

Assessment of table tennis temporary structure

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Abstract: In the field of elite sport, the evaluation of the temporal distribution of the play actions developed in a match is of great interest. The analysis of the temporal structure implies registering the total work time or total match duration and the real play time. The relationship between the total time and the real or movement time determines the load of the existent work. This analysis can represent a useful tool for understanding the physical requirements of modern table tennis and for planning effective training programs. This research evaluated the analysis of the temporal structure of 2007 male and female absolute Spanish championships. Data were statistically analyzed with ANOVA recording no significant differences between groups ($p > 0.05$).

Keywords: Spanish championships, temporal analysis, match time, rally time, rest time.

1. INTRODUCTION

The temporal analysis of the play actions developed during competitions can provide relevant data about the specific characteristics of a sport. This information is representative of the rallies and rest time intervals, indicating the activity levels achieved in each moment. The information that can be extrapolated regarding the energetic metabolism and the physical requirements needed during competition is one interesting aspect of this type of analysis [1]. These data are of great relevance for increasing the sportsmen performance in future competitions [2].

Many investigations evaluated the play actions accomplished in different racket sports as squash [3-4], badminton [5-6] or tennis [7-9]. However, data available in the field of table tennis are limited and preceded the new technical regulation by the International Table Tennis Federation (ITTF) [10-12]. These changes modified the score system, the ball size and the service, affecting the structure and the playing dynamics of this sport as reported by Takeuchi et al. [13].

This new scenario converted table tennis in a more modern and attractive sport.

However, since changes were added by the ITTF, few studies aimed at analyzing the different temporal distribution of the activity and rest time in table tennis competitions [14-15].

An analysis of these new temporal situations is advocated in the attempt of evaluating the new table tennis context.

Thus, the aim of this study was the analysis of the temporal structure of modern table tennis during competition, comparing data depending on the

competition round (eighth-finals, quarter-finals, semi-finals and final) and the category (female and male).

2. METHODOLOGY

Analyzing the actions produced in table tennis during competition is quite complex, due to the large number of motor situations that occur in a very short time and with high speed. The use of a reliable data recording tool that allows observing, differentiating and systematizing the play actions produced in a match is needed for showing the activity and rest time distribution [16-19]. This is the main purpose of the notational analysis applied to racket sports [20, 16-19].

2.1 Participants

High level Spanish players belonging to the absolute category were selected for this research. All the actions developed by the selected players during the matches were analyzed.

2.2 Procedure

Thirteen matches of the absolute Spanish table tennis individual championship (eight belonging to the male category and five belonging to the female category) that was celebrated in Cartagena'07 (Murcia), were recorded and analyzed. In the case of male category, the analysis involved the eighth-finals to final while in female category, quarter-finals, semi-finals and final were evaluated.

The matches selected for the study were recorded using eight miniDV video cameras (Panasonic, NV-GA15, Japan). The cameras were located at a height of 2.5 m laterally to the play court, at a distance of 5 m and perpendicularly to the table. The play table was virtually divided into two independent halves, each one

focused by a video camera. Thus, each camera recorded half of the play court, obtaining two simultaneous records, each one corresponding to one of the two players (Figure 1). After recording, a video organization process was carried out for synchronizing both cameras.

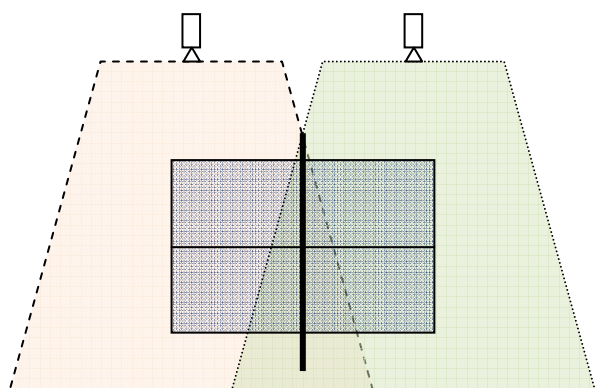


Fig. 1 Overhead view of the video cameras location and recording areas in the play court.

A specific observational tool was designed for carrying out the record analysis [15]. This observational tool was developed with the consensus of all the researchers. An observation protocol was developed and two observers were trained for codification, record and data analysis. The different technical rules that regulate individual table tennis were considered for the analysis. The point was determined when the ball was in play, although pauses were also taken into account for analyzing the total temporal structure of the match.

Data were analyzed by the software Match Vision Studio(r) v3.0 (Figure 2), storing the results in a spreadsheet of Microsoft Office Excel 2007. In each match the following variables were evaluated: total match time (TT); rally time (TJ); rest between rallies (TP) that corresponds to the resting time between each point and the time-out; rest between each game (TPJ).



Fig. 2 Software Match Vision Studio (r) v3.0 and notational protocol.

Data were statistically analyzed with one way ANOVA ($p < 0.05$) using the Matlab toolbox. Inter and intra-observer accuracy was assessed using the error percentage calculation (coefficient of variation).

3. RESULTS

Both observers presented a high level of reliability (error lower than 3 %) with high agreement indexes throughout the observational period (Table 1). An intra or inter observer error lower than 3 % is considered acceptable in sport observational studies [19].

Table 1 Inter and intra observer error obtained for each tested variable.

	% Inter-subject error Observer A	% Intra-subject error Observer B	% Inter-subject error Observer A	% Intra-subject error Observer B
Duration of the match 1	0.00	0.00	0.00	0.00
Duration of the match 2	0.00	0.00	0.00	0.00
Total duration of matches	0.14	0.00	0.02	0.05
Play time match 1	1.44	0.00	1.18	2.37
Play time match 2	0.00	0.00	1.34	2.68
Total play time of matches	1.44	0.00	0.00	0.00
Rest time match 1	0.51	0.00	0.51	0.51
Rest time match 2	0.00	0.00	0.78	0.78
Total rest time of matches	0.50	0.00	0.06	0.05

In the male category, the mean total match time was 2071.5 ± 1036.2 s that was extrapolated when analyzing the total match time (TT), the rest times (TP and TPJ) and the real time (TJ). The real time was only 383.18 s representing 18.5 % of physical activity (81.5% of resting).

In the female category, the mean total match time was 1394.48 ± 577.8 s. The real time was only 309.91 s, representing 22.2 % of time of physical activity.

The rest time between games in male category was 382.66 ± 160.42 s (Table 2) and in female category 241.24 ± 86.9 s (Table 3).

Table 2 Mean temporal values (in seconds) of TT, TP, TPJ and TJ recorded in the different masculine matches.

	TT	TP	TPJ	TJ
Eighth-finals	1274.55	789.64	223.75	261.16
Quarter-finals	1794.35	1138.88	305.8	349.68
Quarter-finals	993.5	531.28	245.54	216.68
Quarter-finals	2248.44	1359.72	514.2	374.52
Quarter-finals	1633.92	1002.84	282.8	348.28
Semi-finals	3379.4	2287	589.5	502.8
Semi-finals	3727.75	2510.8	553.24	663.72
Final	3224.4	2119.28	576.72	528.4

Table 3 Mean temporal values of TT, TP, TPJ and TJ recorded in the different feminine matches.

	TT	TP	TPJ	TJ
Quarter-finals	975.32	459.48	268.6	247.24
Quarter-finals	1106.08	608.92	157.36	339.8
Semi-finals	1199.6	771.36	171.28	256.96
Semi-finals	1712.68	1076.64	323.92	312.12
Final	2379.16	1606.36	348.48	424.32

In Table 4, the frequency and percentage of the rally time (TJ) by game is summarized, considering a total of 44 games in the male category and a medium value of 5.5 games by match. The mean duration of the actual

playing time was 73.75 ± 24.74 s. These data are represented in Figure 2.

Table 4 Frequency and percentage of TJ recorded in each game according to their duration time (in seconds).

	Frequency	Percentage	Accumulated percentage
30-40 s	1	2.27	2.27
40-50 s	7	15.9	18.17
50-60 s	8	18.18	36.35
60-70 s	5	11.36	47.71
70-80 s	9	20.45	68.16
80-90 s	3	6.81	74.97
90-100 s	4	9.09	84.06
100-110 s	2	4.54	88.6
110-120 s	3	6.81	95.41
>120 s	2	4.54	99.95
TOTAL	44	99.95	99.95

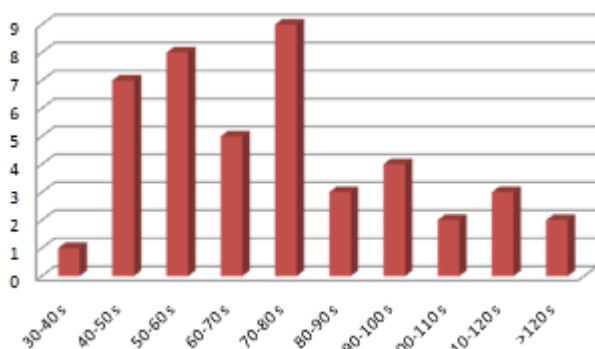


Fig. 3 TJ duration by game recorded in male category.

In the male category, the actual time was between 40 and 80 s in 65 % of the games and it was rarely lower than 40 s or higher than 120 s (Table 4 and Figure 3).

In the female category, fewer matches were analyzed, with a total of 22 games and a mean of 4.4 games by match. The mean duration of the real playing time was 71.83 ± 15.48 s. The frequency of the play time distribution is summarized in Table 5 and in Figure 4.

Table 5 Frequency and percentage of TJ recorded in each game according to their duration time (in seconds).

	Frequency	Percentage	Accumulated percentage
50-60 s	6	27.27	27.27
60-70 s	6	27.27	54.54
70-80 s	5	22.72	77.26
80-90 s	1	4.54	81.8
90-100 s	3	13.63	95.43
100-110 s	1	4.54	99.97
TOTAL	22	99.97	99.97

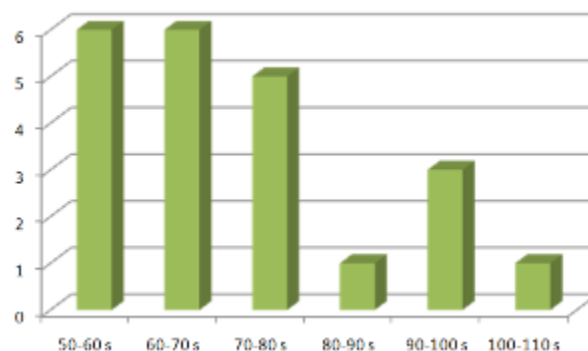


Fig. 4 TJ duration by game recorded in female category.

In the female category, the real time was between 50 and 80 s in more than 75 % of games. Very few games were characterized by a play time higher than 100 s. No games recorded a play time lower than 50 s.

The total play time and rest time between games expressed in seconds and in percentage for male and female categories, are depicted in Figures 5 and 6.

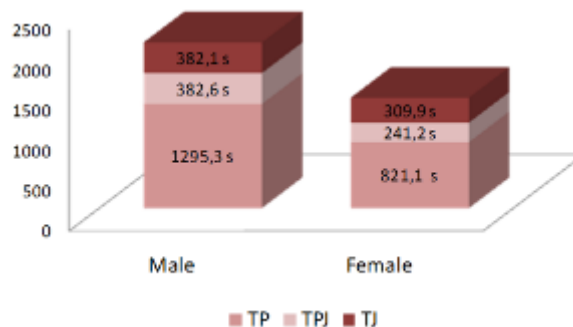


Fig. 5 Temporal distribution of mean TJ, TP and TPJ expressed in seconds in male and female categories.

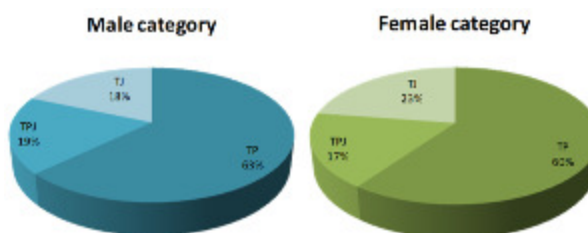


Fig. 6 Temporal distribution of mean TJ, TP and TPJ expressed in percentage in male and female categories.

The analysis of TJ allowed evaluating the mean time devoted to play. In male category, a value of 0.883 ± 0.054 s by rally was assessed. In the female one, this value was 0.856 ± 0.05 s. A comparison of this parameter in the male category as a function of the championship round is reported in Table 5. As the competition round improved, the play time increased, except in the case of the eighth-finals round. The mean rest time between rallies was 3.0 ± 0.63 s. This time increased in the semi-finals and final rounds when compared to the previous rounds.

Table 5 Mean play and rest time by shot according to championship round for male category.

Round	Eighth-finals	Quarter-finals	Semi-finals	Final
TJ	0.867	0.861 ± 0.045	0.912 ± 0.092	0.93
TP	2.623	2.619 ± 0.33	3.808 ± 0.09	3.731

Table 6 summarized the results of the female category. In this case, the rally time decreased as the championship rounds improved, recording the lower time during the final round. The mean rest time between rallies for this category was 2.27 ± 0.67 s.

Table 6 Mean play and rest time by shot according to championship round for female category.

Round	Quarter-finals	Semi-finals	Final
TJ	0.902 ± 0.028	0.846 ± 0.017	0.79
TP	1.647 ± 0.009	2.725 ± 0.32	2.99

The percentage distribution of play time and rest time between games and points is represented in Figure 7 and 8 as a function of the championship round for both male and female category.

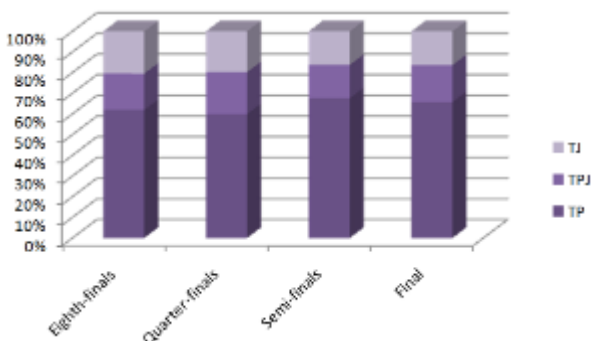


Fig. 7 Temporal percentage distribution of TJ, TPJ, TP by championship round in male category.

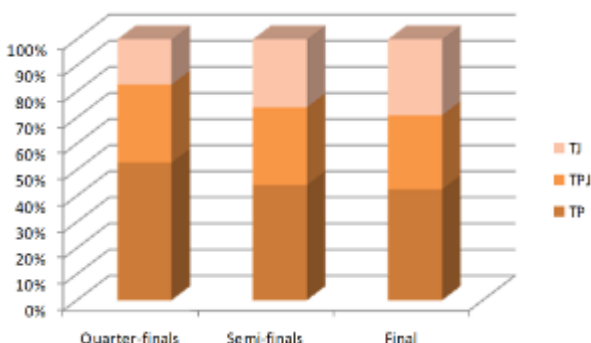


Fig. 8 Temporal percentage distribution of TJ, TPJ, TP by championship round in female category.

Table 9 reports a descriptive analysis of the distribution of play time and rest time by rally for male and female category.

Table 9 Descriptive analysis of play and rest time by shot for male and female category.

Parameter	Male category		Female category	
	Play time	Rest time	Play time	Rest time
Mean	0.882	2.619	0.856	2.27
Median	0.858	2.9	0.856	2.50
Estandar deviation	0.054	0.334	0.050	0.67
Minimum	0.83	2.299	0.79	1.654
Maximum	0.982	3.876	0.923	2.991

One way ANOVA statistical analysis showed that there are no significant differences in the play and the rest time mean value between male and female categories ($p > 0.05$). No significant differences were recorded for the total match time, independently from the championship category ($p > 0.05$).

4. DISCUSSION

The study of match temporal structure is very helpful for understanding table tennis physical needs during competitions [1]. These data are representative of the play and rest times duration between them. Their evaluation provides remarkable information regarding the play time and the passive phases duration, allowing the knowledge of the physical activity level reached during the match.

The analysis of TP and TJ data in the male category shows that the rest time between rallies increased with the level of the competition from eighth-finals (TJ 0.867; TP 2.623) to final (TJ 0.93; TP 3.731). Due to the rise in the TJ actions, the game intensity was higher. This may depend on the increase in the number of shots, more recovery time being necessary between games. However, in the female category it was not the same and a decrease in TJ was recorded, although TP increased.

The play time was between 0.83-0.98 s in male category and 0.79-0.92 s in female modality. In other racket sports as badminton or squash, higher values were recorded [3, 5, 21]. These differences between racket sports may depend on the fact that table tennis is extremely fast.

The match analysis reported mean total match duration of 34.52 min for male category and of 23.24 min for the female one. Similar values were recorded in badminton by Cabello [22]. In table tennis, more than 70 % of the match time is deserved to TP and TPJ, while the total time dedicated to TJ in male category is less than 30 %. These percentages vary in female category (more than 60 % for TP and TPJ and less than 40 % for TJ). These data differ from other racket sports as squash, where a TJ of 70% has been recorded [4].

A study from Yoshida [10] performed during the 9th Asian table tennis championship final in male category, pointed out that the mean duration of TJ was 1.92 ± 0.88 s. In our study, the value recorded during the final match was 8.8 s. The modifications introduced by the ITTF in

the technical regulation of table tennis may explain this difference resulting in a higher number of shots interchanges and play duration.

5. CONCLUSIONS

The temporal structure of table tennis is characterized by fast and strenuous efforts of short duration followed by periods of large recovery between points. The total rest time and the rally time are higher in male category than in the female one, the mean total duration of the match being higher in male category.

Higher activity levels were recorded during the final phases of the competition with a consequent increase of TP, TPJ and TJ in both categories. However, the rally time and the rest time between games were higher in male category than in the female one.

The chance of evaluating the variables related to the table tennis temporal structure is very useful for analyzing the physical and physiological requirements of this sport specialty.

The different temporal variables recorded in this study provide reliable data for organizing, planning and orienting table tennis training program. They represent effective criteria for obtaining high levels of performance in the sportsmen.

6. ACKNOWLEDGEMENTS

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