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Differences in Jumping Characteristics Between Different Competitions in Volleyball: A Case Report

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Abstract

Jumping performance is a crucial aspect of volleyball. Vertical jumps in volleyball are performed in serving, attacking and blocking the opponent. The higher a player can jump, the greater their potential for success in both defensive and offensive actions. In recent years load monitoring is a hot topic in the sports performance field. The aim of this study was to check differences between jumping characteristics during different competitions in volleyball. Female volleyball player (outside hitter) competing at the elite level (champions league, middle Europe league (MEVZA), domestic league, domestic cup). The player analyzed in this study was the most important and most efficient player of the team. Data was obtained during a total of 29 games, using G-vert technology. Data were analyzed as average jump height and number of jumps per set. Our results showed no differences between the number of jumps per set, nor average jump height between different competitions (Champions league, MEVZA, domestic league, domestic cup) (p=0.36-0.82), opponent level (high, middle, low level) (p=0.30-0.94) and type of competition (domestic vs international) (p=0.24-0.45). Results suggest that jumping characteristics (number of jumps and jump height) depend mainly on players' physical ability and players status in the team and do not significantly differ between different competitions and opponents.

Keywords: *load monitoring, jumping, volleyball, vertical jumping*

Introduction

Success in volleyball is strongly influenced by effectiveness of attacking actions, defensive strategies, and serve reception (Borges et al., 2017). From a physical standpoint, the sport is characterized by frequent execution of short and rapid movements, with a particular emphasis on vertical jumping. Vertical jumping is reported to be one of the most important physical capabilities for successful volleyball performance (Künstlinger et al., 1987). The higher a player can jump, the greater their potential for success in both defensive and offensive actions (Riggs & Sheppard, 2009). Vertical jumps are integral to several key actions in volleyball, including serving, attacking, and blocking (Visnes et al., 2014). During attacks and serves, higher jump heights enable players to strike the ball from a point well above the net, resulting in more favorable attacking angles. Conversely, in blocking, a higher vertical reach enables defenders to further extend their hands over the net, thus reducing the angle of impact of the attacking shots to the opponent.

Jumping characteristics are traditionally evaluated through different forms of vertical jumps (single or double leg, standing or with an approach) with the use of different measurement devices (Sattler et al., 2012). With more analytical approach and systematic testing we can evaluate athletes jumping characteristics, their neuromuscular capacity and physical readiness more precisely, which offer practitioners the opportunity for training optimization (Pleša et al., 2022). Such approach, known also as load monitoring is a hot topic in team sports performance field in recent years (Gielen et al., 2022; Modrić, Toni et al., 2021; Salazar et al., 2025). The concept of load monitoring in volleyball involves tracking both the frequency and height of the jumps, which together constitute jumping load (Lima et al., 2019). The idea of load monitoring is to follow the load during practices and games, to get insight about cumulative load exposure of each individual

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athlete. Monitoring jumping load during training sessions and games provides valuable information about training-induced physical adaptations and physical performance on a game day.

Nevertheless, it is well known that jumping load in volleyball largely depends on playing position and length of the game (number of played sets) (Mori et al., 2022). It is well known that the duration of the game is not predetermined, meaning that the shortest games can last less than an hour if only three sets with high point differences per set are played, while close games can last more than two and a half hours, if five sets with close point differences in each set are played. On the other hand, next to the differences in number of jumps per game, there is also a major difference in jumping intensity between different jump types in volleyball games. Jumping intensity is mainly influenced by jumping execution. For example, attacking and serving jumps are executed with short approach and a strong-arm swing, while block jumps are executed with or without a lateral shuffle and with a short arm swing. On the other hand the jump set is usually done without a running approach and without an arm swing (Lima et al., 2019). As the matter of intensity, it is well known that approach jumps are the most demanding, followed by block jumps and jump set. Although almost all players on the court can perform all the mentioned jumps, there is a big difference in how many times a certain jump type is used by the player at specific playing position. For example, setters on average perform the highest number of jumps, while their jump height is significant lower compared to other playing positions such as outside hitters, opposites and middle blockers (Lima et al., 2019; Sanders et al., 2024; Sheppard et al., 2009), as their main priority is to organize offense (most of their jumps are jump sets), while later mentioned positions try to score the point (most of their jumps are approach jumps and block jumps). Based on this it is important to individualize training and analysis of the players' training loads according to the players' position (Lima et al., 2019).

It is well established that better players are usually able to jump higher and can perform more high intensity jumps than lower ranked players (Harat & Lanesman, 2025). On the other hand, there is no information in the literature regarding the differences in jumping load between different competitions in a single athlete or team. It is traditionally thought that harder competitions are also physically more demanding, which would also suggest the need for different training approaches to prepare for the games. Based on this the purpose of this study was to compare the differences between jumping load (number of jumps and jump height) in a single player between different competitions (i.e. national vs international and between different leagues) and between different opponent rankings. This information could help with training-related decisions to develop more structured and goal-oriented training plans to increase athletes' physical performance on a game day, depending on the competition and opponent they are playing against.

Methods

This was a case-study, on elite female volleyball player, playing at the position of the outside hitter (19 years old; height: 191 cm, weight: 80 kg). The study was completed during the competitive season 2024-2025. The participant in this study was playing in the elite European female volleyball team, competing in multiple competitions in a single season (champions league, middle Europe league (MEVZA), domestic league and domestic cup). The player in this study was the most important and most efficient player on the team. During the season she didn't have any serious musculoskeletal injuries and pain syndromes or any other medical conditions that could be exacerbated with the measurement procedure. She played >90% of all the games of the analyzed season. The player was informed about the details of the protocol and was required to sign an informed consent prior to the beginning of the measurements.

During all games players used G-vert technology (Mayfonk Athletic, LLC), and the data were extracted from the VERT software (app version 2.3.8.20240926; Mayfonk Athletic, LLC, USA). On average she performed 517 jumps per week, with an average jump height of 60.8 cm and maximal jump height measured during the game 68.9 cm. Data for this study was obtained only from the games in which our participant played the whole game (without being substituted at any moment of the game). A total of 29 games were taken for analysis. Data was analyzed as average jump height and number of jumps per set. For the purpose of analysis, the data were categorized into groups based on competition type (Champions League, MEVZA, domestic league, and domestic cup), opponent ranking (classified as high, middle, or low level by three independent experts, with 1 being the best/hardest opponent and 3 being the easiest opponent), game outcome (win or loss), and game length (number of sets played). The opponent ranking was done by three independent experts (head coach, manager and sports director) with the 90 % (26/29) overlap in the ranking decision (all three experts choose the same ranking number for the opponent). For three games one of the experts choosed a different ranking than the other two (one ranking higher than the other two). In this case we rank this opponent with the lower ranking, as suggested by majority of the expert group.

Statistics

The data are presented as means ± standard deviations. The normality of the data distribution for all variables was verified with Shapiro-Wilk test. A one-way ANOVA with post-hoc test was used to determine the differences in jumping characteristics between competitions, opponent rankings and different game lengths (3 set game, 4 set game and 5 set game). Furthermore, post-hoc testing was done with a Bonferroni correction to measure statistical differences between groups. The independent t-test was used to check differences in jumping characteristics between national and international competitions and between game outcomes (win or lose). Additionally, for statistically significant effects of one-way ANOVAs and t-tests, partial η2 and Cohen's d were also calculated as measures of effect size. Values of η^2 were interpreted as follows: no effect (<0.01), small effect (0.01-0.039), a medium effect (0.06-0.14) and a large effect (>0.14), whereas the effect sizes according to Cohen's d were considered as trivial (<0.2), small (0.2-0.5), medium (0.5-0.8) and large (>0.8) (Cohen, 2013). The threshold for statistical significance was set at $\alpha<0.05$ and all analyses were carried out in SPSS statistical software (version 25.0, CJ278ML, IBM, USA).

Results

Differences in jumping characteristics between different competitions and opponent rankings are shown in table 1.

Table 1. Differences in jumping characteristics between different competitions and opponent rankings

	Competitions (Mean ± SD)				Opponent ranking (Mean ± SD)		
	Champions league	MEVZA	Domestic league	Domestic cup	1st	2nd	3rd
Jump count	112.8±11.8	119.5±20.2	103.7±16.5	105.8±22.0	114.3±16.1	109.6±18.1	95.1±10.6
Max game jump height	69.3±1.6	69.1±1.9	68.6±2.2	71.4±2.9	69.3±1.2	69.4±3.5	68.9±1.6
Average game jump height	62.4±1.1	62.1±1.4	61.2±2.4	62.0±2.0	61.7±2.3	61.5±1.8	61.9±2.1
Jumps per set	33.2±5.4	32.1±5.4	31.0±5.0	32.4±3.1	33.3±4.1	30.1±6.0	31.7±3.5
Sets played	3.5±0.84	3.75±0.50	3.4±0.63	3.3±0.5	3.5±0.8	3.7±0.5	3.0±0.0

Results of one-way ANOVA show no statistically significant differences in jumping characteristics between different competitions (F=0.303-1.126; p=0.357-0.823; η^2=0.035-0.119), nor between opponent rankings (F=0.067-3.300; p=0.053-0.936; η^2=0.005-0.203).

When comparing jumping characteristics between competition type (international vs national) and between game outcomes, results showed no differences between competition types (t=0.766-1.773; p=0.088-0.450; d=0.29-0.69) neither between game outcome (t=-1.299-(-0.444); p=0.205-0.660; d=0.17-0.54). Furthermore, when analyzed jump characteristics from the perspective of game length (sets played) results indicate significant differences in total jump count (F=6.575; p=0.005; η^2=0.336) and jumps per set (F=6.575; p=0.005; η^2=0.336), but not in average jump height (F=1.009; p=0.378; η^2=0.072). Additionally post-hoc analysis revealed significant differences in jump count between 3 set and 5 set game (mean difference =35.3; CI95%=7.8-62.8; p=0.009) and between 3 set and 4 set games in jumps per set (mean difference =5.4; CI95%=1.1-9.6; p=0.009). Differences between competition type, game outocmes and game length are shown in table 2.

Table 2. Differences between competition type, game result and game length

	Competition type		Game result		Sets played		
	International	National	Win	Lose	3	4	5
Jump count	115.5±15.0	104.1±17.1	105.5±16.8	114.6±17.0	101.7±10.2*	114.2±21.0	137.0±11.3*
Average game jump height	62.3±1.2	61.3±2.3	61.4±2.3	62.4±0.9	61.3±2.4	62.5±1.1	61.4±0.9
Jumps per set	32.7±5.1	31.3±4.6	31.6±4.8	32.4±4.8	33.9±3.4*	28.6±5.2*	27.4±2.3

*Statistically significant difference (p<0.05)

Discussion

This study investigated whether jumping characteristics measured with G-vert device differ with competition level, opponent ranking, match outcome, and game length in an elite female volleyball player. Contrary to initial expectations, no significant differences were found across different competitions (Champions League, MEVZA, domestic league, domestic cup), competition types (national vs international) and opponent ranking. Notably, only game length influenced the total jump count, with five-set games eliciting significantly greater loads than three-set games. These findings are in contrast with the traditional assumption that international or higher-level competitions impose increased physical demands for individual players. It seems that jumping load is primarily determined by player's role, physical capabilities and duration of the game, rather than the competition's prestige or opponent quality.

Contrast to the hypothesized international competitions such as the Champions League do not impose greater physical demands on athletes compared to domestic leagues or cups. However, the data from this case study indicate that for this elite outside hitter, jump count and jump height remained stable regardless of the competition level or the strength of the opponent. This suggests that physical load, at least in terms of jumping demands, is not necessarily escalated by facing stronger opponents or competing on bigger stages. It is possible that tactical game strategies and consistent playing time ensured a stable workload across matches. Additionally, it must be mentioned that this is a professional player playing in a professional team, which means that the nature of her job is to win games, meaning that the results might be different if a lower-level player had taken part in this study. Similar results were found in other team sports (Salazar et al., 2024) as it was found that there are no major differences in load demands between different competition levels in basketball. Interestingly study on football players showed significant differences in load demands between teams from different competition levels on each day of the week, except for the match day (Coutinho et al., 2024). Based on these results it seems that load demands in team sports are primarily determined by sport itself (type and size of the field, number of players, rules, etc.), while competition level or opponent itself does not change its demands significantly. The main differences between competition levels are likely physical and cognitive abilities of the players, such as sprint speed or jump height (Castellano & Casamichana, 2015; Harat & Lanesman, 2025; Palao et al., 2014) and decision making (Ehmann et al., 2022), but not the whole game load demands per see. Better players seem to take advantage of their abilities at certain parts of the game, while the overall load through a longer time period (whole game) stays approximately the same. These findings indicate that load monitoring may be important primary to help with training-related decisions to distribute load through micro-, mezzo- and macro-cycle to achieve the best physical performance at the right time and avoid major health issues (Sousa et al., 2023), while additional diagnostics should be

performed to get deeper insight about individual's physical potential to be competitive at certain competition level.

Regarding jumping characteristics in relation to game outcome, our results showed no significant differences between games that ended in a win versus those that ended in a loss. This finding implies that the jumping demands placed on the player are relatively consistent regardless of the game outcome and on the other hand that the negative outcome of the game was probably not due to lower physical effort. Additionally, as assumed load demands alone cannot explain the game outcome, as success in team sports is multifactorial (Salcinovic et al., 2022).

The study also revealed that game length, measured by the number of sets played, significantly influenced the total jump count, with longer games (four or five sets) resulting in higher jump loads compared to shorter, three-set games. This finding is intuitive, as extended game duration naturally provides more opportunities for jumping actions. However, average jump height remained consistent across game lengths, indicating that the athlete was able to sustain physical performance even during longer, more physically demanding situations. This results are in line with previous research reporting no differences in the heights of jumps between the sets of the games in elite male volleyball players (Lima et al., 2019). These results are somehow expected as elite athletes demonstrated resilience to neuromuscular fatigue during prolonged physical efforts (Charlton et al., 2017; Pawlik & Mroczek, 2022). Practically, these results underscore the importance of considering game duration when planning training loads and recovery protocols, as longer games impose greater cumulative physical demands on players regardless of competition level or opponent strength.

It has to be mentioned that this was a case study performed on outside hitter, meaning that these results cannot be generalized to different playing positions as the difference in jumping load is to some extent also determined by the nature of each playing position. Previous research found that middle blockers and opposites exhibit consistently higher jump loads (combination of jump height and number of jumps) than outside hitters, while setters perform the most jumps, but in lower intensity (Mori et al., 2022). The reason for such results is that opposites are usually the best scorers of the team, meaning that they also get to attack more often than players in other positions. On the other hand, outside hitters have an additional task of receiving the serve and are usually a bit shorter height, which means that they need higher physical effort when trying to score a point by spiking the ball in attacking situations. Future research is desired to expand to multiple athletes across positions and teams to get better insight about volleyball load demands across different competitions. Additionally, it would be valuable for future research to conduct separate analyses of jump intensity based on jump types (approach jump, block jump, and jump set), as the jump height differs among these types. This differentiation could allow for the use of specific intensity thresholds, thereby providing more precise information on individual's training loads and more detailed insights into the physical demands of volleyball-specific movements.

Conclusion

This case study demonstrated that in an elite female outside hitter jumping characteristics such as number of jumps and average jump height remain consistent across different volleyball competitions, opponent levels and game outcomes. The only factor significantly affecting jump load was game length, with longer games eliciting greater total jump counts. These findings suggest that jump load is predominantly influenced by the player's role, physical abilities, and game duration rather than the level or prestige of the competition.

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Conflict of interest
The authors declare that there is no conflict of interest.

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