DOI: 10.4025/jphyseduc.v31i1.3133

**Original Article**

# CHARACTERIZING THE PATTERN OF RALLY TIMES AND COMPLEXES IN SCHOOL VOLLEYBALL

## CARACTERIZAÇÃO DO PADRÃO DOS TEMPOS DE *RALLIES* E DOS COMPLEXOS NO VOLEIBOL ESCOLAR

**Otávio Guerson Rodrigues de Angelis**[1], **Wilian dos Santos Bento**[1], **Isaias Soares da Silva**[1], **Vinícius Resende de Oliveira**[1] and **Frederico Souzalima Caldoncelli Franco**[1]

[1]Southern Minas Gerais' Federal Institute of Education, Science and Technology, Rio Pomba-MG, Brazil.

**RESUMO**
Este estudo objetivou caracterizar o padrão dos tempos de *rally* e dos complexos no voleibol escolar. Analisou-se 52 jogos, que foram gravados em filmadora digital. Avaliou-se os tempos de *rallies* e seus intervalos, a densidade do set, além de quantificar e caracterizar os complexos e as ações nos *rallies*. Os resultados mostram que o voleibol escolar exibe tempo de intervalo entre *rallies* 2,5x maior que o tempo de *rally*, caracterizando-o como um esporte intermitente de alta intensidade em curta duração. Equipes escolares mais jovens e femininas realizam menores números de complexos e de ações, reduzindo o tempo de *rally*, porém, elevam o tempo de intervalos entre *rallies* promovendo menor densidade de jogo. O voleibol escolar exibe padrão dos tempos de *rallies*, frequências dos tipos de complexos e número de ações similares aos de alto rendimento. Também verificou-se que o tempo de intervalo não altera entre os tipos de *rallies*. Todavia, diferem na quantidade de complexos por *rally* e na densidade de tempo jogado, devido apresentar maior tempo de *rally* e menor de intervalos. Conclui-se que o voleibol escolar Sub17 masculino exibe maiores similaridades nos padrões de *rallies* e complexos ao voleibol de alto rendimento.
**Palavras-chave**: Voleibol. Percepção do tempo. Análise e Desempenho de tarefas.

**ABSTRACT**
This study aimed to characterize the pattern of rally times and complexes in school volleyball. A total of 52 matches were analyzed, all video recorded on a digital camera. Rally times were analyzed along with their intervals, and complexes as well as actions in the rallies were quantified and characterized. Results show that school volleyball has an interval time between rallies 2.5x higher than the rally time, characterizing it as an intermittent sport of short-length high intensity. Younger and female teams performed a lower number of complexes and actions, reducing the rally time, but had more interval times between rallies, promoting lower match density. The pattern of rally times, complex type frequencies and number of actions in volleyball are similar to those of high-performance game. It was also possible to observe that interval time did not change between rally times. However, they differ as to number of complexes per rally and to played time density for presenting longer rally times and shorter intervals. It is concluded that male Under-17 school volleyball has more similarities with the patterns of rallies and complexes as high-performance volleyball.
**Keywords**: Volleyball. Time perception. Task analysis and Performance.

## Introduction

Volleyball is the sixth most popular sport worldwide, ranked second among Brazilians, with 15.3 million players[1,2]. The expressive results of Brazilian volleyball have been fostering its school practice, creating a nest of new sports talents, with matches that awaken team spirit and competitiveness. Minas Gerais' School Games [*Jogos Escolares de Minas Gerais*] (JEMG) is a competition organized by the State Government in which 853 municipalities and 160,000 athletes participate[3]. To enhance training and the competitive level of teams, school volleyball demands specific information on their performance, as well as comparisons with excellence practice, which is still quite limited.

The primary unit of volleyball is the rally, characterized by a sequence of foundations executed for as long as the ball remains in the game without falling on the floor[4,5]. During a rally, there is a logic sequence in the execution of foundations, identifying two complexes: Complex I or side-out (serve reception, setting and attack), and Complex II or transition (block, defense, setting and attack)[6-9]. Studies have been conducted to assess the efficacy of complexes as offensive organization and their cause-effect with respect to counter-attack[4,10,11], attack type and time[12], and sitting volleyball performance[13], but it was not possible to find any investigation on the execution of complexes and rallies with school teams, nor their similarities and differences as to high-performance game.

Rally pattern in volleyball is characterized by frequency and types of complexes and their time variables, being differentiated according to the athletes' competitive level, age group and sex[14]. Authors report that more experienced players differ from beginners by their greater cognitive competence in making decisions as to actions of the game, due to their greater precision and speed in perceiving actions, as well as longer training time and participation in competitions[10,15,16]. Other studies have also detected differences as to sex in several volleyball parameters with expert adult athletes[7,14,17], and as to age groups[15,18], but no investigation has been found addressing this theme in school competitions. It was possible to find only one study analyzing school teams, which was conducted by Lopes et al.[19]; it linked decision making in serving, reception and setting to the athlete's technical level, but did not investigate patterns concerning rally time and executed complexes.

Guided by the rule that the ball must not fall on the floor, but rather be hit back by the players alternately, and that the team has up to three touches to send it to the opponent[5], volleyball is characterized by intermittent actions of short-length high intensity, followed by longer moments of low intensity[20,21]. Considering that a ball hit back remains approximately 1"5 in the aerial phase until falling on the floor[2], these volleyball characteristics make length and its intervals between rallies relevant to performance. These characteristics have been studied in high-performance competitions[22,23], and so has been its evolution over the years[4,24,25], but not in base categories.

In a recent scientific review on volleyball in Latin America and Caribe, between 2010 and 2016, Moraes et al.[26] found 94 articles in which the "Training" theme presented the highest incidence (51.1%), while "Sport Initiation and Base Category" had an incidence of only 3.2%. However, they found no publication studying parameters that affect rally pattern in school categories. In this sense, the present study aimed to characterize patterns concerning rally times and complexes in school volleyball according to the sex and age variables, correlating them with high-performance volleyball.

## Methods

The present study was developed at the Physical Education Center of the Academic Department of Education belonging to Southern Minas Gerais' Federal Institution of Education, Science and Technology, Rio Pomba Campus. Analyses were run after approval from the Ethics Committee on Research Involving Humans of IF Sudeste MG, under legal opinion 1.953.631.

*Sample*

The sample of this study was volleyball matches of the Regional Phase (hosted by Além Paraíba) of Minas Gerais' School Games, held in July 2017. The state secretariat of sports sets forth that athletes aged up to 14 years old must participate in category MODULE I, and athletes aged up to 17, in MODULE II[3]. Thus, the JEMG is played in four categories characterized by sex and age: Under14-F (females up to 14 years old), Under14-M (malels aged up to 14 years old), Under17-F (females aged up to 17 years old), and Under17-M (males aged up to 17 years old). In this study, 52 matches were analyzed, with 13 per category, played as best of three sets.

In order to correlate rally pattern in volleyball between school-level game and high-performance game (HPG) using the same analysis parameters, the final match of the South-

American Women's Club Championship (Camponesa/Minas x SESC/Rio, on 24/02/2018), and the match of the second round of the 2017-2018 Men's Super League (SESC/Rio x Cruzeiro/Sada, on 13/01/2018) were assessed. Said matches were randomly chosen for being played in 2018 and having 3x2 as results, as well as for being played by elite teams of the national and continental volleyball.

*Procedures*

The games were recorded behind the defense zone on a digital camera (SONY handycam HDR-PJ380). The images were analyzed on software Adobe®Premiere®Pro; the matches were analyzed by set, and the following characteristics were recorded: score, type and number of complexes, as well as rally start and end time, for match time to be calculated.

*Match Time Determination*

The recordings allowed obtaining rally length and its intervals, total rally and set times, and actual played time (density %).

Rally time was recorded by setting off the timer of the software right when the serving athlete hit the ball until it was considered to be "out of the game", thus finishing the rally. Total rally time was calculated by summing all rally times in the set. The interval time between rallies was defined by the time between the end of a rally and the start of the next rally. Total interval time between rallies in the set was determined by summing all intervals between the set rallies. The sum of rally times and intervals between rallies in the sets determined the total set time, with times being measured in seconds. Actual in-game ball time during a set was determined by the density % of the set, calculated by the following equation:

$$\textbf{Density \%} = \frac{\textbf{Total Rally Time}}{\textbf{Total Set Time}} \textbf{ x 100}$$

*Number of Actions*

This study considered as action any contact with the ball, be it a technical gesture or not. The number of rally actions was quantified by summing all times the players hit the ball in the rally.

*Characterizing and Quantifying Rally Complexes*

Complex was defined as the opportunity of a team performing up to 3 hits/actions in order to send the ball to the opponent's court, in accordance with official volleyball rules[4]. Complex types were characterized by the number of actions executed in each complex. Complex quantification was determined by summing all complexes performed in the rally (Chart I).

| Complex type characterization | |
|---|---|
| 0 action | Serve only; |
| 1 action | Team performs 1 action to send the ball to the opponent; |
| 2 actions | Team performs 2 actions to send the ball to the opponent; |
| 3 actions | Team performs 3 actions to send the ball to the opponent. |
| **Complex quantification** | |
| 0 Complex | Serve only; |
| 1 Complex | Serve is executed and followed by 1 complex. Chance of team executing the attack sequence (Complex I): serve reception, setting and attack. |
| 2 Complexes | Serve is executed and followed by 2 complexes. Complex I, followed by chance of team counter-attacking (Complex II): block, defense, setting and attack. |
| “n” Complexes | Serve is executed and followed by “n” complexes. Complex I, followed by “n-1” chances of teams counter-attacking (Complex II) |

**Chart 1.** Characterizing and quantifying complexes in the rally
**Source**: The authors

*Statistical Analysis*

Initially, all data were assessed through descriptive statistics and displayed by frequency measures. In bivariate analysis, after the normality test (Kolmogorov-Smirnov), data were analyzed by One-Way Anova for the JEMG categories and complex parameters. The Mann-Whitney test, in its turn, was used for the age and sex main factors in the JEMG, and for sex in HPG. Software Sigma Stat 3.0 (Systat Software Inc.) was employed, and the significance level was set at 5%.

## Results

The present study investigated 114 sets with 4,570 rallies, 10,453 complexes, and 25,528 actions in the JEMG. To characterize rally patterns in HPG matches with the same parameters evaluated and make them a reference for correlation with JEMG matches, two matches played by high-performance teams (one for each sex) were analyzed, with the observation of 10 sets containing 435 rallies, 948 complexes, and 2,411 actions.

Table 1 displays results for rally times, interval times and total set times, set density %, and number of complexes and actions executed per rally. Data were analyzed among categories and the age and sex main factors, then correlated with high-performance game as to the sex factor.

The average interval time among rallies in the JEMG was 19"4, which is 2.5x longer than the average rally length (7"8).

Among JEMG categories, Under14-F showed a smaller number of complexes and actions per rally compared to the other categories. Under14-M presented a shorter interval time between rallies and greater density compared to the other categories.

For the age main effect, rally times, interval times, total set times, and number of actions were greater in Under-17 teams compared to Under-14. As for the sex factor, rally time, density %, and number of complexes and actions were greater in JEMG boy's matches than in girl’s matches, but interval times were shorter. Concerning high performance, rally time, density %, and number of complexes and actions were lower in boy's matches, while interval times were longer.

**Table 1.** Length and intervals between rallies, set density, and number of complexes and actions per rally

| | Rally time | Interval time | Total set time | Density % | Complex per rally | Actions per rally |
|---|---|---|---|---|---|---|
| Total | 7”8±6”8 | 19”4±14”8 | 17’56”4±3’48”6 | 28.8±5.3 | 2.1±2.2 | 5.6±5.1 |
| JEMG categories | | | | | | |
| Under14-F | 6”8±6”2a | 20”5±15”1 a | 16’32”4±0’49”2a | 25.2±4.2a | 1.8±1.9a | 4.5±4.4a |
| Under14-M | 8”1±7”2a | 16”9±14”6 b | 17’52”2±3’33”0a | 32.3±5.1b | 2.3±2.6b | 6.0±5.5b |
| Under17-F | 7”8±7”2a | 20”3±14”6 a | 18’21”6±3’27”0a | 27.6±5.7a | 2.1±2.1c | 5.7±5.2b |
| Under17-M | 8”6±6”6a | 20”3±14”5 a | 19’01”2±3’46”2a | 29.8±3.4a | 2.1±2.0c | 6.1±5.0b |
| | p=0.169 | p<0.001 | p=0.629 | p=0.006 | p<0.001 | p<0.001 |
| JEMG Age Main Factor | | | | | | |
| Under14 | 7”5±6”8 | 18”6±14”9 | 17’12”0±3’53”4 | 28.8±5.9 | 2.1±2.3 | 5.3±5.1 |
| Under17 | 8”2±6”9 | 20”3±14”6 | 18’42”9±3’36”0 | 28.7±4.7 | 2.1±2.1 | 5.9±5.1 |
| | p<0.001 | p<0.001 | p=0.036 | p=0.963 | p=0.458 | p<0.001 |
| JEMG Sex Main Factor | | | | | | |
| Female | 7”3±6”7 | 20”4±14”8 | 17’25”2±3’54”6 | 26.4±5.1 | 1.9±2.0 | 5.1±4.8 |
| Male | 8”3±6”9 | 18”5±14”6 | 18’27”0±3’40”8 | 31.1±4.5 | 2.2±2.3 | 6.0±5.3 |
| | p<0.001 | p<0.001 | p=0.159 | p<0.001 | p<0.001 | p<0.001 |
| High Performance Game | | | | | | |
| Female | 7”4±5”5 | 27”8±15”9 | 23’50”1±5’30”0 | 21.5±2.1 | 2.6±2.2 | 6.8±4.9 |
| Male | 4”4±3”4 | 34”6±19”9 | 29’35”7±2’32”0 | 11.4±0.6 | 1.4±1.3 | 4.4±3.1 |
| | p<0.001 | p<0.001 | p=0.066 | p<0.001 | p<0.001 | p<0.001 |

**Note:** Under14-F: girls up to 14 years old; Under14-M: boys up to 14 years old; Under17-F: girls up to 17 years old; and Under17-M: boys up to 17 years old. Values as Mean±SD. Category means in the same column followed by equal upper-case letters do not differ from each other by Dunn's Test (p<0.05). The Mann-Whitney test identified differences in the JEMG age and sex main factors and between Girl’s and Boy’s High-Performance Volleyball
**Source**: The authors

Results for the frequency of complex types and their respective rally times, interval times, and number of actions are displayed in Figure 1.

Among the 10,453 complexes executed in the JEMG, 1 complex presented the highest occurrence (~31%), with 3.0 actions performed, lasting 4"8. An accumulated frequency of 81.7% was identified for the occurrence of up to three complexes, executed in up to 10"3 and 7.7 actions. Correlating results with HPG, similarities were found in complex characterization, with differences in number of complexes per rally, and non-significant decrease (p>0.05) in rally times for each complex type (Figure 1b).

In the JEMG, as the number of complexes rose, rally time increased on average by 3"0 (1b), and the number of actions rose on average by two (1d). However, the interval time between rallies (1c) remained without significant changes (p>0.05). The same complex characterization was observed in HPG, with rally times rising 2"5 among complex types.

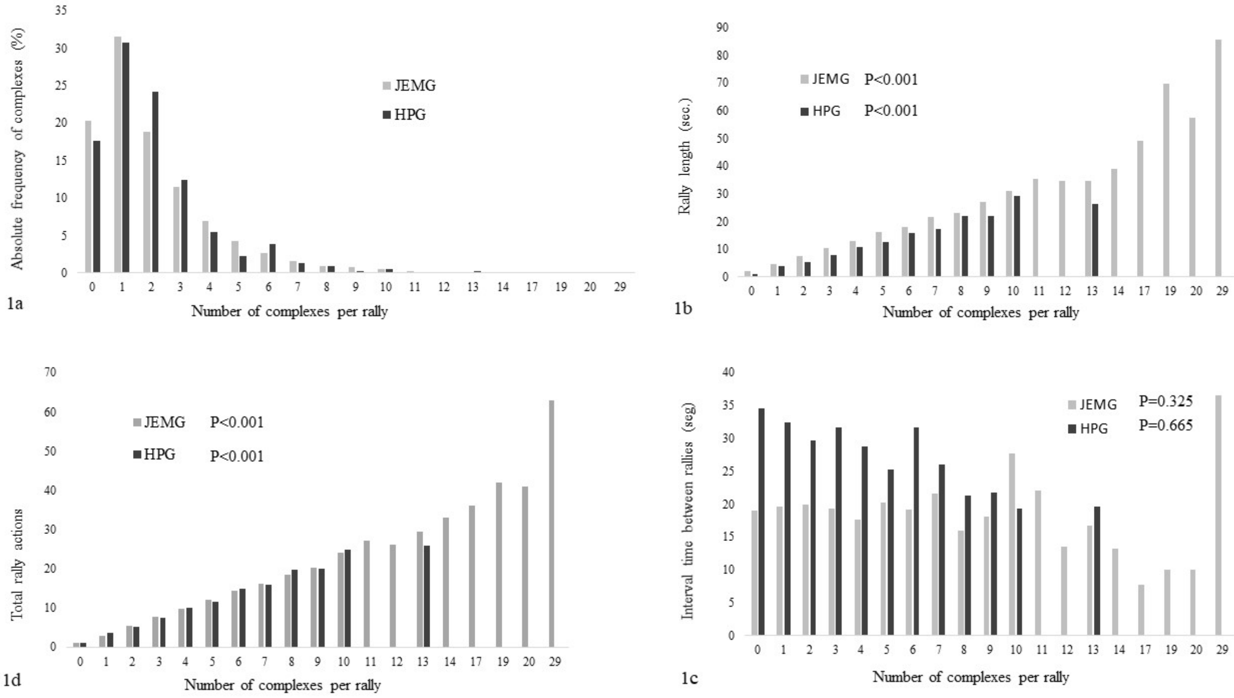


**Figure 1.** Complex quantification per rally (1a), rally length (1b), interval time between rallies (1c) and total rally actions (1d) among competitions

**Note:** JEMG: Minas Gerais' School Games; HPG: High-Performance Game. Values as Means. Significant difference (P<0.05) among numbers of complexes per rally for JEMG and HPG

**Source**: The authors

Figure 2 shows that the rallies in boy's HPG matches occurred with seven complexes at most, with rallies containing "1" complex predominating. As for girl's, occurrence stood at up to thirteen complexes, with rallies containing "1" and "2" complexes predominating.

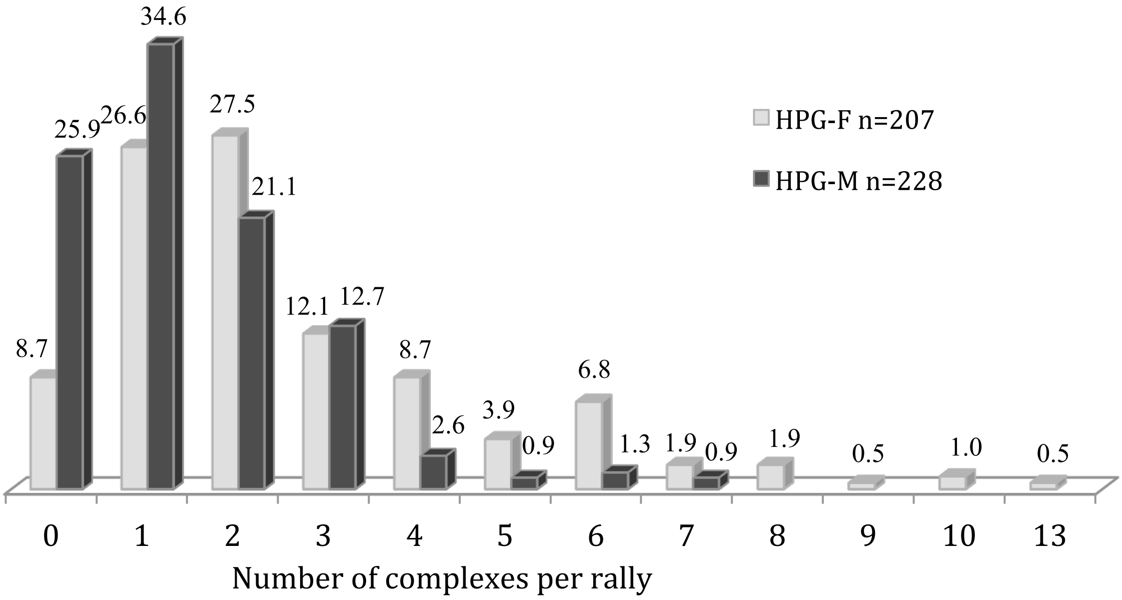


**Figure 2.** Frequency percentage of complexes per rally in HPG

**Note:** HPG-F: Girl's high-performance game; HPG-M: Boy's high-performance game; Values: percentage of absolute frequency

**Source**: The authors

Figure 3 shows that, concerning complex types in the JEMG, complex 3 was the most frequent, while complex 0 was the least frequent one. This behavior was detected in categories Under14-M, Under17-F and Under17-M; however, in Under14-F, complexes 1 and 3 showed similar values.

Among JEMG categories, the frequency of complex 3 rose proportionally from Under14-F, Under14-M and Under17-F to Under17-M, showing a compensating inverse frequency in the other complexes.

For the JEMG age main factor, category Under-17 presented a higher frequency of complex with 3 actions than Under-14 did. Correlating complex frequencies between JEMG and HPG, it is possible to observe that the younger the athlete the higher the frequency of complex 2.

For the sex main factor, JEMG boy's matches presented a higher frequency for complex 3, with Under17-M having complex-3 percentages identical to those of HPG-M and HPG-F, differing in complex 2.

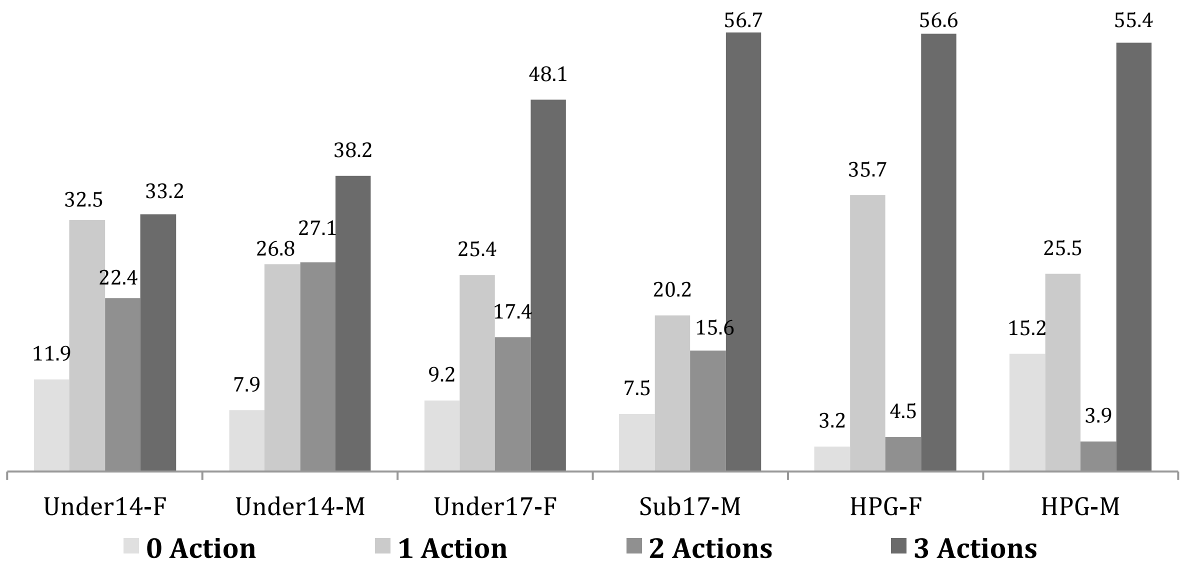


**Figure 3.** Frequency percentage of complex types in rallies by category in the JEMG and HPG

**Note:** Under14-F: girls up to 14 years old; Under14-M: boys up to 14 years old; Under17-F: girls up to 17 years old; Under17-M: boys up to 17 years old (JEMG); HPG-F: Female's High-Performance Game; HPG-M: Male's High-Performance Game. Values as percentages

**Source**: The authors

## Discussion

The main findings of this study indicate that school volleyball is characterized by interval times between rallies 2.5x longer than rally times, which makes it an intermittent sport of similar energy demands compared to elite volleyball. However, school games tend to be denser as to actual play time (28.8%) than high-performance game (Girl's: 21.5%, Males: 11.4%), most likely for presenting longer rally times (JEMG: 7"8 vs. Girl's 7"4, Boy's: 4"4) and shorter interval times (JEMG: 19"4 vs. Girl's: 27"8, Boy's: 34"6). The frequency for number of complexes per rally in school games was similar to that of high-performance matches, especially among females in HPG, as to which school games differ for presenting rallies with more complexes. Under-17 boy's school games have an occurrence of complexes with 3 actions, similarly to male and female high-performance teams, but differ in the other complexes.

The results of this investigation reveal a density % in the JEMG of 28.8%, and interval time between rallies of 19"4, with a proportion 2.5x greater than the length of the rally (7"8). Similar proportions were also found in these JEMG categories: Under14-F (3.0), Under14-M (2.1x), Under17-F (2.6x), and Under17-M (2.4x). In HPG, higher proportions were found for girls (3.8x), due to a longer interval time between rallies, with this proportion being even higher for boys (7.9x), due to shorter rallies. The low play time density in the JEMG ratifies that school volleyball has a game pattern similar to that of high-performance, being an intermittent sport with short high-intensity periods followed by longer low-intensity moments[20,27].

In this study, the average time of exertion during the rally, associated with a recovery time 2.5x longer, indicates the predominance of use of the anaerobic alactic creatine phosphate pathway (ATP-CP) as energetic requirement for rally exertion in the JEMG and HPG[22,23,28]. Moreover, Arruda and Hespanhol[23] report that only 1/3 of the activities executed in volleyball rallies are performed at maximum exertion, and Dantas[29] states that the time of use of this energy pathway can be prolonged by up to 20 seconds, when exertion is submaximal, which better represents the profile of JEMG matches, in which 95.9% of the rallies occurred up to this time (Figure 1). In HPG, 98.2% of the rallies lasted up to 20 seconds, confirming the similarity in energy use between school and high-level volleyball, corroborating with previous reports on elite teams[4,20,24,25].

Analyzing results by the age main factor, it was possible to identify that rally time and its intervals were slightly longer in matches with Under-17 teams compared to Under-14, leading to a longer total set time in Under-17 matches. On the other hand, density % and numbers of complexes did not differ with age, but the number of actions per rally rose in Under-17, suggesting that these teams engaged in more intense rallies for performing a larger number of technical gestures in the same complex. Comparing these aspects with HPG, adult matches show greater intervals and total set times, reducing the density % of the set, which could be influenced by media-related factors, not assessed herein. These findings corroborate with Lopes et al.[19] and Bordini et al.[18], who mention that younger athletes have less motor experience in executing volleyball foundations, which may reduce performance.

The findings on the sex main factor show that, in JEMG boy's matches, the numbers of complexes and actions were higher than those for girls, leading to longer rallies, which, associated with a shorter interval time between rallies, promoted a higher density %. Contradictorily to HPG-M, the numbers of actions and complexes and rally times were smaller than those of HPG-F, leading to longer intervals that reduced match density. Such a difference in the patterns of rally times and complexes among competitions can be attributed to the power of male adult attack being more efficient in winning the rally[7,10], as also seen in Figure 2, with fewer complexes being needed in HPG-M to win the rally. Moreover, two more complexes were executed in HPG-F, confirming that this category executes complex II more often (counter-attacks) due to the inferior power of their attacks[12,17].

Figure 1b shows that the number of complexes during the rally in the JEMG ranged from 0 to 29, and the rally time between 2"3 and 85"6, while in HPG complexes ranged from 0 to 13, with rally times between 1"0 and 26"5, respectively. Figure 2 confirms this difference by showing that, in HPG-M, the maximum number of complexes per rally was seven, against 13 in HPG-F. This reinforces the capacity of a team in the male adult category being more effective in winning the rally[7,14,15,17]. Despite this difference as to age and sex in the competitions, the frequency for complex types and numbers of actions in the rallies was similar. Figure 1 shows the predominance of frequency of "1" complex (~31%) in both competitions, with the teams executing the serve and one complex I, rallies lasting ~4", and three actions performed. This similarity remained until ten complexes, with accumulated frequency of 99.2% of the rallies in the JEMG, and 99.6% in HPG, totaling 24 and 25 actions, respectively, which reveals similarities in frequency as to times, complexes and actions between school and elite teams.

In this study, interval times did not change significantly between rallies with different complex types. The interval time between rallies was longer than the rally time, with a proportion of 2.5x in the JEMG, and 3.8x in HPG-F, and 7.9x in HPG-M (Table 1). This suggests that, regardless of rally length, the recovery time between rallies was sufficient to restore the energy expended in the submaximal or maximal exertion promoted in the rally[23,28,29]. However, a sequence of long rallies, in which interval time was longer than rally time, could impact recovery after physical exertion in the rally and hinder the team's performance in subsequent rallies[4,22], mainly in younger teams with worse physical fitness. However, the incidence of long rallies with lengths greater than their intervals occurred as of the seventh and eighth complexes, and with frequencies of only 2.98% and 1.84% of the analyzed rallies (JEMG and HPG, respectively), suggesting the promotion of an insignificant impact on recovery after exertion.

The characterization of complex types evidenced that, for all categories assessed in this study, the complex with 3 actions was the most frequent (33.2 to 56.6; Figure 3). The predominance of the rally pattern with 3 actions in the JEMG, similarly to HPG, suggests a better technical level of the matches for characterizing that the execution of complex I enables a greater opportunity to win the rally due to the higher performance of settings and attacks[10,12]. Such results corroborate with previous studies on high-level teams[4,10,12] and ratifies the importance of higher frequencies of the complex with 3 actions in male Under-17 matches of the JEMG (56.7%), just as of HPG-M (55.4%) and HPG-F (56.6%).

As for complex frequency in the JEMG, analyzing the sex and age main factors, boy's and Under-17 matches presented higher frequencies of complexes with 3 actions than girl's and Under-14 matches did. This behavior was also observed among categories, as it was shown that the frequency of 3 actions rose progressively from categories Under14-F, Under14-M and Under17-F to Under17-M. These findings are confirmed by other authors who show differences between sexes in volleyball game pattern[7] as for frequency of execution of complexes I and II[17], as well as by Lopes et al.[19], who state that younger athletes may present reduced performance of volleyball foundations due to their inferior motor experience.

In contrast with the predominance of 3 actions, the complexes with 1 and 2 actions had an inversely proportional occurrence from the youngest to the oldest age, and from females to males. In the JEMG matches of category Under14-F, the occurrence of 1 action was equal to that of 3 actions (32.5 vs. 33.2%), evidencing the individuals' lower motor skill to execute volleyball foundations. This behavior decreased progressively from categories Under14-F, Under14-M and Under17-F to Under17-M, ratifying the trend of boy's and Under-17 teams having greater motor skills[12,17-19]. A similar behavior was found in HPG for the complex with 2 actions, which, in this category, could be understood as the setter's tipping actions. However, high rates of complexes with 1 action in HPG was detected, which could be attributed to the greater effectiveness of blocking players in returning the ball to the opponent.

The complex with 0 action, meaning that only the serve was executed, had the lowest frequency in the JEMG (8.9%) and HPG (9.2%; Figure 3). In a trend, girl's matches in the JEMG presented a higher frequency of 0 action compared to boy's matches; 75% of these rallies started with a failed serve, generating points to the opponent. However, in HPG, there was an inversion in the frequency of complex with 0 action between sexes. HPG-F presented 3.2% of 0 action, while HPG-M presented 15.2%, but both showed the same occurrence of failed serves (Fem: 88.9%, and Male: 88.1%). Previous studies report differences between sexes for the type of serve used and game pattern in volleyball[4,8,14]. Sanchez-Moreno et al.[4] argue that, to make serve reception and the performance of complex I more difficult, male teams take greater risks in serving, which allows a higher number of errors. However, both the sexes and the team level showed low ace effectiveness when serving.

This study has the methodological limitations of not comparing JEMG and HPG matches statistically, due to differences in the number of assessed matches, as well as of not qualitatively analyzing the foundations executed in the rally, the influence of their cause and effect on the logic sequence of the rally and of the opponent's complexes I and II on winning the point. It also did not investigate physiological parameters to detect match intensity and, thus, to confirm the predominance of the athletes' energy expenditure. In this context, it suggests the conduction of new researches that address the concentration of blood lactate to ratify volleyball match intensity, as well as to assess the qualitative parameters of the execution of school volleyball and high-performance volleyball foundations, applying technical scout to foundations as well as to offensive and defensive tactical systems, in order to identify where technical differences as to the teams' ages and sexes lie.

## Conclusions

The results of this study reveal that school volleyball has rally patterns that characterize it as an intermittent sport with short-length, high-intensity moments followed by longer resting periods, similarly to elite volleyball. The interval times between rallies were 2.5x longer than the rally times, proving to be enough for recovering the expended energy. This suggests that the periodization of training for school teams should be developed with anaerobic activities of the ATP-CP system as energy source.

Younger and female school teams perform a smaller number of actions of complex I, making the rallies less intense than those of more experienced and male teams. This could be explained by the individuals' inferior motor skills in technical gestures in these categories. Such findings reinforce the need for stimulating the employment of 3 actions for greater chances of winning the rally, as identified in high-level matches.

School volleyball is similar to high-performance game as to rally pattern, to frequency of complex types, and to number of actions. However, both differ when it comes to actual play time, because school volleyball presents longer rally times and shorter intervals, enabling a lower recovery of the energy expended during the match.

Finally, it is concluded that Under17-M school volleyball has more similarities as to rally and complex patterns with high-performance sport.

## References


1. Ciesla E, Dutkiewicz R, Mglosiek M, Nowak-Starz G, Markowska M, Jasinski P, et al. Sports injuries in plus league volleyball players. J Sports Med Phys Fit 2015;55(6):628-38. https://www.ncbi.nlm.nih.gov/pubmed/25369275
2. Fagundes FM, Ribas JFM. A dinâmica do voleibol sob as lentes da praxiologia motriz: Uma análise praxiológica do levantamento. R bras Ci e Mov 2017;25(3):134-149. http://dx.doi.org/10.18511/rbcm.v25i3.7575
3. Jogos Escolares de Minas Gerais (JEMG) [Internet]. Regulamento Geral / 2017. [acesso em: 01 fev 2018]. Disponível em: <http://jogosescolares.esportes.mg.gov.br/documentos/regulamentos-4/>
4. Sánchez-Moreno J, Marcelino R, Mesquita I, Ureña A. Analysis of the rally length as a critical incident of the game in elite male volleyball. Int J Perf Anal Sport 2015;15(2): 620-31. Doi: 10.1080/24748668.2015.11868819
5. Confederação Brasileira de Voleibol (CBV). Regras Oficiais de Voleibol 2017 - 2020. Aprovadas pelo 35º Congresso da FIVB de 2017. Rio de Janeiro: Sprint; 2017.
6. Costa GC, Barbosa RV, Freire AB, Matias CJAS, Greco PJ. Analysis of the structures of side-out with the outcome set in women's volleyball. Motri 2014;10(3):40-9. Doi: 10.6063/motricidade.10(3).2899
7. Costa G, Afonso J, Brant E, Mesquita I. Differences in game patterns between male and female youth volleyball. Kinesiology 2012;4(1):60-6. UDC: 796.325.058-053.6

8. Palao JM, Santos JA, Ureña A. Effect of team level on skill performance in volleyball. Int J Perf Anal Spor 2004;4(2):50-60. Doi: 10.1080 / 24748668.2004.11868304
9. Marcelino R, Mesquita I, Sampaio J, Moraes JC. Estudo dos indicadores de rendimento em voleibol em função do resultado do set. Rev bras Educ Fís Esporte 2010;24(1):69-78. Doi: 10.1590/S1807-55092010000100007
10. Matias CJ, Greco PJ. Análise da organização ofensiva dos levantadores da superliga de voleibol. Rev Bras Ciênc Esporte 2011;33(4):1007-28. Doi: 10.1590 / S0101-32892011000400014
11. Costa GCT, Ceccato JS, Oliveira AS, Evangelista BFB, Castro HOC, Ugrinowitsch H. Men's volleyball hight level: association between game actions on the side-out. J Phys Educ 2016;27(e):2752. Doi: 10.4025/jphyseduc.v27i1.2152
12. Costa GCT, Mesquita I, Greco PJ, Ferreira NN, Moraes JC. Determinants of attack tactics in youth male elite volleyball. Int J Perf Anal Sport 2011;11(1):96-104. Doi: 10.1080/24748668.2011.11868532
13. Haiachi MC, Oliveira BRR, Almeida MB, Santos TM. Indicadores de desempenho no voleibol sentado. J Phys Educ 2014;25(3):335-343. Doi: 10.4025/reveducfis.v25i3.19845
14. Palao J, Manzanares P, Ortega E. Techniques used and efficacy of volleyball skills in relation to gender. Int J Perf Anal Sport 2009;9(2):281-93. Doi: 10.1080/24748668.2009.11868484
15. Lopes EMS, Greco PJ, Matias CJAS. Counter-communication in 1x1 and 1x2 in offensive situations 3rd time: from beginners to high level training in volleyball. Biomotriz 2016;10(2):161-85. (http://revistaeletronica.unicruz.edu.br/index.php/BIOMOTRIZ/article/view/4126/pdf_51)
16. Porath M, Nascimento JV, Milistetd M, Collet C, Salles WN, Quinaud RT. Nível de desempenho técnico-tático e experiência esportiva dos atletas de voleibol das categorias de formação. J Phys Educ 2012;23(4):565-74. Doi: 10.4025/reveducfis.v23.4.16313
17. Bergeles N, Barzouka K, Elissavet N. Performance of male and female setters and attackers on Olympic level volleyball teams. Inter J Perf Anal Sport 2009;9(1):141-8. Doi: 10.1080/24748668.2009.11868470
18. Bordini FL, Costa MA, Medina-Papst J, Ribeiro DA, Okazaki VHA, Marques I. The effect of spatial information occlusion in volleyball spike on defensive decision-making in athletes with different levels of experience. J Phys Educ 2013;24(3):331-43. Doi: 10.4025/reveducfis.v24.3.17006
19. Lopes MC, Magalhães RT, Diniz LBF, Moreira JPA, Albuquerque MR. The influence of technical skills on decision making of novice volleyball players. Rev Bras Cineantropom Desempenho Hum. 2016a; 18(3): 362-70. DOI: http://dx.doi.org/10.5007/1980-0037.2016v18n3p362
20. Freitas VH, Nakamura FY, Andrade FC, Pereira La, Coimbra DR, Bara Filho MG. Pre-competitive physical training and markers of performance, stress and recovery in young volleyball athletes. Rev Bras Cineantropom Desempenho Hum. 2015b;17(1):31-40. Doi: http://dx.doi.org/10.5007/1980-0037.2015v17n1p31
21. Andrade FC, Nogueira RA, Coimbra DR, Dias BM, Freitas VH, Bara Filho MG. Internal training load: perception of volleyball coaches and athletes. Rev Bras Cineantropom Desempenho Hum 2014;16(6):638-47. Doi: http://dx.doi.org/10.5007/1980-0037.2014v16n6p638
22. Marques Junior NK. Periodização específica para o voleibol: atualizando o conteúdo. Rev Bras Prescrição Fisiol Exerc 2014;S2;8(47): 453-84. (http://www.rbpfex.com.br/index.php/rbpfex/article/view/662/616)
23. Arruda M, Hespanhol JE. Fisiologia do voleibol. São Paulo: Phorte, 2008.
24. Haiachi MC, Filho JF. Analysis of jumps and rally in the confrontation between Brazil and Italy in Athens Olympic games. Ação & Movimento 2006;3(1):16-20. (https://pt.scribd.com/document/317792416/Revista-Acao-Movimento-2006)
25. Bissochi MO. Mudanças temporais de esforço e pausa e número de ocorrências de fundamentos em partidas de voleibol entre olimpíadas de 1992 e 2004. Rev Educ Fís Motriz 2005;11(1):S22. https://doi.org/10.5016/85
26. Moraes LCL, Gomes LC, Wruca Junior E, Rojo JR, Silva MM. The profile of scientific production on volleyball in Latin America and Caribbean newspapers. Corpoconsciência 2018;22(2):48-60. (http://periodicoscientificos.ufmt.br/ojs/index.php/corpoconsciencia/article/view/6670/4440)
27. Sheppard JM, Gabbett T, Taylor KL, Dorman J, Lebedew AJ, Borgeaud R. Development of a repeated effort test for elite men's volleyball. Int J Sports Physiol Perform 2007;2:292-304. Doi: doi.org/10.1123/ijspp.2.3.292
28. Bompa T. Periodização: teoria e metodologia do treinamento. São Paulo: Phorte, 2002.
29. Dantas EHM. A prática da preparação física. 5ª ed. Rio de Janeiro: Shape, 2003.

**Aknowledgements**: Authors thanks to FAPEMIG for scholarships, to Southern Minas Gerais' Federal Institute of Education, campus Rio Pomba for research resources and researcher scholarship

Author's **ORCID**:
Otávio Guerson Rodrigues de Angelis: https://orcid.org/ORCID 0000-0001-7273-4001
Wilian dos Santos Bento: https://orcid.org/0000-0002-9734-0751
Isaias Soares da Silva: https://orcid.org/0000-0002-7684-8898
Vinícius Resende de Oliveira: https://orcid.org/0000-0003-1783-5779
Frederico Souzalima Caldoncelli Franco: https://orcid.org/0000-0002-7880-4258

Received Oct, on 03, 2018.
Reviewed on Aug, 13, 2019.
Accepted on Sep, 20, 2019.

**Correspondence address:** Frederico Souzalima Caldoncelli Franco. Av. Dr. José Neves, 500, Centro, Rio Pomba, MG, CEP [Postal code]: 36180-000. E-mail: frederico.franco@ifsudestemg.edu.br