

Effect of different height and distance oppositions on basketball shooting precision

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Abstract:

Basketball shooting is the most important technical element because it is where games are won or lost. The presence of an opponent represents an increase in difficulty, when compared to a shot with no opposition. During the game, the players have a defender trying to contest the shot and avoid them scoring. Thus, understanding the opponent's effect on the shot could help optimize practices to work with opposition, closer to what happens during a game. As this aspect can improve the quality of the game, and the literature on the topic is scarce, the study of the opponent and his influence on shooting is an added value to optimizing performances. Basketball coaches and players need to know the shooting constraints that can best improve shooting accuracy and practice them to mechanize the shooting movement, with opponents and movement variables. The goal of this study was to analyse the effect of opposition on basketball shooting accuracy. A sample with 23 athletes, 5 male and 18 female (21.1 ± 4.2 years; 171.5 ± 8.9 cm), with at least 4 years of federated basketball practice (12.4 ± 5.7 years), volunteered to perform 10 shots in 7 conditions. The shots were carried out with and without an opponent at different distances (1 m and 1.5 m from the shooter) and heights (1.10*shooters height, 1.15*shooters height, and 1.20*shooters height), proportional to the height of the shooting athlete. To compare precision, a system with 5 values was used. Shooting without an opponent was the one condition in which the precision shooting results were lower (60.4% of accuracy). This might result from a relaxation by the shooter, which refers to an incorrect movement, and from the fact that this condition was the first for all athletes. Although there were no statistically significant differences between the six types of opposition, the shot accuracy decreased when the opponent was closer to the shooter, which is similar to what happens during a game. However, the higher condition and lower distance of opposition was the one opposition condition with lower values of precision, showing a tendency of the opponent to influence the accuracy of shooting, probably due to the reduced vision of the basket. Unopposed shots had lower effectiveness when compared to opposed shots. Also, the closer the opponent, the lower the shooting accuracy. In this way, introducing an opponent into shooting practice can help improve athletes' performance.

Key Words: accuracy, body scale information, jump shot, task constraints, team sports.

Introduction

Basketball is one of the sports with higher popularity around the world (Cabarkapa, Fry, & Deane, 2021; Stanković, Kocić, Milenković, & Bubanj, 2021). It is mostly an anaerobic sport (Balciunas & Stonkus, 2003) involving intermittent, alternating periods of low to moderate intensity, with periods in which intensity is high (Edwards et al., 2018; Stojanović et al., 2017).

Basketball shooting is considered to be the most important and relevant technical element during the game (Palao et al., 2004; Wissel, 2000), with a huge and direct influence on the game-winning team (Vencúrik et al., 2021). Athletes should practice shooting in different contexts and with different associated constraints (Okazaki et al., 2015). Comparing shooting accuracy between winning and losing teams, the winning team shoots successfully significantly more, leading to successful game outcomes (Cabarkapa et al., 2021).

There are five different types of shots: 1) layup, 2) one-foot jump shot, 3) two-foot jump shot, 4) jump shot, and 5) free throw. During a game, approximately 60% of all field goals attempted is the jump shot (Vencúrik et al., 2021) – normally catch and shot, which means without dribble. Two studies in basketball shooting – particularly layups on both right and left sides – evaluate differences in the muscular (Amaro et al., 2021) and kinetic behaviour (Amaro et al., 2020) of the same athletes throughout the season.

Okazaki et al. (2015) defined three conditions that affect the shooting standard and effectiveness: 1) variables that affect the trajectory, 2) shooting phases, and 3) additional variables with some influence in the shooting. Okazaki et al. (2013) suggests that in a real practice situation, the shooting movement depends on the task (type of throw, distance to the basket, etc.), involvement constraints (free throw, opponent's opposition, etc.), and the athlete (morphological and functional variables, physical and motor aspects, etc.).

According to Newell's model of constraints, movement is the result of interactions between various constraints – namely, the individual, the task to be performed, and their involvement. The same author states that a change in one of the factors results in a change in the level of difficulty of the task to be performed, requiring an adaptation (Newell, 1986). These interact for the appearance of the optimal pattern of movement coordination; if there is a change in one of the constraints, there tends to be a change in the response, or, eventually, a new response. A knowledge of the constraints and how to overcome them helps technical teams and athletes improve individual and team performance (Renshow et al., 2019).

In terms of the constraints, the opposition is a constraint that must always be considered in competitive sports. An athlete never competes alone, and the presence of an opponent with different characteristics and strategies will make the athlete more uncomfortable; they must create mechanisms to get used to it (Duprat, 2019). The presence of an opponent makes the athlete adapt his behaviour, immediately, in order to succeed. Thus, training under conditions of opposition makes this adaptation easier and more natural in a stressful situation (Práxedes et al., 2018).

The opposition conditions change the jump direction and the ball's entry position (Viggiano et al., 2014), and they also reduce the execution time and increase the ball's jump and flight time (Maarseveen & Oudejans, 2018). The probability of winning the game increases for teams that achieve open throws, shooting without opposition. The presence of an active opponent at the time of shooting decreases the percentages of effectiveness (Csataljay et al., 2017). Rojas et al. (2010) states that the speed of the throw increases when the player shoots with opposition, and the height that the ball reaches is considered more appropriate when compared to the free throw, a shot without opposition.

The presence of an opponent also affects the athlete's posture, with a significant increase in angles related to the shoulder and elbow (Rojas et al., 2010). Maarseveen & Oudejans (2018) conclude that, although there are no differences in the effectiveness of shooting with and without opposition, there are significant differences according to the motor behaviour of the movement. A study with young athletes concludes that the presence of an opponent causes high variability in the athlete's motor behaviour during the shooting, causing changes, for example, in the shooting time and jump time; the efficiency decreases by 20% (Gorman & Maloney, 2016).

In a study with different distances from the defender to the shooter (0.5 m, 1 m, 1.5 m, and 2 m), Esteves et al. (2015) concludes that, for the higher distance, the time to fix the gaze in the space between the shooter and the defender increases. Without a defender, the fixation time on the ball decreases; for positions closer to the defender, the fixation time on the table increases and the fixation time on the ball decreases. Performing exercises that involve the active presence of an opponent during practice to simulate real game situations can be beneficial for improving the athlete's performance (Rojas et al., 2010). So, this study aimed to evaluate the effect of different types of opposition in basketball shooting precision. There is a lack of practical studies about the effect of opposition during the shooting. Most of the studies are related to game statistics, where it is possible to understand and compare shots without any opposition and shots with opponents to see the differences in effectiveness. For this reason, studies that relate the presence of an opponent with shooting efficiency may represent an advance in sports training – in this case, specifically, in basketball. Providing data that help coaches and technical teams optimize training processes leads to better athlete performance and, consequently, greater team success.

This study aimed to analyse the effect of the height and distance of the opposition in basketball shooting at 5.80 m. It was hypothesized that shooting with no opposition allows higher precision and efficiency of shooting; otherwise, the closer and higher the opposition, the lower the effectiveness.

Material & methods

Participants

Before participating in this study, all the athletes were fully informed of the nature of the investigation and gave written informed consent. The study was approved by the ethical committee of the Polytechnic of Coimbra and performed according to the Declaration of Helsinki (CEIPC 83/2021). All the participants' data have been registered and stored anonymously.

The group was formed by athletes of both genders (5 males and 18 females) with different ages and levels of experience, for a total of 23 participants (21.1 ± 4.2 years; 171.5 ± 8.9 cm). All of them had at least 4 years of federated basketball practice (12.4 ± 5.7 years), and no injuries were reported in the 3 months before the acquisition. Table 1 shows each athlete's gender, age, years of practice, and height (Table 1).

Table 1. Pairwise comparison of opposition conditions.

	MEAN	SD	SE	CI min.	CI max.	SIG.
C1-C2	-1.087	5.744	1.198	-3.571	1.397	0.374
C1-C3	-0.783	6.487	1.353	-3.588	2.023	0.569
C1-C4	-0.696	5.896	1.229	-3.245	1.854	0.577
C1-C5	-1.609	7.303	1.523	-4.767	1.550	0.302
C1-C6	-2.087	5.999	1.251	-4.681	0.507	0.109
C1-C7	-0.913	4.542	0.947	-2.877	1.051	0.345
C2-C3	0.304	6.093	1.271	-2.331	2.939	0.813
C2-C4	0.391	5.541	1.155	-2.005	2.787	0.738
C2-C5	-0.522	5.799	1.209	-3.029	1.986	0.670
C2-C6	-1.000	5.161	1.076	-3.232	1.232	0.363
C2-C7	0.174	5.263	1.097	-2.102	2.450	0.876
C3-C4	0.087	5.830	1.216	-2.434	2.608	0.944
C3-C5	-0.826	6.279	1.309	-3.541	1.889	0.535
C3-C6	-1.304	5.620	1.172	-3.735	1.126	0.278
C3-C7	-0.130	5.294	1.104	-2.420	2.159	0.907
C4-C5	-0.913	5.044	1.052	-3.094	1.268	0.395
C4-C6	-1.391	5.375	1.121	-3.715	0.933	0.227
C4-C7	-0.217	6.223	1.298	-2.908	2.474	0.868
C5-C6	-0.478	6.605	1.377	-3.334	2.378	0.732
C5-C7	0.696	6.175	1.288	-1.975	3.366	0.594
C6-C7	1.174	5.46	1.177	-1.268	3.615	0.330

SD, standard deviation, SE, standard error, CI min., confidence index minimum, CI max., confidence index maximum, SIG., level of significance considering 95% confidence interval, C1, shooting with no opposition, C2, shooting with an opposition with 1 m length and 1.10*athlete height, C3, shooting with an opposition with 1 m length and 1.15*athlete height, C4, shooting with an opposition with 1 m length and 1.20*athlete height, C5, shooting with an opposition with 1.5 m length and 1.10*athlete height, C6, shooting with an opposition with 1.5 m length and 1.15*athlete height, C7, shooting with an opposition with 1.5 m length and 1.20*athlete height.

Procedure

To evaluate if opposition influences shooting precision, all athletes performed a total of 70 shots from 5.80 m, in 7 different conditions, which means 10 shots in each condition. The first condition was shooting with no opposition; the other six were shots with opposition. This opposition was made by adjustable equipment simulating a fixed opposition. The height of the opposition was set based on the athlete's height, in six different conditions. First, two conditions were defined for the opponent's distance, varying the heights within these two distance conditions. Considering the shooter's height, the opponent's height was calculated by multiplying the shooter's height by three different constants (1.10, 1.15, and 1.20), as illustrated below. In this way, equal opponent height was guaranteed for all athletes depending on their height.

The seven shooting conditions were:

- C1 – shooting with no opposition;
- C2- 1-meter length and 1.10*athlete height ($c=1$; $a=1.10$);
- C3- 1-meter length and 1.15*athlete height ($c=1$; $a=1.15$);
- C4- 1-meter length and 1.20*athlete height ($c=1$; $a=1.20$);
- C5- 1,5-meter length and 1.10*athlete height ($c=1.5$; $a=1.10$);
- C6- 1,5-meter length and 1.15*athlete height ($c=1.5$; $a=1.15$);
- C7- 1,5-meter length and 1.20*athlete height ($c=1.5$; $a=1.20$);

The protocol started with a 10-minute warm-up before shooting, including some specific functional exercises and shooting drills. After the warm-up, all athletes started with a baseline of 10 shots with no opposition (C1), followed by the shots with opposition (C2–C7). The sequence of shooting with opposition was randomized for each athlete in order to minimize external factors like fatigue and routine and avoid a learning bias. Between positions, the athletes had 30 seconds to rest.

All athletes received the ball by a breast pass, always made by the same person with a basketball coaching specialization, and shot immediately, which means catching and shooting with no dribble. The data were acquired in a basketball gym with an official basketball backboard, using a game ball with the recommended pressure of 0.62 bar. The ball size changed between the female and the male athletes, according to the official recommendations. All players used their normal basketball shoes.

A system with values between 0 and 4 points was used to evaluate the precision of the basketball shooting. Before the shots, the athletes had no knowledge of the scoring system, having only been asked to perform the shots as accurately as possible. The points system was adapted from (Ferreira & Abrantes, 2001) to be more discriminated than one system that was developed more recently (Boddington et al., 2019):

- 4 points: Shot converted without the ball touching the hoop or the backboard

- 3 points: Shot converted with the ball only touching the hoop
- 2 points: Shot converted with the ball touching the hoop and/or the backboard
- 1 point: Missed shot where the ball touches the hoop or the backboard
- 0 points: Missed shot where the ball does not touch the hoop or the backboard

Considering a total of 70 shots (10 in each position), the maximum value for each athlete in each position is 40 points and the minimum value is 0 points.

Statistical analysis

The data were statistically processed with IBM SPSS Statistics 26.0 (IBM Corporation, New York, USA). Descriptive statistics are presented with mean $\pm$ standard error and 95% CI. The assumptions of normality were tested with the Shapiro–Wilk test. Pairwise comparisons between different opposition conditions were performed with a t-test. The significance level was set at $p \leq 0.05$.

Additionally, an Excel sheet calculating the height and length of opposition with a higher confidence index was used. All values of each opposition condition for each athlete were added together and given a final value. This final value was placed in Excel, after which a comparison was made that considered the group as a whole for the different conditions of opposition.

Means, standard deviation (SD), standard error (SE), confidence indices (CI), and percentage of values within the confidence index (% CI) were considered, defined by:

$$\text{Mean} = \text{Sum} / (\text{total values}) \quad (1)$$

$$\text{SE} = \text{SD} / \sqrt{(\text{total values})} \quad (2)$$

$$\text{CImin} = \text{Mean} - 1.96 \times \text{SE} \quad (3)$$

$$\text{CImax} = \text{Mean} + 1.96 \times \text{SE} \quad (4)$$

$$\% \text{ CI} = (\text{values inside CI} / (\text{total values}) \times 100 \quad (5)$$

Results

The statistical analysis through the t-test showed that there are no significant differences between the seven conditions for all athletes, considering a confidence index of 95%, with comparisons between all conditions being made two by two (Table 2).

Table 2. Sum, mean, standard deviation, standard error, confidence indices, and values inside confidence index for all conditions.

	SUM	MEAN	SD	SE	CI min.	CI max.	Values Inside CI	% CI
C1	567	24.65	5.18	1.08	22.54	26.77	7	30.43
C2	592	25.74	3.82	0.80	24.18	27.30	5	21.74
C3	585	25.43	5.63	1.17	23.13	27.74	5	21.74
C4	583	25.35	4.93	1.03	23.33	27.36	7	<u>30.43</u>
C5	604	26.26	4.50	1.04	24.22	28.30	6	26.09
C6	65	26.74	4.87	1.01	24.75	28.73	5	21.74
C7	588	25.57	3.76	0.78	24.03	27.10	4	17.40

SD, standard deviation, SE, standard error, CI min., confidence index minimum, CI max., confidence index maximum, % CI, percentage of values inside the confidence index, C1, shooting with no opposition, C2, shooting with an opposition with 1 m length and 1.10*athlete height, C3, shooting with an opposition with 1 m length and 1.15*athlete height, C4, shooting with an opposition with 1 m length and 1.20*athlete height, C5, shooting with an opposition with 1.5 m length and 1.10*athlete height, C6, shooting with an opposition with 1.5 m length and 1.15*athlete height, C7, shooting with an opposition with 1.5 m length and 1.20*athlete height.

The qualitative analysis shown that C1 – when the players shot with no opposition – is the condition with the lowest mean values (25.65 points), meaning that the average of the score values depending on the shooting accuracy was lower, and C4 is the opposition condition with the lowest mean values (25.35 points). C6 is the condition with a higher mean value (26.74 points) (Table 3).

Table 3. Percentage of scored and failed shots for each condition.

	C1	C2	C3	C4	C5	C6	C7
Nº scored shots	139	145	141	141	150	153	142
Accuracy %	60.4	63.0	61.3	61.3	65.2	66.5	61.7

Nº scored shots, number of scored shots, C1, shooting with no opposition, C2, shooting with an opposition with 1 m length and 1.10*athlete height, C3, shooting with an opposition with 1 m length and 1.15*athlete height, C4, shooting with an opposition with 1 m length and 1.20*athlete height, C5, shooting with an opposition with 1.5 m length and 1.10*athlete height, C6, shooting with an opposition with 1.5 m length and 1.15*athlete height, C7, shooting with an opposition with 1.5 m length and 1.20*athlete height.

Considering only shots scored and missed, without a score from 0 to 4, it is observed once again that the condition of shooting with no opposition, C1, was the one in which the athletes had the lowest accuracy percentage (60.4%).

Dicussion

The present study evaluated the effect of opponents' height and distance on basketball shot accuracy. Contrary to the assumption and to the study of Csatalai et al. (2017), the unopposed shots were the ones in which the athletes had the lowest values of accuracy and effectiveness. Condition C1 was probably the one with the lowest mean because, despite being the one without opposition, it was always the first condition in which the athletes shot in this study. It is possible that the practice of the movement led to greater success when performing in the remaining six conditions.

Furthermore, the lack of opponent can lead to the shooter's relaxation, which can interfere with the shoot quality by decreasing it. Analysing the confidence index, it is possible to observe that C1 and C4, the conditions with the lowest mean values, are those with the highest number of values inside the confidence indices (highest % CI). This means that, although the accuracy of throws was lower for these two conditions, there was a greater number of athletes with a similar level of accuracy. The closer and taller the opponent is, the more difficult it will be to shoot the ball, as vision for the basket is reduced. Thus, condition C4 is the one that presents the greatest difficulty for the athlete; for this reason, it was the one in which they had lower levels of precision.

In conditions with opposition, after C4, those with lower levels of precision are conditions C2 and C3. The similarity between these three conditions is the fact that the opponent was only 1 m from the shooter, while in conditions C5–C7, the opponent was at a greater distance, 1.5 m. In this way, considering the groups where the opponent is at a distance of 1 m and where the opponent is at a distance of 1.5 m, it is possible to conclude that the one that presents the greatest difficulty for the shooter (lowest values of precision) is the distance of 1 m. For the same distance from the opponent to the shooter, it is possible to verify that, at both distances, the conditions with lower precision values are C4 and C7. The similarity between these two conditions is the fact that, in both, the opponent is at the greatest height ($1.20 \times \text{athlete height}$) of the three opposition heights under study.

Although performances in the seven conditions under study are different, these differences were not statistically significant, in line with the study by Maarseveen & Oudejans (2018). This can be justified by an improvement in the technical performance of shooting when subjected to more constraints, thus improving efficiency.

While the sample of this study consisted of federated basketball players with at least four years of experience, the athletes were of different ages, which may be a limitation to the study. In addition, a larger sample may bring greater reliability to the results. Using a moving opponent, simulating what happens in a game, rather than fixed equipment, and randomizing all conditions under study and not just the conditions with opposition (C2–C7) may also help.

Conclusions

In this study, the athletes in the sample had lower effectiveness on unopposed shots when compared to opposed shots. This may be due to a relaxation of the athlete when the shot is theoretically easier, which leads to lower shooting effectiveness. In contrast, the presence of an opponent can lead the shooter to try to perform the movement in a better way, due to the greater difficulty that is presented.

Also, this study allowed us to conclude that the closer the opponent is to the shooter, the lower the accuracy of the shot – that is, the lower the shooter effectiveness. Despite this, there were no statistically significant differences between the seven conditions under study.

It was hypothesised that shooting with no opposition increases the precision and efficiency of shooting; otherwise, the closer and taller the opposition, the lower the effectiveness. Taking this into account, the results show that the presence of an opponent does not represent a decrease in the accuracy of the shot. Furthermore, an opponent at a shorter distance from the shooter results in a decrease in effectiveness. In this way, putting into practice some exercises that force the athlete to shoot with opposition and simulating situations that happen in a game can be advantageous for shooting efficacy training.

Conflicts of interest: The authors don't have any conflicts of interest to declare.

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