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Exploring the relationship between total vertical jump load and block performance in elite volleyball players: Position-specific analysis

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Abstract

Aim: The study aimed to examine the relationship between total load jumps and negative block performance of elite male volleyball players. **Method:** During the research, 18 elite volleyball athletes were monitored, composed of 7 middle players, 8 spikers, and 3 opposite players. The total vertical jump and block performance of volleyball players were assessed during 23 demo matches completed in routine training sessions. The tracking of vertical jump count was facilitated by employing a vert belt, while the assessment of block performance relied on the application of Data Volley 4 Pro software. The statistical analysis of the data was conducted using the SPSS 22.0 package program for Windows. The Spearman correlation test was applied to assess the relationship between jump load and block performance. **Results:** A negative, weak, and significant relationship was found between vertical jump load and ineffective block (r=-,206; p<0,05) and a weak but insignificant relationship for block error (r=,100; p>0,05) for middle players. A positive, insignificant relationship was found between vertical jump load and block error (r=,007; p>0,05), and a negative, insignificant, for the ineffective block (r=-,079; p>0,05) for spikers. A positive, insignificant relationship between total jump load and ineffective block (r=,054; p>0,05), and block error (r=,027; p>0,05). **Conclusion:** Across all players, the findings suggest that the total jump load is not significantly related to either block errors or ineffective blocks. The positive correlations observed between jump load and both block errors and ineffective blocks are not statistically significant for the entire group.

Keywords: Volleyball; vertical jump load; block error, negative block; elite players.

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Introduction

Volleyball, an intermittent sport, involves brief, intense bouts of movement followed by periods of lower intensity (Vasić et al., 2021). Usual movements include sprints, jumps, hits, and multidirectional shifts. Nevertheless, scoring actions (spike, block, serve) are performed primarily by jumping, and jumping frequency depends on the players' position, aligned with diverse technical-tactical and match-related motor demands (Sheppard et al., 2007; Sheppard et al., 2009). Therefore, the capacity for powerful jumping is pivotal in volleyball performance. A heightened ability to rebound gives players a competitive edge in offensive actions (resulting in elevated block height and attack angle) and an expanded defensive reach (Wang et al., 2020). Numerous instances of research consistently indicate that jumping ability holds notable significance in influencing the outcomes of successes and defeats (Inkinen et al., 2013; Pawlic & Mrozcek, 2023); scoring skills also have a strong correlation with the match results (Laios & Kountouris, 2004). Blocking, as a crucial component of scoring skills, is partially dependent on forceful jumping, and it has been reported to be a determinant of team success. Data from a men's Spanish league demonstrates that for every mistake in receiving a serve, the likelihood of winning diminished by a factor of 0.6, and for each blocked attack, the probability of winning decreased by a factor of 0.7 (Pena et al. 2013). Findings derived from a men's league in Serbia revealed that the efficacy of the blocking action emerged as one of the foremost determinants of success (Majstorovic et al., 2015). Data from the 2010 Senior Men's Volleyball World Championship held in Italy found that two factors directly influence victory: scoring points through serves and blocking errors (Silva et al., 2014). Similarly, Lobietti et al. (2006) determined that, following the attack, the block constituted the second most pivotal skill: the points scored through blocking per set exhibited a strong correlation with the ultimate ranking in the Italian Volleyball Professional League (R=0.74). In order to achieve efficient blocking, players should adopt a technique that minimizes the time taken to reach the ball-contact point, maximizes lateral movement along the net, and incorporates a vertical jump (Lobietti, 2009).

Beyond competitive matches, volleyball athletes encounter substantial weekly instances of jumping during training, with figures exceeding 650 impacts weekly for male participants in school-aged students. At the same time, informal observations indicate these numbers can surpass several thousand for national teams (Bahr & Bahr, 2014). Consequently, a significant requirement arises for the repeated and rapid dispensation of substantial force, mainly focusing on the muscles responsible for extending the lower limb. This situation has the potential to result in chronic fatigue syndrome for the athletes (Lian et al., 2015). Jumping holds significance as a fundamental skill in volleyball, yet recurrent jumping is the primary reason for muscle fatigue (Wang et al., 2020). The fatigue due to vertical jumping can change muscle characteristics, decrease muscle effectiveness, and change the maximum joint torque. A decline in jumping performance could detrimentally affect athletes' capacity to block effectively, potentially leading to unfavorable game results. Reasonably, there may exist a correlation between vertical jump load and performance in blocking. Therefore, this study aimed to analyze the jump load performed by elite-level volleyball players during an entire training season in terms of the player position and investigate the relationship between jump load and block error.

Method

Table 1. Age, height, weight averages, and total jump numbers of the participating athletes

Position	Age ($\bar{x}\pm$sd)	Weight($\bar{x}\pm$sd)	Height($\bar{x}\pm$sd)	Total Jumps
Middle (n=7)	26,7±3,2	201,6 ± 2,7	89,7±8,8	22.421
Spiker (n=8)	24,8±4,3	194,6±2,5	86,5± 4,1	22.288
Opposite (n=3)	25,5±2,3	199,1±2,6	96±3,1	9609

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Jumping Measurements

The athletes were fitted with Vert belts at the end of the warm-up period of the demo competitions and vertical jump data were recorded with the Vert Team System (version 2.0, Mayfonk Inc., Fort Lauderdale, FL, USA) during the competition. The device records jumps above 15 cm (Mahmoud, Othman, Abdelrasoul, Stergiou & Katz, 2015).

Negative Block Technique

Technical analysis of the competitions was performed with Data Voley 4 professional (version 4.02.32 ginius spor, Italy), a volleyball-specific analysis program. Negative statistical data related to block technical performance (-) ineffective block and (=) block error percentages were evaluated. (Silva, Sattler, Lacerda & João, 2016).

Ethics of Research

The necessary approval was obtained from Erzincan Binali Yıldırım University Human Research Health and Sports Sciences Ethics Committee. We acknowledge that the principles recommended in the Declaration of Helsinki for human and animal studies have been followed.

Data Analysis

The normality of the data obtained in the study was tested with the Kolmogorov-Smirnov test and it was determined that the data did not show a normal distribution. In the literature, skewness kurtosis values are also used in normality assumption applications. The value range of -1.5 +1.5 suggested by Tabachnick, Fidell, & Ullman (2013) for kurtosis skewness values was taken into consideration and it was seen that the data were not within this range. Accordingly, the relationship between the average number of jumps by position and negative attack parameters was analyzed using Spearman correlation analysis. The coefficients obtained from the results were evaluated according to Schober, Boer & Schwarte, (2018) (.00-.10: insignificant, .10-.39: weak, .40-.69: moderate, .70-.89: strong, .90-1: very strong).

Results

Table 2. Spearman correlation analysis results for the relationship between total number of jumps and block parameters of middle players

Negative Block Technique		Number of Jump
(-)%: Ineffective block	r	-,206**
	p	**,000**
	n	517
(=)%: Block error	r	,100*
	p	**,023**
	n	517

In Table 2, it was determined that there was a weak negative relationship between the total number of jumps of the athletes and the ineffective block performance (r=-,206; p<0,05) and an insignificant positive relationship between block error (r=,100; p<0,05) and this relationship was statistically significant.

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Table 3. Spearman correlation analysis results for the relationship between total number of jumps and block parameters of spikers

Negative Block Technique		Number of Jump
(-)%:Ineffective block	r	-,079*
	p	**,049**
	n	618
(=)%: Block error	r	,007
	p	,866
	n	620

According to Table 3, although there is a positive and insignificant relationship between the total number of jumps of the spikers and block error (r=,007; p>0,05), this relationship is not statistically significant. There is an insignificant negative relationship with ineffective block (r=-,079; p>0,05) and this relationship is statistically significant.

Table 4. Spearman Correlation Analysis Results for the Relationship Between Total Number of Jumps and Block Parameters of Opposite Players

Negative Block Technique		Number of Jump
(-)%:Ineffective block	r	,054
	p	,398
	n	245
(=)%: Block error	r	,027
	p	,672
	n	245

In Table 4, although there was a positive insignificant relationship between the total number of jumps of the opposite players and ineffective block (r=,054; p>0,05) and a positive insignificant relationship with block error (r=,027; p>0,05), this relationship is not statistically significant.

Discussion and Conclusion

This study was conducted to investigate the relationship between the number of jumps recorded in training matches and ineffective block and block error performance of elite male volleyball players including opposites, spikers and middles. A total of 18 athletes, including 3 opposites, 8 spikers and 7 middles, participated. During 4 training matches, the total number of jumps, ineffective block and block error performances of the athletes were recorded. As a result of the recorded data, it was observed that as the number of jumps of the middle players increased, block errors increased and ineffective blocks decreased. It was determined that the ineffective blocks of the spikers decreased with the increase in the number of spikes, while there was no significant difference in their blok error. There was no significant correlation between the number of jumps and ineffective block and block error of the opposites.

de Leeuw et al. (2022) found that perceived load and fatigue due to training load negatively affect competition performance in volleyball players. Brazo-Sayavera et al. (2017) reported that fatigue increases with increasing number of jumps and decreases block performance in volleyball players. Wnorovski et al. (2013) examined volleyball players individually in competition and reported that there was a decrease in jumping performance throughout the sets, while Lima et al. (2019) reported that there was no difference in jumping performance between sets and that the increase in jumping did not negatively affect block performance. García-de-Alcaraz et al. (2020) and Mori et al. (2020) reported that middle players performed a higher number of jumps in competition than setters and spikers. Similarly, Pinto, Vale & Vicente (2018) stated that middle players have high jumping

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performances, while analyzing the performance data of 24 middle players in 30 competitions, 54.9% of their block performances were ineffective, 14.4% were error and 29.6% were successful. (2015) examined the risk of lower extremity injury by applying jump, block and landing training with 2 different techniques in a laboratory environment with 14 elite volleyball players. As the number of jumps increased, fatigue and unsuccessful block increased. Weakness in landing techniques was observed and it was stated that it may increase the risk of injury, especially the risk of anterior cruciate ligament injury.

It was observed that most of the studies in the literature were on jump height and block performance. The general conclusion of the studies is that volleyball players' jump and block performances differ according to their positions as expected and that block performance increases as jump height increases (Ficklin, Lund & Schipper, 2014; Pawlik & Mroczek, 2023; Sattler et al. 2015; Skazalski, 2018). The other most common study topic related to jumping and blocking is the risk of lower extremity injury. For the general result of these studies, it can be said that jumping and falling technique is important and should be improved, and as the number of jumps increases, it increases the risk of injury, which negatively affects block performance and biomechanics with fatigue (Favre et al. 2016; James, Kelly & Beckman, 2014; Mercado-Palomino et al. 2020; Fatahi & Molahoveizeh, 2021).

A limited number of studies on the number of jumps and negative block performance were found. It is difficult to make a clear interpretation as a result of the studies and this research. Basically, the common results are that position-specific jump count and block performance vary, and that negative block performance is likely to be seen with fatigue as the jump load increases. It is thought that more specific and detailed studies on the subject are needed. Across all players, the findings suggest that the total jump load is not significantly related to either block errors or ineffective blocks. The positive correlations observed between jump load and both block errors and ineffective blocks are not statistically significant for the entire group. In summary, the study indicates that the relationship between total vertical jump load and block performance in elite volleyball players varies depending on player positions. For middle players, a higher jump load is associated with a greater likelihood of ineffective blocks. However, for spikers and overall players, the associations between jump load and block performance are not statistically significant, implying that other factors may play a more prominent role in determining block effectiveness and errors for these groups.

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