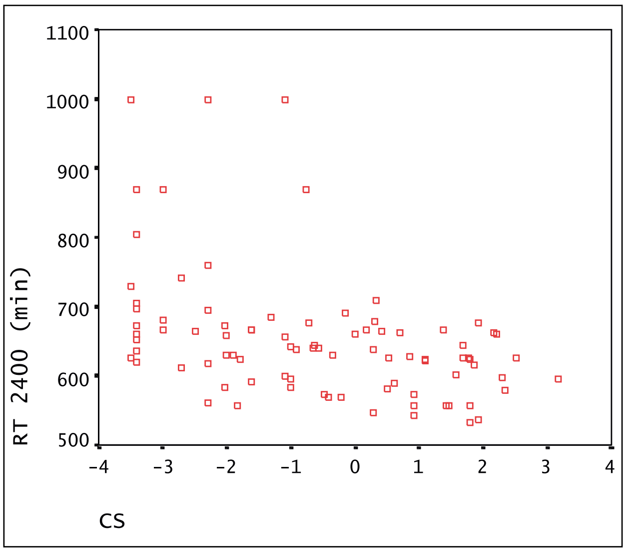

Fig. 2: Correlation between RT2400 and CS

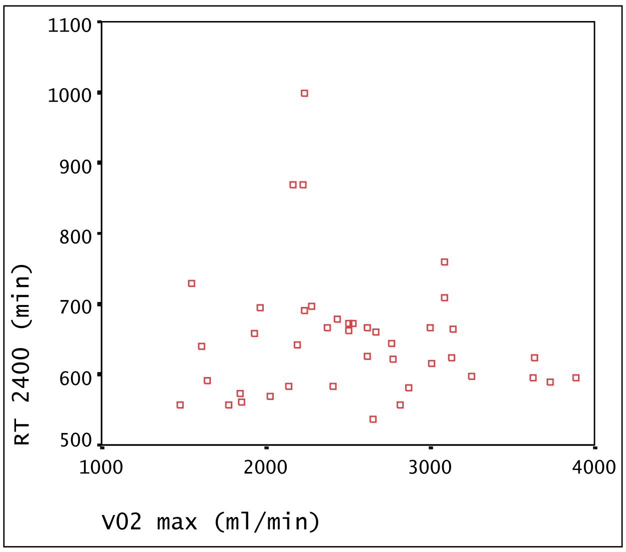

Fig. 3: Correlation between RT2400 and VO_2max

We were interested in this research in the relationship between aerobic power and running endurance in tennis, when played by young athletes. Table 1 shows the basic statistical parameters. The values of Kolmogorov-Smirnov test show a normal distribution of the results in all three used variables.

The correlations between the variables (Table 2) show a medium high and statistically significant association between CS, VO_2max and RT2400. The variable VO_2max has a somewhat higher correlation with the criterion.

Discussion

If we inspect the correlation of both predictor variables with the criterion also graphically we can conclude that the correlation between VO_2max and CS (Fig. 1) is weak, even if statistically significant, as can be seen from the great dispersion of the results at the individual values of competitive successfulness.

The correlation between RT2400 and CS (Fig. 2) is weak, negative, but logically positive and statistically significant. It would be very difficult to claim that there is any sort of dependence, leading to a conclusion that CS might be in any way dependent on running endurance. This leads us to the conclusion that CS depends more on other factors, which were not analysed in this research.

The correlation between VO_2max and RT2400 (Fig. 3) is weak (-.104), negative, but logically positive and statistically non-significant. This is because young tennis players are not runners, are not motivated for running, therefore their results do not express just their aerobic capacity, but include also their (non)motivation for running.

All this leads us to conclude that the correlation of both variables (RT2400 and VO_2max) with the criterion variable (SC) is statistically significant, but weak (Fig. 1 and 2). The lowest correlation is between the two predictor variables. Competitive successfulness is therefore less dependent on aerobic power and running endurance and more on factors, which were not dealt with in this study.

The analysis of the association of both predictor variables with the criterion showed that it is not possible to predict competitive successfulness of young tennis players well enough with these two tests of aerobic capacity, which was also the reason why multiple regression analysis was not performed. The reasons for the rather low predictive power lie probably in the characteristics of the used subject sample and the characteristics of tennis and the factors, which are important determinants of success in tennis. It is possible that the analysed sample of young tennis players is inappropriate from the age point of view, too small and heterogeneous. The main reasons for the weak correlation probably lie with the bad aerobic power of young tennis players. Competitive successfulness does not have a marked association with aerobic power or running endurance, which can lead us to conclude that some other kind of endurance is more important already for the younger categories of tennis players. Recent analyses of duration of points in matches of elite tennis players on surfaces of medium speed show that 86% of the points are shorter than 10 s in duration and 14% of the points last from 10 to 25 s (Schönborn, 1999). In light of this data on elite tennis players, we can conclude with high certainty that anaerobic endurance has an important role already for young tennis players. It is therefore necessary to determine precisely the optimal level of development of aerobic endurance, which would enable the players to overcome the workloads of longer duration in the training process and competitions.

It would probably be useful in future to try two things: repeat both measurement procedures on a larger sample of adult tennis players and perform a similar study in the field of anaerobic endurance of tennis players.

References

1. Filipčič, A. (1990). *Oris problematike razvijanja vzdržljivosti teniških igralcev* [An Outline of the Problems Related to the Development of Endurance in Tennis Players]. Ljubljana: Fakulteta za šport.
2. Lea, A., & Febiger, B. (1986). *Guidelines for Exercise Testing and Prescription* (3rd Ed.). Indianapolis: ACSM (American College of Sports Medicine).
3. Pluim, B. M. (2000). *Exercise Physiology*. Amsterdam: Royal Netherlands Lawn Tennis Association.
4. Schönborn, R. (1999). *Advanced Techniques for Competitive Tennis*. Aachen: Meyer und Meyer Sport.
5. Weber, K. (1989). Theory and practise of tennis-specific endurance. *ITF Coaches Review*, *1* (5), 7-14.