Journal of King Saud University – Science 34 (2022) 102316

HOSTED BY

ELSEVIER

Contents lists available at ScienceDirect

Journal of King Saud University – Science

journal homepage: www.sciencedirect.com

Original article

An empirical study of parameters in different distance standing shots

Xinjian Wang

Xi'an Physical Education University, Xi'an|Xi'an Physical Education University, Xi'an 710068, People Republic of China

A R T I C L E I N F O

Article history:
Received 17 November 2021
Revised 4 September 2022
Accepted 6 September 2022
Available online 13 September 2022

Keywords:
Basketball players
Shooting
Bio-mechanical
Theoretical parameters
Shooting angle

A B S T R A C T

In order to reveal the characteristics of shooting techniques, this study, on the basis of bio-mechanical theory, analyzes the theoretical parameters of shot with the help of high-speed camera system. The parameters involving three different distances standing shot are obtained by testing 12 target objects who were U16 top male basketball players from China national team. The present work has carried out the theoretical analysis and the empirical research. The results show that the shooting distance, shooting height and shooting angle can be acquired by calculating the flight speed and flight trajectory of basketball. Under the condition of shooting at the same shooting height at a distance, the shooting angle is the key factor affecting the shooting rate.

1. Introduction

Shooting is the only scoring technique in basketball. Standing shooting is the foundation of all shooting techniques and the least influential shooting technique (Hamilton and Reinschmidt, 1997). There are lots of research results on shooting, and the most researches are focused on jump shots, free throw and field goal percentage (Okubo and Hubbard, 2006; Okazaki, and Rodacki, 2012; Okubo and Hubbard, 2015). Since the 1950s, the research on the basketball shooting angle, shooting velocity, and entry angle and basketball flight trajectory has been deeply concerned (Millers and Bartlettr, 1996). With the continuous advancement of scientific technological means and the improvement of shooting techniques, the research about the bio-mechanical characteristics and techniques aspects in basketball shooting has also gradually deepened (Vencúrik et al., 2021). This study takes the standing shooting as the research object and intends to further analyze the controllable factors affecting the shooting rate, by the technical parameters analysis, biomechanics theoretical calculation and experimental testing of U16 top male basketball players in China. The study also summarizes the characteristics of the parameters of the standing shooting of different distances, which provides a theoretical basis for analyzing standing shooting techniques, and also offers a reference for shooting technique training means innovation.

E-mail address: wangxinjian0830@163.com

Peer review under responsibility of King Saud University.

ELSEVIER Production and hosting by Elsevier

2. Research subjects and methods

2.1. Research subjects

This research mainly studies on the standing shooting techniques of free throw, mid-distance and three-points shooting. Test subjects are 12 male players of U16 national basketball team of China.

3. Research methods

3.1. Experimental method

The research uses a high-speed camera (JVC-PX100-BAC) to shoot 12 male athletes in different distance shooting techniques. Shooting velocity 100 frames / *sec*, shooting distance: 23 m; lens height: 2.46 m; shooting location: National Sports General Administration Training Bureau basketball hall; test site layout shown in Fig. S1.

4. Motion technology image analysis method

The research applies Dartfish 10.0 motion technology analysis system, through video transcription, application analysis module

https://doi.org/10.1016/j.jksus.2022.102316
1018-3647/

of tracking and formation of ball flight trajectory, the study analyzed the displacement (distance), time and interval velocity and other indicators analysis, and collected the parameters of standing shots, which provide the first-hand data for the theoretical and empirical research shown in Fig. S2.

5. Results and analysis

5.1. In-standing shooting theory model

Standing shooting can be seen as a diagonally throwing activity that ignores air resistance. The theoretical model is shown in Fig. S3 and Fig. S4.

In Fig. S4, H0 refers to the height of the player's shot when shooting in the field. h_1 is the height of the basket, i.e., the vertical height of the ball to the ring. h_2 is the height of the basket, i.e., the highest height of the basketball flight to the vertical height of the hoop, so $H_0 + H_1 = 3.05\ m$; v_x is the horizontal velocity when the ball is shot, v_y is the vertical velocity when the ball is shot, v is the velocity of the shot, and α is the angle of the shot, so there are $v_x = v \times sin\alpha$, $v_y = v \times cos\alpha$; β is the incidence angle; S is the shooting distance, i.e., the horizontal distance from the geometric center of the ball to the center of the hoop.

Therefore, according to the principle of physics oblique throw, the relationship between displacement, velocity, time and shooting angle can be obtained:

$$S = v_x t \tag{1}$$

$$h_1 + h_2 = v_y t + \frac{1}{2} g t^2 \tag{2}$$

$$v_x = v \times \cos\alpha \tag{3}$$

$$v_y = v \times \sin\alpha \tag{4}$$

According to (1), (2), (3) and (4) t *is* eliminated, taking y as the vertical height variable, and x as the horizontal direction variable, we can obtain the theoretical trajectory equation:

$$y = H_0 + x\tan\alpha - \frac{gx^2}{2(v\cos\alpha)^2}\ \textit{That is},\ y = H_0 + x\tan\alpha - \frac{gx^2}{2v_x^2}$$

It can be seen that, regardless of the air resistance, the arc trajectory of the fixed-range standing shooting mainly depends on the shooting height H_0, the shooting velocity v and the shooting angle α. For the top players, the stability of the standing shooting technique can ensure that the shooting height is basically unchanged. Therefore, we can conclude that the arc trajectory of the top players' fixed-range field goal percentage is mainly determined by the shooting velocity and the change of the shooting angle.

5.2. Calculation of biomechanics theoretical parameters of standing shooting at different distances

5.2.1. The range of the incidence angle in swish shot

Basketball shooting belongs to the oblique throwing movement in physics. Excluding the human factors, we use mechanical reasoning. The larger the shooting angle, the higher the arc, the larger the incidence angle, the higher the field goal percentage. The field goal percentage is the highest when the incidence angle is vertical, and the allowable error range is the largest. With the arc of the shot decreasing, the incidence angle decreases, the incident cross-sectional area also decreases, and the allowable error range decreases, too.

As shown in Fig. S5, in theory, when the basketball with minimum angle enters the basket, the distance between the ends of the basket diameter and the tangent of the basketball sphere should be the diameter of the basketball. According to the mathematical theorem, we can see that the diameter of the tangent point of the circle is perpendicular to the tangent, and the foot is the tangent point. Therefore, the triangle ABC in Fig. S5 is a right triangle, and β is the angle of the basket at this time. According to the knowledge of solving the right triangle, we can get $sin\beta = AB/BC$, where AB is the diameter of the basketball and BC is the diameter of the hoop. Then, the incidence angle β of swish shot is equal to the value of arc-sine function of the ratio of the basketball diameter (d) to the basket diameter (D), namely, β = arcsin(d/D). Because the inverse sine function ranges from −90° to 90°, the maximum shot angle of the shot is 90°.

According to the competition rules of FIBA, the standard hoop diameter is 45 cm, and the parameters for the ball model for basketball competitions in different groups shown in Table 1.

It can be seen that the male's minimum incidence angle β is 32.54°. The short axis of the cross-sectional area of the basket is equal to the diameter of the basketball. At this time, the allowable error has dropped to zero. If the incidence angle is reduced, the basketball will hit the hoop and cannot be shot directly.

In summary, the range of the incidence angle of the swish shot in the standard male game is [32.54°, 90°].

5.2.2. Theoretical parameters analysis of basketball flight trajectory when shooting from different distances

U16 male players shooting testing distance and shot height analysis.

According to the experimental test of 12 U16 male players, and high-speed image analysis of different distance shootings, we can obtain the shooting distance and the shooting height parameters. The results are shown in Table 2.

The data in Table 2 derives from the experimental test. The experimental design requires the player to follow the free throw line (*4.225 m*) shot, top of free-throw lane shot (*5.8 m*) and the three-point shot (*6.75 m*). The data in the above table is the actual shooting distance. Among them, the shooting distance is the horizontal distance from the geometric center of the basketball to the center of the hoop. The shooting height refers to the vertical distance from the geometric center of the ball to the ground.

2. Analysis of the relationship between minimum incidence angle, minimum shooting angle, shooting velocity and field goal percentage.

The shooting angle refers to the angle between the tangent of the flight path of the basketball center and the horizontal plane of the shot point when the ball is off the hand (Chinese Basketball Association, Basketball Rules. Beijing Sport University Press, Beijing, China, 2018). The shooting angle is positively correlated with the incidence angle. The shooting angle enlarges when the incidence angle increases (Darling and Cooke, 1987a; Darling and Cooke, 1987b; Guo et al., 2015). Theoretically the maximum incidence angle can be 90°, which is because the theoretical range of shots is the largest. However, due to the increase in the incidence angle, the shooting angle and the shooting velocity also increase. As a result, the control effect of basketball is greatly reduced, which makes the goal percentage uncontrollable (Darling and Cooke, 1987; Guo et al., 2015). According to the results of Yang et al. (2016), the minimum velocity shooting angle is the 45° together with the half of the slant angle of the shot, as shown in Fig. S7.

$$\alpha = 45^\circ \frac{\phi}{2}$$

As shown in the figure, φ = arctan(h_1/S), then there is,

Among them, h_1 refers to the vertical distance from the geometric center of the basketball to the horizontal level of the basket

Table 1
Results of diameter size and minimum incidence angle of standard basketball models.

Type	Group	Height (G)	Circumference (cm)	Basketball Maximum Diameter(d/cm)	Standard Hoop Diameter(D/*Cm*)	Minimum Incidence Angle Arcsin (d/D)
6#	female	510–550	70–71	22.6	45	30.16
7#	male	600–650	75–76	24.2	45	32.54

Note: Based on the competition rules of FIBA(FIBA.2019).

Table 2
Results of test distance and shooting height for standing shooting (n = 12).

Free Throw		Middle Distance Shooting		Three-Points Shooting	
shooting distance(m)	shooting height(m)	shooting distance(m)	shooting height(m)	shooting distance(m)	shooting height(m)
4.06 ± 0.10	2.48 ± 0.11	5.72 ± 0.16	2.58 ± 0.16	6.46 ± 0.06	2.58 ± 0.10

when shooting, that is, $h_1 = 3.05\text{-}H_0$, in which H_0 is the shot height, and S is the shooting distance. According to the data in Table 3, the minimum velocity shot angle parameters for different distances and shot heights can be obtained, as shown in Table 3.

The data in Table 3 shows that the shooting height H_0increases slightly, h_1 decreases, and the tilt angle φ and the shot angle α decrease as the shooting distance increases.

3. Analysis of minimum shot velocity.

According to the above trajectory theory equation, it can be known that

$$y = H_0 + x\tan\alpha - \frac{gx^2}{2v_x^2}$$

From the trajectory equation, it is not difficult to see that the shot angle and the shot velocity present nonlinear correlations when other factors are constant. For an excellent sport, the shot height of the fixed distance tends to be stable, so the equation is a function of v and α. When α is the minimum value, we bring the data in Table 2 and Table 3 into different athletes and obtain the minimum shot velocity, as shown in Table 4.

The data in Table 4 displays the theoretical shot velocity corresponding to the minimum shooting angle of the certain distance. i.e., the minimum velocity at which the distance can be swish shot. Theoretically, the shooting velocity in minimum shooting angle enlarges as the shooting distance increases. Since air resistance is neglected in the theoretical analysis, we can see the velocity should be slightly larger than the actual velocity value, but the trend is unchanged. Lower velocity shots are easier to control and can reduce motion variation, thus improving the stability of the shots (Knudson, 1993; Liu, 2004). The better the shots are, the smaller the shot velocity is, and the higher the shot hit rate is. Accordingly, top players tend to shoot with a shooting angle close to the minimum shooting velocity (Liu, 2010; Ma, 2009; Millers and Bartlettr, 1996). Therefore, the minimum entry angle and the corresponding minimum shot velocity can provide the groundwork for the athletes to weigh the three controllable factors, to determine the hand stability and the maximum controllability in order to maintain a high hit rate.

4. Calculation of the shooting velocity in different distances in theory.

According to the experimentally measured shooting distance, shot height, shot angle and other parameters into the shooting arc trajectory equation, we can calculate the theoretical velocity parameters and obtain the following results, shown in Table 5.

The data in Table 5 shows that with the increase in the distance from the penalty basket, the mid-range shot and the long-range shot, the shooting velocity increases, while the shooting angle gradually decrease.

In summary, based upon the theoretical parameters, when the same athlete shoots with a stable shot height, the same distance increases with the shot angle, and the shot velocity increases. When the same athlete shoots at three different distances, the shot angle is reduced, and the shot velocity is increased, as the shooting distance and the shot height increase.

5.3. U16 top male basketball players test and empirical analysis of in-standing shooting parameters in different distances

5.3.1. Results analysis of the actual shooting angle and the angle of the basket in different distances

In the study, U16 outstanding male basketball players were subjected to on-site experimental shooting and post-analysis of the penalty shots, CIC and long-range shooting. The relevant technical analysis parameters were obtained. The results are shown in Table 6.

The data in Table 6 shows that when the athletes shoot in the field, the shot height increases slightly, and the shot angle decreases, as the shooting distance increases. This is because the farther the distance is, the higher the accuracy of the shooting technique is. The increase of the shot height plus the smaller angle of the shot can form the ability to control the ball (Ma, 2009). Combining the parameters of same distance and the height of the shot, the actual tested shooting angle of the shot is slightly larger than the minimum shot angle, and the entry angle is also greater than the minimum entry angle.

5.3.2. Analysis of actual shooting velocity parameters of different distances in standing shooting

The experiment filmed high-speed images of different distances in-standing shooting on U16 male athletes. The motion analysis

Table 3
Results of minimum velocity shooting angle from different standing shots (n = 12).

Shooting Distance *(m)*	$h_1(m)$	h_1/s	Slant Angle (°)	Shooting Angle α(°)
4.06 ± 0.10	0.58 ± 0.09	0.14 ± 0.02	8.05 ± 1.23	49.03 + 0.61
5.72 ± 0.16	0.47 ± 0.11	0.08 ± 0.02	4.73 ± 1.12	47.36 ± 0.56
6.46 ± 0.06	0.47 ± 0.08	0.07 ± 0.01	4.20 ± 0.76	47.10 ± 0.38

Table 4
Results of minimum shooting velocity from standing shots in different distances (n = 12).

Shooting Distance(m)	Shooting Height (m)	Shooting Angle A(°)	*V(m/s)*	*vx(m/s)*	*vy(m/s)*
4.06 ± 0.10	2.48 ± 0.11	49.03 ± 0.61	6.84 ± 0.12	4.48 ± 0.06	5.17 ± 0.14
5.72 ± 0.16	2.58 ± 0.16	47.36 ± 0.56	7.58 ± 0.11	5.13 ± 0.09	5.57 ± 0.12
6.46 ± 0.06	2.58 ± 0.10	47.10 ± 0.38	8.04 ± 0.12	5.48 ± 0.12	5.89 ± 0.07

Table 5
Results of theoretical parameters of shooting velocity in standing shots in different distances (n = 12).

Shooting Distance*(m)*	Shooting Height *(m)*	Shooting Angle A*(°)*	Shooting Velocity*(m/s)*	Horizontal Shooting Velocity (*m/s*)	Vertical Shooting Velocity (m/*s*)
4.06 ± 0.10	2.48 ± 0.11	49.16 ± 2.98	7.07 ± 0.15	4.18 ± 0.34	5.68 ± 0.35
5.72 ± 0.16	2.58 ± 0.16	47.67 ± 5.41	7.60 ± 0.18	4.58 ± 0.25	6.05 ± 0.38
6.46 ± 0.06	2.58 ± 0.10	46.65 ± 2.63	8.28 ± 0.26	5.10 ± 0.32	6.50 ± 0.54

Table 6
Analytical results of shooting angle and incidence angle in standing shots in different distances (n = 12).

Shooting Distance (m)	Shooting Height (m)	Shooting Angle A (°)	Incidence Angle (°)
4.13 ± 0.09	2.33 ± 0.14	53.60 ± 3.71	45.16 ± 4.25
6.04 ± 0.07	2.40 ± 0.15	52.83 ± 3.12	48.37 ± 4.28
6.84 ± 0.06	2.42 ± 0.14	51.78 ± 3.92	48.34 ± 4.50

software is used to analyze the parameters such as time, displacement and angle. The horizontal average velocity is obtained through calculation, and the vertical velocity and velocity parameters are obtained through calculation, too. The results are shown in Table 7.

5.3.3. Comparative analysis of in-standing shooting theory and tested parameters at different distances

1. Results of shot velocity parameters.

According to the actual shooting distance, shot angle and shot height of 12 athletes, we can calculate the theoretical velocity of the shot by the above formula. At the same time, we can also get the measured parameters of the shot velocity at different distances in the experiment. The results are shown in Table 8.

From the mean of data, we can intuitively find that the theoretical value is slightly larger than the measured value. In order to prove the accuracy of the theoretical trajectory equation (excluding the actual air resistance) and the accuracy of the test parameter analysis, we intend to do a two-sample *t*-test on the two sets of data.

2. Differences between the theoretical value of the original shooting and the measured value of variance (F test).

According to the statistical principle, there are two cases of Equal variance and Heteroscedastic for the two groups of data mean consistency test, so the theoretical and measured values of the shooting velocity of shots are subjected to F test to verify the differences between the two sides. The results are shown in Table 9:

Table 8
Comparison results between the theoretical and measured parameters of shooting velocity in standing shots in different distances (n = 12).

Shooting Distance *(m)*	Shooting Angle α*(°)*	Shooting Velocity in Theory (m/s)	Shooting Velocity in Testing (m/s)
4.13 ± 0.09	53.60 ± 3.71	7.07 ± 0.15	6.99 ± 0.12
6.04 ± 0.07	52.83 ± 3.12	7.60 ± 0.18	7.58 ± 0.15
6.84 ± 0.06	51.78 ± 3.92	8.28 ± 0.26	8.18 ± 0.39

The data in Table 9 are the theoretical and measured F-test results of three different distances in the penalty basket, from U16 male National Team players. The results show that the p-values of free throw is smaller than 0.05. But the other two pairs of data are all greater than 0.05.Thereby there is no significant difference between the theoretical values of two pairs of different distance data and the measured values, and the *T*-test of the equal-variance mean samples can be performed. And there is significant difference between the theoretical values of the free throw of different distance data and the measured values, and the *T*-test of the Heteroscedasticity *t* test mean samples can be performed.

3. Variance *t*-test of the theoretical and measured values of the shooting velocity of different distance shots.

According to the data results of Table 9, we can make a two-sample and variance hypothesis T test for the theoretical and measured values of the three sets of data at different distances. The results are shown in Table S1.

The data of Table 10 shows that P values of the three pairs of data are all greater than 0.05, indicating that there is no difference between the theoretical calculation parameters and the measured parameters of three different distances. The theoretical value is consistent with the mean value of the measured values. Therefore, we can calculate the velocity of the shot and the trajectory of the basketball flight based on the shooting angle of the shot, the distance of the shot and the height of the shot.

In summary, for the same elite athlete, the shot height of the same distance shot is basically stable, and the shot stability is mainly determined by the angle of the shot. The shot angle is the

Table 7
Analytical results of shooting velocity in standing shots in different distances (n = 12).

Shooting Distance (m)	Shooting Angle A(°)	Shooting Velocity (m/s)	Horizontal Shooting Velocity *(m/s)*	Vertical Shooting Velocity (m/s)
4.13 ± 0.09	53.60 ± 3.71	6.99 ± 0.12	4.14 ± 0.38	5.61 ± 0.27
6.04 ± 0.07	52.83 ± 3.12	7.58 ± 0.15	4.57 ± 0.28	6.03 ± 0.34
6.84 ± 0.06	51.78 ± 3.92	8.18 ± 0.39	5.03 ± 0.27	6.43 ± 0.63

Table 9
Test results for equal variance (F Test) between tested and theoretical values of shooting Velocity.

	Free Throw		Middle Distance Shooting		Three-points Shooting	
	Tested Values	Theoretical Values	Tested Values	Theoretical Values	Tested Values	Theoretical Values
Average	6.97	6.86	7.58	7.60	8.10	8.11
Variance	0.05	0.01	0.02	0.03	0.05	0.03
Observations	12	12	12	12	12	12
Df	11	11	11	11	11	11
F	4.29		0.67		1.60	
P(F<=f) one-tailed	0.01*		0.26		0.22	
F single tail critical	2.82		0.35		2.82	

*means P-value is smaller than 0.05, the pairs data is significant difference.

Table 10
Results of T-test between measured and theoretical velocity.

	Free Throw		Middle Distance Shooting		Three-points Shooting	
	Tested Values	Theoretical Values	Tested Values	Theoretical Values	Tested Values	Theoretical Values
Average	6.97	6.86	7.58	7.59	8.10	8.11
Variance	0.05	0.01	0.32	0.02	0.05	0.03
Observations	12	12	12	12	12	12
Merger variance	0		0		0	
Df	16		12		22	
t Stat	1.44		−0.10		−0.19	
P(T<=t) one-tailed	0.08		0.46		0.42	
t single tail critical	1.75		1.78		1.72	
P(T<=t) two-tailed	0.17		0.92		0.85	
t double tail critical	2.12		2.18		2.07	

decisive factor for the stable shooting percentage of the same distance.

6. Findings

We have drawn the following findings from the empirical study:

a. The range of the basket in the standard ball for the male game ball is [30.16°, 90°];

b. The theoretical shooting velocity corresponding to the minimum shooting angle of the fixed distance, is the minimum velocity at which the distance can hit the hollow sphere. The minimum shooting angle (degree) of the excellent U16 male basketball players at different distances is, the free throw (distance 4.06 ± 0.10) m): 49.03 ± 0.61, CIC (5.72 ± 0.16 m): 47.36 ± 0.56, long shot (6.4 6 ± 0.20 m): 47.10 ± 0.38, and the corresponding minimum exit velocity (m/s) is 6.84 ± 0.12, 7.58 ± 0.11 and 8.04 ± 0.12.

c. Through the theoretical trajectory equation, the shooting distance, the shot height and the shot angle parameters can be collected, and the shot velocity and the basketball flight trajectory can be obtained through calculation.

d. For the same athlete, the shot angle is the only factor affecting the hit rate in the case of a high shot at the same distance.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

The authors are thankful to the higher authorities for the facilities provided.

Authors' contribution

This study was done by the authors named in this article, and the authors accept all liabilities resulting from claims which relate to this article and its contents.

Funding

No funding source for this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jksus.2022.102316.

References

Chinese Basketball Association, 2018. Basketball Equipment. Basketball Rules. Beijing Sport University Press, Beijing, China, pp. 220–225.
Darling, W.G., Cooke, J.D., 1987a. Changes in the variability of movement trajectories with practice. J. Motor Behav. 19 (3), 291–309.
Darling, W.G., Cooke, J.D., 1987b. Movement related EMGs become more variable during learning of fast accurate movements. J. Motor Behav. 19 (3), 311–331.
Guo, B., Zhong, B., Wu, Z., Wang, X., Bao, Y., 2015. Experimental study on the shooting rate of combined rotation and variable diameter rim training. J. Xi'an Inst. Phy. Edu. 32 (05), 637–640.
Hamilton, G.R., Reinschmidt, C., 1997. Optimal trajectory for the basketball free throw. J. Sports Sci. 15 (5), 491–504.
Knudson, D., 1993. Biomechanics of the basketball jump shot Six key teaching points. J Phys. Edu. Recreate Dance. 64 (2), 67–73.
Liu, H., 2004. Calculation method of human joint angle in 3D photography analysis. J. Beijing Sport Univ. 06, 1–9.
Liu, Y., 2010. Application of biomechanics in motion control and coordination research. Sports Sci. 11, 1–12.
Ma, L., 2009. Research on the effect of improving the free throw percentage training. J. Beijing Sport Univ. 10, 1–10.
Millers, S., Bartlettr, R., 1996. The relationship between basket-ball shooting kinematics, distance and playing position. J. Sports Sci., 1996, 14(3), 243–253.

Okazaki, V.H.A., Rodacki, A.L.F., 2012. Increased distance of shooting on basketball jump shot. J. Sports Sci. Med. 11 (2), 231.
Okubo, H., Hubbard, M., 2006. Dynamics of the basketball shot with application to the free throw. J. Sports Sci. 24 (12), 1303–1314.
Okubo, H., Hubbard, M., 2015. Kinematics of arm joint motions in basketball shooting. Procedia Eng. 112, 443–448.
Vencúrik, T., Knjaz, D., Rupčić, T., Sporiš, G., Li, F., 2021. Kinematic analysis of 2-point and 3-point jump shot of elite young male and female basketball players. Int. J. Environ. Res. Public Health 18 (3), 934.
Yang, Z., Mi, J., Liu, H., 2016. Research progress on the sports characteristics of basketball shooting. Sports Sci. 36 (01), 79–90.