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ORIGINAL ARTICLE

Mechanical differences between three block jump approaches in NCAA DII college volleyball players

Djuly Schmorantz . *Barry University. Miami, United States of America.*
Tal Amasay. *Barry University. Miami, United States of America.*
Nataniel Boiangin. *Barry University. Miami, United States of America.*
Claire Egret. *Barry University. Miami, United States of America.*

ABSTRACT

The purpose of the study was to examine the kinematics and kinetics differences between three common block approaches used in volleyball games: (1) shuffle block, (2) chicken wing block, and (3) swing block, from a fixed distance of 1.8 m. Ten female collegiate volleyball players from NCAA DII participated in the study. They performed, in a randomized order, a total of 18 blocks equally distributed among the three block types. Noraxon MyoResearch 3 software was used to analyze the block approaches. The statistical analysis was performed by running a Repeated Measurement ANOVA on Jamovi statistical software 2.3.24. The results showed that there was a significant main effect for time to take off, jump height, max knee flexion angles, peak power, relative peak power, net impulse, reactive strength index, max rate of force development, peak force, and relative peak force between the three types of blocks ($p < .05$). While max valgus knee angles and max flexion hip angles did not show any effect ($p > .5$). To cover a distance of 1.8m, it was clear that shuffle block was the weakest option for good block performances, while chicken wing and swing blocks were similar in many aspects. Both chicken wing and swing blocks can be used to elevate the block effectiveness of volleyball players compared to shuffle block.
Keywords: Performance analysis, Kinematics, Kinetics, Effectiveness, Shuffle block, Chicken wing block, Swing block.

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Corresponding author. *Barry University. Miami, United States of America.*
E-mail: djuly.schmorantz@mymail.barry.edu
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INTRODUCTION

One of the most difficult skills to be performed in volleyball is the blocking skill (Patsiaouras et al., 2011). There are various approaches to executing a block in volleyball, with the primary intention of intercepting the opposite team's attack, or dampening (i.e., slowing down) the attack of the opposing team (Alexander, 2012). The action of blocking is a defensive technique that involves a lot of tactics and game reading ability (Patsiaouras et al., 2011). The demand for physical excellence, as well as talent in volleyball has been increasingly sought after, making attacks and jump serve become even more aggressive. Consequently, the execution of these offensive skills has also dramatically increased the importance of the block during game (Braakhuis, 2016).

The main pattern of movement that drives the athlete's success in block skill is the ability to jump (Gollhofer and Bruhn, 2003). Jump movement is a multi-joint action which requires coordination of both lower limbs and upper limbs, summating forces to produce the desired movement outcomes (Mosier et al., 2019). High-performance volleyball athletes, who shows advanced physical development, typically have great vertical jump capacity; thus, being able to penetrate the net with their arms and cover a sufficient area to block the attack and score directly with this movement (Cabarkapa et al., 2020).

Researchers have been trying to identify which volleyball block approach is more effective and in which scenario; however, as the blocking action is an open skill, where external factors influence performance and different approaches can be used, the results are still very abstract (Lobietti, 2009). The success of a block depends on positioning, timing, and movement. In other words, the current description for the most effective block is one that is executed with the following criteria: the right lateral displacement in the shortest time, timing of a fast jump, the right height, great arm penetration, and hand angulation (Lobietti, 2009). On the other hand, the efficiency of blocking is still low (Scates, 1972, as cited in Buekers, 1991). For instance, one of the factors why blocks have low efficiency is because blocking requires a high demand of decision-making ability; thus, making it harder to master this skill in a short timeline (Buekers, 1991). Coaches at the higher volleyball levels cannot wait for the athletes to gain experience. Therefore, to solve this dilemma, of developing "*game reading skill*" ability more efficiently, coaches prepare their teams by organizing techniques to achieve the ideal blocking style (Patsiaouras at el, 2011).

A fast lateral approach is a key factor for block effectiveness. For effective lateral movement analysis, Buekers (1991), analyzed players' approaches moving from the middle of the court to the side of the court (3 m distance) focusing on the timing of feet movement and hands arriving over the net. According to Buekers (1991), who looked at female players from first and second Belgium national league, the fastest approach for a lateral displacement was the running step (crossover approach, mean time of 1,899 ms), and the one that took the longer time was the slide step (shuffle approach, mean time of 2,013 ms). Buekers (1991) suggested that the technique used must vary according to the distance the player must cover when blocking. Specifically, the slide step is more effective if the player must cover short distances (less than 1.8 m) as the player can keep the body facing the net consuming less time to block. While in longer distances (more than 1.8 m) the most recommended block approach is the crossover approach.

When evaluating arm movement effectiveness in blocking, it was found that the arms motion affected the speed of the previously mentioned lateral movement footwork, as well as the jump height performance (Neves et al., 2011). For instance, Neves and colleagues (2011) compared three arms movement techniques with the crossover step. Traditional block keeping a stationary arm position with hands about shoulder level, chicken wing block keeping elbows on 90° while making the arms swing movement, and swing block with a typical counter-jump motion with elbows extended during the swing. It was found that the traditional block did not produce any advantages, while the other two techniques produced different advantages. The chicken wing block technique produced quicker takeoff movement and hands over the net, while the swing block technique resulted in a higher jump capacity and greater arm penetration (Neves et al., 2011). Even with these findings, there is still lack of clarification of the effectiveness of combining arms motion and footwork approaches within the same distance. More research is needed comparing the mechanical components of the different approaches used within the same lateral displacement.

The purpose of the study was to examine the kinematics and kinetics differences between three common block approaches used in volleyball games: (1) shuffle block, (2) chicken wing block, and (3) swing block, from a fixed distance of 1.8 m. A combination of two footwork approaches and three arms motions were investigated. The different footwork approaches were crossover (chicken wing and swing blocks), and lateral shuffle steps (shuffle block) and the arms motions were stationary arms (shuffle), arms swing with elbows flexed at 90 degrees (chicken wing), and arms swing with full elbows extension (swing).

MATERIAL AND METHODS

Participants

Ten female NCAA DII collegiate level participated in the study (mean ± SD); age 21.8 ± 1.9 years; height 179.0 ± 5.0 cm; body mass 72.2 ± 7.6 kg; body fat percentage 22.3 ± 3.2%; playing experience 10.5 ± 2.8 years, see Table 1. The study was approved by the IRB of the University and all participants signed a consent form before participating in the study. Once consent was acquired, participants were asked to fill out a brief demographic questionnaire. The questionnaire included questions about previous injuries to the lower and upper body for the past year that could compromise performance of any type of block jump, their experience background in competitive volleyball, and strength and conditioning training experience. Inclusion criteria included being an NCAA DII college player with a minimum of four years of volleyball experience and at least one year at college level.

Table 1. Demographic information.

	Age	Height (m)	Weight (kg)	Body Fat %	Years of Experience
N	10	10	10	10	10
Mean	21.80	1.79	72.21	22.31	10.50
Median	21.00	1.78	71.75	23.05	10.00
Standard deviation	1.87	0.05	7.55	3.19	2.80
Minimum	19	1.73	56.40	15.90	7
Maximum	25	1.88	82.60	26.20	16

Measures

Kinematic data were collected using eight Noraxon MyoMotion inertial measurement units (IMUs) (Noraxon MyoMotion, Noraxon USA Inc.), and kinetic data were collected using two AMTI force plates (Boston, MA, USA), and variables were calculated using the MyoForce software (Noraxon MyoForce, MyoForce USA Inc). The sensors were placed on the participant lower body symmetrically based on Noraxon lower body model. The sensors placement location was on the feet (upper foot slightly below the ankle), shanks (front and slightly medial area along the tibia), thighs (frontal and distal portion), pelvic (body area of sacrum), and the last one on upper thoracic (right below C7, in line with spine column). The data analysis was done using the MyoResearch system using Noraxon MyoResearch 3 software (Noraxon MR3 3.20.08).

Procedures

Warm Up: Once all forms were completed, eligible participants' height, weight, and % body fat were collected before the actual data collection session. Subsequently, participants started with five minutes of general warm-up on a cycle ergometer at a pace of 50 RPM and 1 Kp resistance, followed by five minutes of specific dynamic warm-up for lower body. The specific dynamic warm-up included one set of 10 repetitions of high knees, butt kicks, squats, side lunges (five each side), high knees, and power skip. After the warm-up, the participants were instructed about the desired movements for each jump block approach, and they finished by practicing the three different block jump approaches, at least two trials of each block type for both directions (left and right), with a total of 12 jumps. Participants had at least 5 min rest before the data collection.

Block Jump Session: Athletes performed three trials of each block jump approach from each direction, for a total of 18 block jumps. After each jump the participant had at least 30 s rest interval and at least 2 min break between block jump type and direction, to prevent fatigue effects between jumps. The order of the blocks type and direction were randomized. The block types were shuffle block, chicken wing block, and swing block. The shuffle block is a side steps with toes pointing towards the net the whole time, hand at shoulder level, and no arms swing at all. In the chicken wing block the participant started first by lateral stepping with the leg of the same direction of the movement, foot parallel to the net, then second step crossing the other leg, and finishing the third step in a base with feet facing the net at shoulder width apart, there is an arm swing, but elbows kept flexed at 90° max. The swing block has the same footwork as the chicken wing block, but with arms extended during the arms swing motion. All three movements ended with vertically jumping and extending arms overhead touching the target (ball). The participant started 1.8 m to the right and to the left of the two AMTI force plates. The players started in a ready position to block (feet shoulder width apart, bent knees, and palms facing forward at shoulder level). The participants were instructed on the side and the type of block they would perform before each trial. When the participant was ready to start the test, the researcher instructed the participant to touch the ball with both hands, simulating a block, as fast as possible through a verbal command of 'ready, go'. If the participant did not perform the correct blocking technique the participant had to repeat the trial. The criteria for trial success were (i) not crossing legs during lateral movement on shuffle block type, (ii) keeping hands at hip level or upper the hip on chicken wing block, and (iii) fully elbow extension when hands are down and going behind the back during the swing block (iv) jumping from and landing on the force plates(v) participants had to touch the ball with both hands. Target was set at specific height and distance from the force plate to simulates a real blocking situation, at a vertical distance of 2.34 m and anterior distance of 40 cm, from the force plates. The target height location was estimated based on the net height which is 2.24 m plus the center of volleyball height which 10 cm the horizontal distance of the target was based on the estimated distance of the player from the net which is 20 cm plus 20 cm for forearm overall penetration over the net. Testing was completed once 18 successful trials were obtained.

Data reduction and analysis

The independent variable was block approach type. The dependent variables for this study were shortest time to takeoff, jump height, max knee valgus angle, max knee and hip flexion angles, peak power, relative peak power, peak force, relative peak force, net impulse (NI), reactive strength index (RSI), and max rate of force development. The best of three jump trials, meaning the fastest time to takeoff of each block type and direction was selected for further analysis. Vertical jump height and RSI for all blocks approaches were derived from net impulse. The time to take off was identified from the instant of the 'go' command and the moment in which the player's feet left the force plates. For peak power and angles variables, the 'loading leg' (the first one touching the force plate in each approach) was chosen for the analysis. The angles were calculated based on the maximum change in angular position, with respect to the participant calibration position.

Descriptive statistics (mean ± SD) were calculated for each variable observed in this study. Repeated measure analysis of variance (ANOVA) was used to determine variations between the three different approaches followed by Post Hoc Pairwise Comparisons using Tukey test correction. Mauchly's test of sphericity was used to test whether variances of differences between conditions are equal or not. The significance was set a priori to $p < .05$ and confidence-interval of 95%, using Jamovi statistical software (version 2.3.24).

RESULTS

A randomized block of repeated measures ANOVAs revealed significant main effects between the three different approaches in three kinematics variables ($p < .01$) and all kinetics variables ($p < .01$).

Kinematics variables

Time to Take Off (s): There was a significant main effect in time to take off between the three block jump approaches, ($F_{2,38} = 7.46$, $p = .002$, $\eta^2 = 0.14$). Tukey Test revealed shuffle block was significant slower than swing block by 0.09s and chicken wing block by 0.12s, $p < .05$. No significant difference was found between 'chicken wing' and 'swing' approaches, $p > .05$. See Table 2.

Jump Height (cm): There was a significant main effect in jump height variable between the three block jump approaches, ($F_{2,38} = 9.5$, $p < .001$, $\eta^2 = 0.15$). Tukey Test revealed chicken wing block jump height was significantly higher than shuffle block jump height by 2.8cm, $p < .05$. Swing block jump height was also higher than shuffle block by 3.3cm, $p < .001$. No significant difference was found in the jump height between chicken wing and swing blocks, $p > .05$. See Table 2.

Table 2. Kinematic variables.

	Shuffle Block	**Chicken Wing Block**	**Swing Block**
Time to Take off (s)	1.73 ± 0.03	1.61 ± 0.03	1.64 ± 0.03
Jump Height (cm)	25.43 ± 0.86	28.21 ± 0.78	28.73 ± 0.68

Note: mean ± standard deviation.

Max Flexion Knee Angle (degree): There was a significant main effect in max knee flexion angle between the three block jump approaches, ($F_{2,38} = 36.85$, $p < .001$, $\eta^2 = 0.38$). Tukey Test revealed that chicken wing block max knee flexion angle (72.26 ± 1.34°) was significantly higher than shuffle block max knee flexion angle (62.11 ± 1.13°), $p < .001$. Chicken Wing block max knee flexion angle was significantly higher than swing block max knee flexion angle (68.64 ± 1.24°), $p < .001$. Swing block max knee flexion angle was significantly higher than shuffle block max knee flexion angle, $p < .001$. See Figure 1.

Max Valgus Knee Angles (°): There was no significant main effect in max valgus knee angle between the three block jump approaches, ($F_{2,38} = 2.81$, $p = .07$, $\eta^2 = 0.04$). The average means of shuffle block approach was 11.91 ± 1.8°, chicken wing block 15.65 ± 2.04°, and swing block 15.19 ± 1.72°. See Figure 1.

Max Flexion Hip Angle (degree): There was no significant main effect in max hip flexion angle between the three block jump approaches, ($F_{2,38} = 0.5$, $p = .6$, $\eta^2 = 0.01$). The average means of shuffle block approach was 65.43 ± 1.5°, chicken wing block 66.04 ± 2.17°, and swing block 63.89 ± 1.72°. See Figure 1.

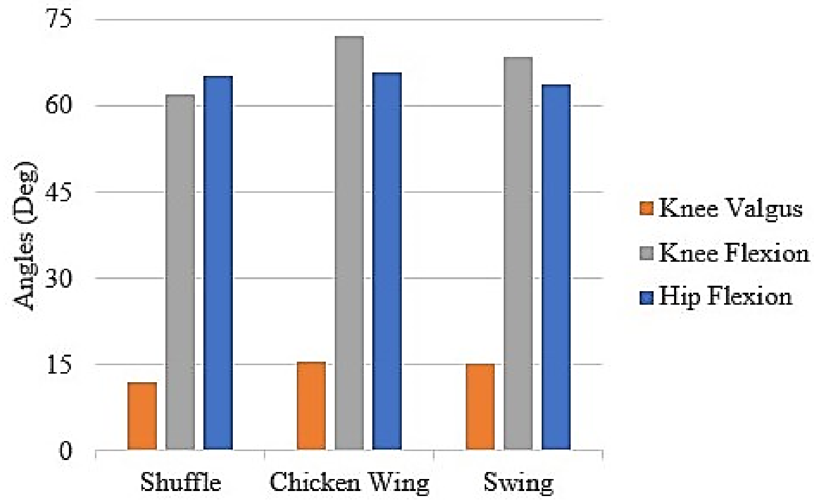

Figure 1. Max angles.

Kinetics variables

Peak Power (W): There was a significant main effect in peak power between the three block jump approaches, ($F_{2,38} = 23.82$, $p < .001$, $\eta^2 = 0.12$). Tukey Test revealed that chicken wing block peak power (4026.50 ± 164.52 W) was significantly higher than shuffle block peak power (3578.76 ± 124.81 W), $p < .001$. Swing block peak power (4148.57 ± 154.93W) was significantly higher than shuffle block peak power, $p < .001$. There was no significant difference between chicken wing and swing block approaches, $p > .05$. See Table 3.

Relative Peak Power (Watt/kg): There was a significant main affect in relative peak power between the three block jump approaches, (F2,38 = 18.89, $p < .001$, $\eta^2 = 0.21$). Chicken wing block relative peak power was significantly higher than shuffle block relative peak power (54.08 ± 1.55 W, and 48.59 ± 1.14 W respectively), $p < .01$. Swing block relative peak power (55.83 ± 1.37 W) was significantly higher than shuffle block relative peak power, $p < .001$. There was no significant difference between chicken wing and swing block approaches, $p > .05$. See Table 3.

Net Impulse (Ns): There was a significant main effect for net impulse between the three block jump approaches, ($F_{2,38} = 9.10$, $p < .001$, $\eta^2 = 0.05$). Chicken wing block net impulse was significantly higher than shuffle block net impulse (174.32 ± 4.67 Ns, and 165.63 ± 5.14 Ns respectively), $p < .05$. Swing block net impulse (175.45 ± 3.94 Ns) was significantly higher than shuffle block net impulse, with $p < .001$. There was no significant difference in net impulse between chicken wing and swing approaches, $p > .05$. See Table 3.

Reactive Strength Index (m/s): There was a significant main effect for reactive strength index between the three block jump approaches, ($F_{2,38} = 9.96$, $p < .001$, $\eta^2 = 0.15$). Chicken wing block reactive strength index was significantly higher than shuffle block reactive strength index (0.6 ± 0.02 m/s, and 0.52 ± 0.02 m/s respectively), $p < .01$. Swing block reactive strength index (0.6 ± 0.02 m/s) was significantly higher than shuffle block reactive strength index, $p < .001$. There was no significant difference in RSI between chicken wing and swing approaches, $p > .05$. See Table 3.

Max Rate of Force Development (N/s): There was a significant main effect for max rate force development between the three block jump approaches, ($F_{2,38} = 12.74$, $p < .001$, $\eta^2 = 0.22$). Tukey Test revealed that chicken wing block max rate of force development (37994.15 ± 2190.95 N/s) was significantly higher than shuffle block max rate of force development (26121.35 ± 1611.65 N/s), with $p < .001$. Swing block max rate of force development (34955.15 ± 2666.52 N/s) was significantly higher than shuffle block max rate of force development, with $p < .01$. There was no significant difference in max rate of force development between chicken wing and swing approaches, $p > .05$. See Table 3.

Peak Force (N): There was a significant main effect of peak force between the three block jump approaches, ($F_{2,38} = 8.62$, $p < .001$, $η^2 = 0.13$). Shuffle block peak force (1227.45 ± 40.03 N) was significantly higher than chicken wing block peak force (1082.58 ± 47.31 N), with $p < .05$. Shuffle block peak force was significantly higher than swing block peak force (1073.52 ± 39.02 N), $p < .01$. There was no significant difference in peak force between chicken wing and swing approaches, $p > .05$. See Table 3.

Relative Peak Force (BW): There was a significant main effect for relative peak force between the three block jump approaches, ($F_{2,38} = 7.61$, $p < .002$, $η^2 = 0.19$). Shuffle block relative peak force was significantly higher than relative chicken wing block peak force (1.68 ± 0.05, and 1.49 ± 0.05 BW respectively), $p < .05$. Shuffle block relative peak force is significantly higher than relative swing block peak force (1.47 ± 0.04 BW), $p < .01$. There was no significant difference in relative peak force between chicken wing and swing approaches, $p > .05$. See Table 3.

Table 3. Kinetic variables.

	Shuffle Block	**Chicken Wing Block**	**Swing Block**
Peak Power (W)	3578.76 ± 124.81	4026.50 ± 164.52	4148.57 ± 154.93
Relative Peak Power (Watt/kg)	48.59 ± 1.14	54.08 ± 1.55	55.83 ± 1.37
Net Impulse (Ns)	165.63 ± 5.14	174.32 ± 4.67	175.45 ± 3.94
Reactive Strength Index (m/s)	0.52 ± 0.02	0.60 ± 0.02	0.60 ± 0.02
Max Rate of Force Development (N/s)	26121.35 ± 1611.65	37994.15 ± 2190.95	34995 ± 2666.52
Peak Force (N)	1227.45 ± 40.03	1082.58 ± 47.31	1073.52 ± 39.02
Relative Peak Force (BW)	1.68 ± 0.05	1.49 ± 0.05	1.47 ± 0.04

Note: mean ± standard deviation.

DISCUSSION

The aims of the study were to investigate differences of kinematics and kinetics variables in three volleyball blocks techniques within the same lateral displacement distance: shuffle block, chicken wing block, and swing block. Our first null hypothesis was that there are no differences in kinematics variables between the three blocks techniques. This null hypothesis was rejected. Overall, chicken wing and swing block produced faster time to take off and higher vertical jump than shuffle block, when covering 1.8 m horizontal distance on a volleyball court.

In terms of effectiveness, the best block approach is the one with the fastest lateral approach, with the highest jump, and greatest hands penetration over the net (Linebach, 2014). The fastest approaches were the chicken wing block (1.61s), and the swing block (1.63s), and both were significantly faster than the shuffle block (1.73s), that utilize lateral steps. The findings of this study were similar to the findings in Buekers (1991), who stated that that the fastest block jump was using a crossover step (i.e., swing and chicken wing block types), while the slowest one was using lateral steps (i.e., shuffle block type). Neves et al. (2011) found that chicken wing block presented significant faster take off time than swing block. Our study did find that time to take off was faster in chicken wing block than in swing block, although not significant. These differences may be related to our small sample size (10 participants). On the other hand, Dona et al. (2006) found no significant differences in approach time between shuffle and crossover steps approaches, but those results also can be related to her small sample size based only in three athletes.

In terms of jump height, swing block (28.73 cm) and chicken wing (28.21 cm) were significantly higher than shuffle block (25.43 cm). Although not significant, our study found similar results to Neves et al. (2011) where they found that swing block had a significant higher jump height than the chicken block. These differences may be attributed to the small size of our participant sample. In contrast again, Dona et al. (2006) study did not find significant differences in jump height between shuffle and crossover approaches when analyzing data of only three athletes.

Analyzing the joints angular displacements displayed significant differences in knee flexion angles, while neither knee valgus nor hip flexion displayed significant differences between the three block techniques. Our study found a significant difference in knee flexion angle in the propulsive phase between all three types of block jump techniques. Chicken wing block (72.26 ± 1.34°) had higher knee flexion than swing block (68.64 ± 1.24°) and shuffle block (62.11 ± 1.13°), and swing block was higher than shuffle block, see Figure 1. This difference can be related to the arm movement of the block as was identified by Lees et al. (2004) demonstrating that knee flexion angle changes were related to arms movement (e.g., arm swing vs stationary arm). In addition, the results of our study were different from Lobietti (2009) study, where they found that knee flexion angle at the downward phase was closer to 90 degrees in both shuffle and crossover approaches. This difference can be related to the way the knee angle was measured. In our study we measure the change in angular displacement, whereas they measure angular position.

A review article by Moura and Okazaki (2022) mentioned that the squat depth influences the jump height performance. The best jump performance happens when the knee flexion is smaller than 90 degrees, and when the squat reaches a greater depth, the lower the peak force. In our study, shuffle block was the one that flexed the knees the least before jumping and it achieved the lowest jumps. Chicken swing block was the one that flexed the knees the most before jumping, being the fastest approach, but not the highest jump. While the swing block achieved the highest jumps with an average of 68 degrees of knee flexion. An optimal squat depth may be crucial for jump height performance. The influence of the full arm swing movement to jump in the swing block can unconsciously compensate for the lower knee flexion angles at the time of the jump, compared to the chicken wing which has less influence of the upper limbs in the jump, expanding the role of the lower limbs strength to jump. Even though there was a significant difference between all three block types in terms of max knee flexion, the difference found between chicken wing and swing block did not reflect in a difference in block effectiveness as both achieved similar time to take off and jump height.

Our second null hypothesis was that there are no differences in kinetics variables between the three blocks techniques. This null hypothesis was rejected. Overall, chicken wing and swing block produced higher peak power, net impulse, reactive strength index, max rate of force development than shuffle block, when covering 1.8 m horizontal distance on a volleyball court. Whereas peak force was higher in shuffle block than chicken swing and swing blocks.

The kinetic variables analyzed in this study are good indicators of jump performance, with some more influential than others. Moura and Okazaki (2022), identified that peak power can be the greatest indicator of muscle power during a jump, establishing a positive relationship with jump performance, whereas rate of force development may not predict alone a good jump performance, as it depends on type and velocity of contraction (Moura and Okazaki, 2022). In this present study, chicken wing block and swing block presented the higher values of peak power and max RFD than shuffle block. These findings support the differences in jump height between chicken wing and swing blocks and shuffle block. Impulse is also an essential factor for vertical jump performance. The higher the impulse, the higher is the jump height (Moura and Okazaki, 2022). In our study, both net impulse means of chicken wing and swing blocks were significantly higher than the shuffle one (Table 3), matching with the greatest jump height results. Moura and Okazaki (2022) also mentioned that high peak force is needed but not enough to achieve good jump height performances. In agreement with Moura and Okazaki (2022), our results showed that the type of jump that presented the highest peak force means had the shortest jumps (i.e., shuffle), while the other two types presented higher jumps with significantly lower peak force means, however with higher peak power.

The results of this study are limited to the performance of only ten volleyball players during their off season. However, we believe that the higher level of the athletes can give a better insight to the performance of the three different block techniques. Blocking is also an open skill, in which its efficiency also depends on external factors such as reading and decision-making ability of the athletes, as well as the different types of offensive plays and distances that defensive players must cover. Thus, another limitation that may influence the results is analyzing those three common blocks approaches used in the game, is the fact that the test took place in a laboratory, with a single block displacement covered (1.8 m), and it may constrain the idea of replicating the study in real life scenario.

There are many different movements that athletes are exposed to when learning how to block. When covering a horizontal distance of 1.8 m, it was clear that shuffle block is the weakest option for a good performance. However, it is still unclear what is the best block jump technique option to increase players blocking skill effectiveness, seeing that chicken wing and swing block are similar in many aspects. Thus, coaches may rely on athletes' physical conditions and status (e.g., person height, physiological characteristics, and level of competition) to decide which block approach is better to use in different scenarios.

CONCLUSIONS

When comparing the three most common techniques of a volleyball block jump, the chicken wing and swing block approaches were faster and achieved higher jumps than the shuffle block when covering horizontal distance of 1.8 m. Between chicken wing and swing block types, the only significant difference found was the max knee flexion, which did not impact the overall block jump efficiency. Thus, both chicken wing and swing block jump types are better choices than shuffle block to elevate the block effectiveness of volleyball players, when covering horizontal distance of 1.8 m. Therefore, the study reinforces the need for further investigation on block jump approaches within a game like situation exposure, between different genders, volleyball players role, and volleyball category levels.

AUTHOR CONTRIBUTIONS

Djuly Schmorantz carried out the experiment. Djuly Schmorantz and Tal Amasay contributed to the design of the research, to the analysis of the results and to the writing of the manuscript. All authors provided critical feedback and helped shape the research and manuscript.

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