Analysis of Tokyo Summer Olympic Games Badminton Men's Singles Competition*

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ABSTRACT

Objectives. The aim of the study was to analyses Tokyo Summer Olympic Games badminton men's singles competitions in the context of winning and losing strokes and rally times. Methods. The study analyzed 8 men's matches in the quarter-finals, semi-finals and finals of the Tokyo Olympic games. Consistency was ensured between the video analyzers, and the two encoders were analyzed notationally by the person. Types of coding strokes; short service, high service, lop-lift, net drop, net kill, defense, drive, dunk, clear and drop strokes were analyzed and the durations of the matches played in the competition were also examined. Descriptive analysis (mean, standart deviation, and percentage) was used to present study data. Results. As a result of the research, it was observed that they made the most net drop strokes in the men's singles category by 23.77%, the hit with the most points won as a percentage was the dunk, and the hit with the most points lost was the lop-lift stroke. Looking at the playing time, each rally for men averages 9.2±7.15s. The average time was 10.21.7±7.73 innings and the rest time after the stroke was 26.52±12.08 seconds. Conclusion. As a result of the study, it is predicted that notation analyses may be very useful for trainers and athletes.

KEYWORDS: *Badminton, Data Envelopment Analysis, Olympic Games, Racket Sports, Performance*

INTRODUCTION

The importance of performance analysis in elite athletes in important event is crucial issue (1). Technical and tactical factors have been studied in professional badminton, and the analysis of such variables allows to present the most important actions during the competation (2, 3). Badminton is a sport that is not very difficult to learn and everyone, from 7-year-old to 70-year-old individuals, can easily play and is one of the rare sports branches that can be played by both male and female athletes together. Badminton is also a sports branch with a high level of enjoyment for both athletes and the audience (4). Displaying skills such as quick decision-making, mobility, balance, quickness, agility, game intelligence, and talent in this sports branch makes it an enjoyable sport to watch (5,6). Badminton is a sport, which requires the ability to think very quickly during the game and in which the right decisions and moves are required and in which the tactic, the quality of the shot, and the technique for throwing the ball to the targeted points are very important (7). Badminton is a sport with many physiological, psychological, and mental demands (8,9) and can be said to be one of the most difficult racket sports played worldwide (10). With the decision of the International Olympic Committee (IOC) to include badminton in the 1992 Olympics, it has been included in the program of the Olympic Games since the 1992 Barcelona Olympics and has been accepted as an Olympic sports branch (11,12). At the Thomas and Uber Cup tournaments held in 2006, the International Badminton Federation (IBF) switched from the 15-point system to the 21-point system (13). At Scotland's World Team Championship held in 2007, the highest speed of the shuttlecock was measured as 421 km/h, and the shuttlecock took its place in the literature as the world's fastest ball (14,15). Badminton, which is a sport with high-intensity, short-time points and pauses between these points (16) and also psychological demand, includes studies specific to the performance of badminton athletes, match analysis, and physical profiling studies (12).

The purpose of the analysis is to analyze men's singles matches in the Tokyo Olympic Games.

METHOD

A total of 8 elite matches, including 4 quarter-finals, 2 semi-finals, and 2 finals, in men's singles matches in the Tokyo 2020 Summer Olympic Games in the badminton branch were analyzed.

This study is an analysis with multiple outcomes.

Badminton Court Zones

While researchers divided the court into 12 in (17,18) they divided it into 9 in (19), 6 in (20), and 3 in (4,21,22,23,24,25,26,27). However, we see in all studies that researchers generally divided the court into 3 zones.

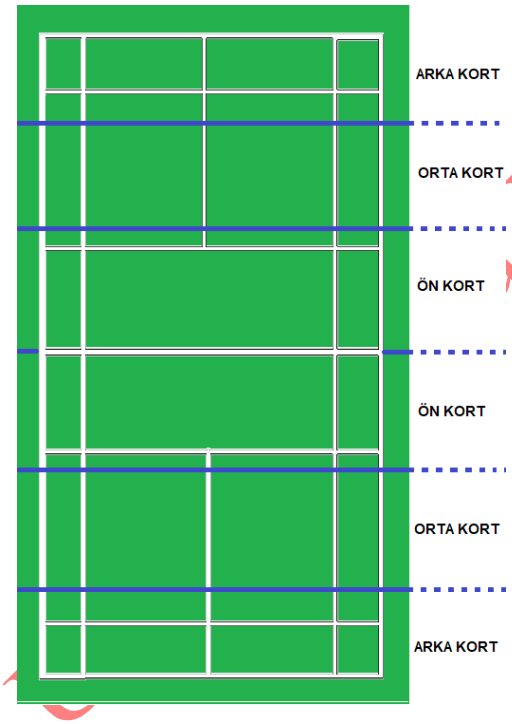

Figure 1. *Badminton Playground Analysis Zones*

Each zone has a length of 2.23 m, a width of 5.18 m, and an area of 11.91 m^2 (28).

Data Collection Process

After the Tokyo Summer Olympic Games, the match videos were accessed, recorded, and backed up through the International Olympic Committee (IOC) to access the video footage of the matches.

Study Design

Variables coded in the analysis;

Shots; short serve, high serve, clear, drop, smash, drive, defensive, lop-lift, net drop, and net kill shots were coded.

Time;

Game rally time: The time from the moment the racket and the ball meet until the ball drops to the ground.

Idle game time: The time from the moment the ball drops to the ground (touching the ground) to taking the kick-off for the next rally. The breaks in the eleventh point and the rest periods between sets were not included.

Match time: It is the sum of the game time and the idle game time.

Successful and unsuccessful shots were divided into the front court, middle court, and back court zones and were coded.

Inter-Coder Consistency

A four-stage procedure was employed for consistency.

Stage 1: It was ensured that coders agreed on how they should code the shots in badminton and all issues by analyzing a separate match from the study matches together.

Stage 2: Two coders also analyzed a separate match from the study match videos and fulfilled the success criteria of 95% (29).

Stage 3: Of the total match videos, 42% (3 match videos) were randomly selected and coded independently of each other. Inter-coder consistency should be at least 85% to complete this step (30). Inter-coder consistency was found to be successful by 96.89%.

Stage 4: The remaining 4 match videos were shared by lot.

Data Analysis

The shots in the badminton match, shot zones, and match times were notationally analyzed. The custom-made spreadsheet (Microsoft Excel) was transferred, and then the frequency, total, mean, standard deviation, and percentages were calculated using the SPSS 24 program.

RESULTS

According to the study findings, it was observed that they made the most net drop strokes in the men's singles category by 23.77%, the hit with the most points won as a percentage was the dunk, and the hit with the most points lost was the lop-lift stroke. Looking at the playing time, each rally for men averages 9.2±7.15s. The average time was 10.21.7±7.73 innings and the rest time after the stroke was 26.52±12.08 seconds.

All study findings are listed as tables below.

Table 1. General Table of the Men's Singles Category

Match Point	8
Set Point	18 (8 in the 1st set, 8 in the 2nd set, 2 in the 3rd set)
Total Score Point	626
Game Time/Number of Shots	1 shot (in 0.90 seconds)
Game Time / Idle Game Time	2.72
Longest Match Time	4093 sec.- 1.08.13 hours
Shortest Match Time	1899 sec.- 31.39 min.
Longest Rally Time	44 sec. (46 shots, 32 sec. i.g.)
Longest rally number of shots	47 shots (43 sec. game, 49 sec. i.g.)

Table 2. Distribution of Total, Mean and Standard Deviation of Men's Singles Game, Idle Game, and Match Times and Number of Shots

	Mean	SD	Total
Game Time	725 sec.- 12.05 min.	214	5797 sec.- 1.36.37 hours
Idle Game Time	1969 sec.- 32.49 min.	638	15752 sec.- 4.22.32 hours
Match Time	2694 sec.- 44.54 min.	847	21549 sec.- 5.59.09 hours
Number of Shots	804	243.66	6442

Table 3. Percentage Distribution of Total Shots of Men's Singles by the Types of Shots

Types of Shots	Forehand		Backhand		Total	
	f	%	f	%	f	%
Short Serve	0	0.00%	566	20.02%	566	8.79%
High Serve	0	0.00%	65	2.30%	65	1.01%
Net Drop	810	22.41%	721	25.50%	1531	23.77%
Drive	129	3.57%	89	3.15%	218	3.38%
Lop-Lift	776	21.47%	681	24.09%	1457	22.62%
Defensive	320	8.85%	419	14.82%	739	11.47%
Drop	412	11.40%	178	6.30%	590	9.16%
Clear	255	7.05%	52	1.84%	307	4.77%
Smash	865	23.93%	33	1.17%	898	13.94%
Net Kill	48	1.33%	23	0.81%	71	1.10%
Total	3615	100.00%	2827	100.00%	6442	100.00%

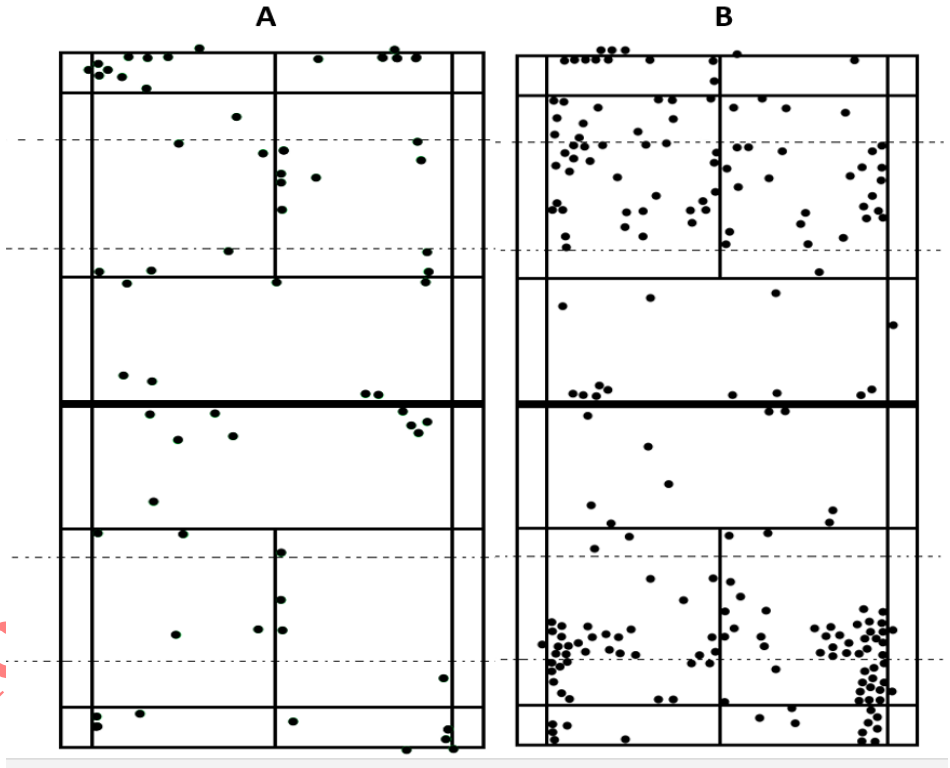

Figure2. a. *Distribution of Points Won by Forehand Shot in the Men's Singles Category by the Zones Where the Ball Drops;* ***b.*** *Distribution of Points Won by Backhand Shot in the Men's Singles Category by the Zones Where the Ball Drops*

When 204 points won by forehand shots in men's singles matches were analyzed by zones, it was observed that the shot with a point was made from the front court zone (22 points,

3.51%), the forehand shot with a point was made from the middle court zone (111 points, 17.73%), and the forehand shot resulting in points was made from the back court zone (71 points, 11.34%). A total of (204 points, 32.59%) points were obtained with the forehand shot in all three court zones.

Upon examining the ball traces of 59 points won by backhand shots in men's singles matches by zones, while points were obtained by backhand shot from the front court zone (15 points, 2.40%), points were also obtained by backhand shot from the middle court zone (20 points, 3.19%) and back court zone (24 points, 3.83%). In total, athletes made shots by which they won points with backhand shots (59 points, 9.42%).

Table 4. Numerical Distribution of Scoring and Lost Shots in Men's Singles and the Ratio of the Total Number of Shots to the Number of Shots Won and Lost

Types of Shots	Score/Lost	Points	Percentage (%)	Total Number of Shots (A)	Number of Shots Won (B)	% Ratio of B/A
Short Serve	Scoring Shots	0	0.00%	566	0	0.00%
	Shots Lost	3	0.83%	566	3	0.53%
High Serve	Scoring Shots	1	0.38%	65	1	1.54%
	Shots Lost	5	1.38%	65	5	7.69%
Net Drop	Scoring Shots	21	7.98%	1531	21	1.37%
	Shots Lost	76	20.94%	1531	76	4.96%
Drive	Scoring Shots	16	6.08%	218	16	7.34%
	Shots Lost	22	6.06%	218	22	10.09%
Lop-Lift	Scoring Shots	29	11.03%	1457	29	1.99%
	Shots Lost	82	22.59%	1457	82	5.63%
Defensive	Scoring Shots	11	4.18%	739	11	1.49%
	Shots Lost	65	17.91%	739	65	8.80%
Drop	Scoring Shots	15	5.70%	590	15	2.54%
	Shots Lost	24	6.61%	590	24	4.07%
Clear	Scoring Shots	7	2.66%	307	7	2.28%
	Shots Lost	20	5.51%	307	20	6.51%
Smash	Scoring Shots	118	44.87%	898	118	13.14%
	Shots Lost	61	16.80%	898	61	6.79%
Net Kill	Scoring Shots	45	17.11%	71	45	63.38%
	Shots Lost	5	1.38%	71	5	7.04%
Total	Scoring Shots	263	100.00%	6442	263	4.08%
	Shots Lost	363	100.00%	6442	363	5.63%

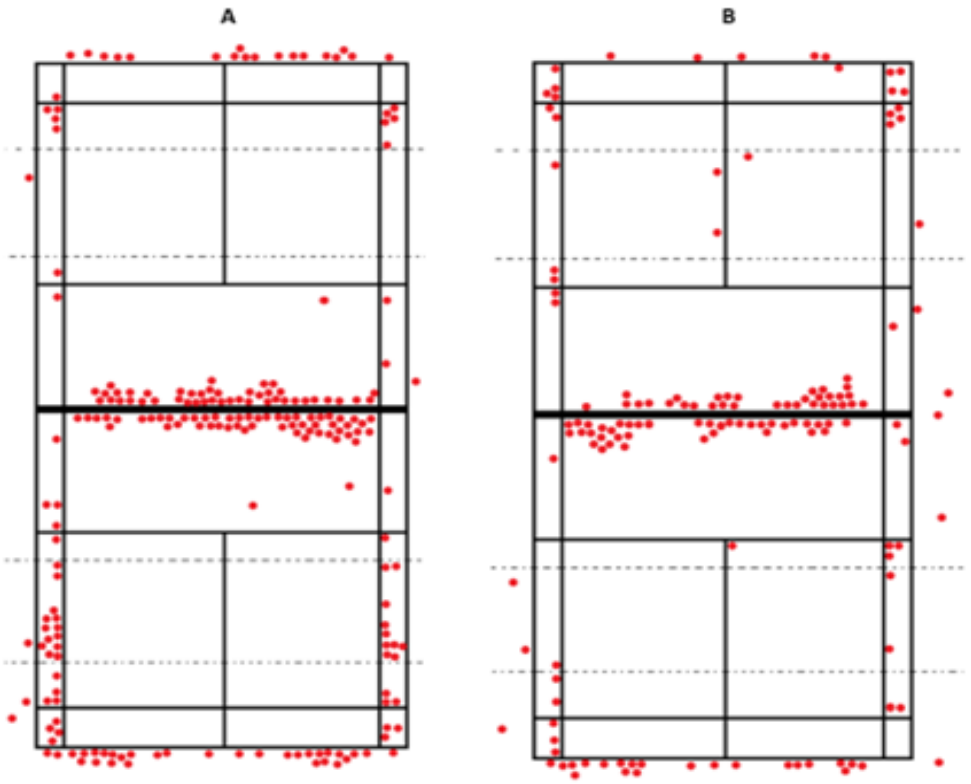

Figure 3.a *Distribution of Forehand Points Lost in the Men's Singles Category by the Zones Where the Ball Drops;* ***b*** *Distribution of Backhand Points Lost in the Men's Singles Category by the Zones Where the Ball Drops*

Considering the shots lost by forehand shots in the men's singles category, it was observed that athletes made mistakes in a total of (218 points, 34.82%) forehand shots. When the forehand shots lost were analyzed by the court zones, they made point-losing shots in the back court (73 points, 11.66%), middle court (32 points, 5.11%), and front court (113 points, 18.05%).

The total lost backhand shots were found to be (145 points, 23.16%). When the lost backhand shots were analyzed by the court zones, it was seen that athletes lost points from backhand shots in the front court (76 points, 12.14%), middle court (19 points, 3.04%), and back court (50 points, 7.99%).

Table 5. Times of Matches in the Men's Singles Category

	1st SET		2nd SET		3rd SET		TOTAL	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Game Time (sec.)	331.5	77.15	296.5	43.42	386.5	67.17	332.06	66
Idle Game Time (sec.)	864.5	173.88	801.63	166.32	1215.5	102.53	875.11	202
Total Game Time (sec.)	1196	245	1097.1	204	1602	170	1197.2	260
Game Time in Each Rally (sec.)	9.22	7.21	9.35	6.95	10.45	8.13	9.2	7.15
Idle Game Time in Each Rally (sec.)	25.65	11.42	26.09	11.57	34.73	14.24	26.52	12.08
Number of Shots in Each Rally	10.62	8.51	9.73	7.05	12.03	9.04	10.21	7.73

DISCUSSION AND CONCLUSION

In this study, the shots made in the men's singles category in the badminton matches played in the Tokyo Olympic Games, the shots won and lost, and the time structures of the matches were analyzed. The results of the analyses will be discussed in this section with similar studies in the literature.

Considering the shots in the men's singles matches (Table 3), it was found that the most used shots were net drop shot by 23.77%, lop shot by 22.62%, and smash shot by 13.94%, while the least used shot was backhand high serve by 1.01%. In the review of studies in the literature, Casal et al. (31) analyzed the 2015 World Championship final matches and reported net drop shots by 36.09%, lop shots by 22.08%, and smash shots by 11.46% in men's singles. In their review of the London Olympics, Salman et al. (28) determined that net drop shots by 31.9%, lop shots by 30.2%, and smash shots by 12.5% were mostly made in men's singles semi-finals, and net drop shots by 33.2%, lop shots by 25.9%, and drop shots by 14.8% were made in the final. In another study, While these studies in the literature are completely parallel to our study in the order, Ardiantoro and Sunarmi (32) analyzed the shots of Indonesia's most successful badminton players and revealed that net drop shots by 26%, lop shots by 18.67% and drop shots by 18% were made, which was highly parallel to the order in our study. In their study, Alcock

and Cable (33) observed that athletes mostly made an average of 36.3% clear shots, 16.0% drop shots, and 14.9% smash shots in men's singles. It can be said that this study differs from the results of our study because it was conducted in the old point system, shots with longer flight paths were preferred in rallies, and after the new point system, it evolved into more aggressive shots with shorter flight paths over the years. Considering studies in general, it was revealed that the most used shots in the men's singles category were net drop, lop-lift, and smash shots.

As seen in (Table 4), the shots by which points were won in this category were smash shots by 44.87%, net kill shots by 17.11%, and lop shots by 11.03%, respectively, and athletes won the least points with the clear shot by 2.66% in the Tokyo Olympics. Considering the results of the relevant studies, Putri (34) examined through which shots the points were won in the men's singles final at the London Olympic Games and found that while Lee Chong Wei won points from smash shots by 15.87%, followed by net drop shots by 9.34% and lop shots by 8.41%, the Champion Lin Dan won points from smash shots by 18.69%, lop shots by 12.15%, and net drop shots by 9.34%. Obviously, it can be said that the smash shot had a high percentage of the shots scored.

Considering the points lost (Table 4), the points were lost with lop-lift shots by 22.59%, net drop shots by 20.94%, defensive shots by 17.91%, and smash shots by 16.80% in men's singles in the Tokyo Olympics. Putri (34) reported that Lin Dan lost points from lop shots by 13.08%, net drop shots by 10.28%, and defensive shots by 9.34%, while Lee Chong Wei lost points from defensive shots by 14.02%, net drop shots and lop shots by 12.14%. Yüksel (24) found that the shots by which points were mostly lost in the 5th International Mevlana children's games were net drop shots by 24.6%, lift shots by 18.8%, and defensive shots by 16.9%. The results of these studies are parallel with the results of our study. The athletes competing in the men's singles category mostly lost points from the lop, net drop, and defensive shots, and they should pay more attention to these shots. Concerning the ratio of the shots of the points lost to total shots (Table 4), points were lost with drive shots by 10.09%, defensive shots by 8.80%, backhand high serve by 7.69%, and net kill shots by 7.04% compared to total shots in the men's singles category in the Tokyo Olympics. Yüksel (24) found that athletes lost points from defensive shots by 28.77%, net drop shots by 17.04%, and drive shots by 14.75% compared to total shots in the 5th International Mevlana children's games. In general, the ratio of the shots made in lost points to total shots was the same net kill, defensive, and drive shots.

Considering the mean match time in men's singles (Table 2), it was found to be 44.54 minutes. Şenel and Eroğlu (35) revealed that the mean match time was 51.58 min. in men's singles in the 2004 Athens Olympics. While Arslanoğlu, Arslan, and Şenel (36) found that the mean match time in the 2008 Beijing Olympics was 41.7 min. in men's singles, Aydogmus, Arslanoglu, and Senel (36) determined that the mean match time was 45.12 sec. in the London Olympics. Considering the results, it can be said that the mean match times in men's singles continued to increase and the high time in the Athens Olympics was due to the 15x3 point system. Furthermore, although it was seen that the time decreased in this category in Tokyo, it was thought to be caused by the fact that it was calculated by including the last 8 matches. Chiminazzo et al. (38) detected that while the mean match time in the play-off matches was 57.44 minutes in the Rio Olympics, the mean match time was 42.02 minutes in group matches. We can say that play-off match times are longer than the Olympic match times.

Concerning the mean time of each rally in men's singles (Table 5), the mean game time in each rally was 9.2 seconds in the men's singles category in the Tokyo Olympics. In their study, Salman et al. (28) analyzed the London Olympics and recorded that the game time in this category was 11.3 seconds. While Abian et al. (39) found that the mean time of each rally was 9.0 seconds in the Beijing Olympics and 10.4 seconds in the London Olympics, Alcock and Cable (33) determined that the mean rally time in men's singles was 5.0 seconds, Gawin, Beyer, and Seidler (40) identified the mean rally time in this category as 9.3 seconds. On the other hand, when Laffaye, Pdomsoupha, and Dor (41) examined the mean time in each rally in men's singles finals, they observed that the mean time in each rally was 12.9 seconds in the 1992 Olympics, 5.5 seconds in the 1996 Olympics, 9.6 seconds in the 2000 Olympics, 8.4 seconds in the 2004 Olympics, 9.3 seconds in the 2008 Olympics, and 10.1 seconds in the 2012 Olympics. In light of this information, it is seen that the rally times in men's singles tended to decrease.

Considering the ratios of shots in each rally (Table 5), it was observed that 10.21 shots were made in men's singles. Abian et al. (39) analyzed the mean number of shots in each rally and found that 9.8 shots were made in men's singles in the Beijing Olympics and 11.1 shots were made in men's singles in the London Olympics. Alcock and Cable (33) revealed that an average of 4.4 shots were made in each rally. It was considered that the low average number of shots in this study was due to the different point system in badminton. Based on this information, we can say that athletes made more shots in play-off matches and had fewer mean shots in groups and fewer mean shots in finals than in groups. In another study, Laffaye,

Pdomsoupha, and Dor (41) analyzed the men's singles Olympic finals and revealed that athletes made an average of 13.3 shots in the 1992 Olympics, 5.4 shots in the 1996 Olympics, 9.7 shots in the 2000 Olympics, 9.8 shots in the 2004 Olympics, 10.8 shots in the 2008 Olympics, and 12.0 shots in the 2012 Olympics. In the study, it was thought that the frequency of shots increased over the years. Concerning the idle game time in each rally, it was seen that athletes rested for 26.52 sec. in men's singles (Table 5). With regard to the mean idle game time, Abian (39) reported that the rest period was 24.7 seconds in the men's singles category in the Beijing Olympics and 26.7 seconds in the London Olympics. Salman et al. (28) found that athletes rested for 30.8 seconds in the London Olympics in men's singles. Based on this information, we can say that the longest rest period in men's singles was 33.5 seconds in the 2012 Olympics in the study by Laffaye, Pdomsoupha, and Dor (41). However, it was found to be high because only the final match was analyzed. The rest periods recorded in badminton are higher compared to other racquet sports, such as tennis and squash (43). The longest rally time (Table 1) in the Tokyo Olympics was found as 44 seconds in men's singles. Şenel and Eroğlu (35) observed the longest rally time in men's singles as 58 seconds in the 2004 Athens Olympics. Arslanoğlu, Arslan, and Şenel (36) reported that the longest rally time was 105 seconds in men's singles in the 2008 Beijing Olympics, Aydogmus, Arslanoglu, and Senel (37) reported it as 85 seconds in the men's singles category in the 2012 London Olympics, and Türkeli, Şenel and Gülmez, (42) reported it as 100 seconds in men's singles in the 2016 Rio Olympics. It was revealed that the longest rally time was 105 seconds in men's singles in the Beijing Olympics and 89 seconds in women's singles in the Rio Olympics.

The current study has some limitations. First, future studies should investigate the importance of points according to player-related factors. Secondly, other performance parameters could be included to make a more comprehensive analysis.

As a result of the study, it was revealed that the athletes made an average of 10.21 shots in a rally in the men's singles category, performed these shots in an average of 9.2 seconds, and then rested for 26.52 seconds, 26.92% of the total match time was the game time, and 73.08% of it was the idle game time. This means that the athletes rested at a rate of (1 / 2.72) in men's singles. It is considered appropriate to train single male athletes according to this rate when they are training and resting. The shot frequency continues to increase toward longer rest intervals, pushing the limits of the badminton branch with each passing day. It is predicted that notation analyses may be very useful for trainers and athletes.

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