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ORIGINAL RESEARCH

The Effect of Arm Length and Hand Quickness on Shot Accuracy Rates in Basketball Players

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Abstract

Objective: *The effects of various physical and motor skills on the performance of basketball players are well known. Scoring through shooting is one of the most commonly used techniques in basketball. This study analysed the connection between arm length and hand quickness among basketball players and their shooting accuracy.*

Method: *The study was carried out on 17 male and 16 female athletes, aged 18-25 years, who played basketball in university teams in 2021-2022 and had at least 5 years of eligibility. The athletes' height, body weight and full length of each athlete's arm were measured. The AAHPERD Basketball Speed Spot Shooting Test was used to measure the shooting accuracy of the athletes. For the athletes' hand quickness, Hand Quickness Test (Touching Discs) was used.*

Results: *Results indicated a moderate positive correlation between hand quickness score and shot accuracy score among male athletes, but this relationship was not statistically significant. However, a moderate positive and statistically significant correlation was found between hand quickness score and shot accuracy score among female athletes. Among all athletes, there was a positive and statistically significant correlation between arm length, hand quickness speed, and shot accuracy score.*

Conclusion: *The study's findings indicated that shooting accuracy was also impacted by arm length, with particular emphasis on hand quickness of the athletes.*

Keywords: *Basketball, Arm length, Hand quickness, Shooting accuracy*

Introduction

Morphological characteristics not only play a key role in shaping human movement, but also have a significant impact on athletic performance. Commonly studied topics within the field of morphology include dimensions such as length and width, environmental factors and body composition [1].

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Sport is a comprehensive term encompassing all physical or mental activities, undertaken either individually or as a team according to predetermined guidelines, predominantly reliant on competitive play and personal pleasure or striving for excellence [2].

The demands of everyday life necessitate motor skills, including strength, endurance, speed, flexibility, coordination, and proprioception, which involve the pushing, pulling, rotating, and level changes required for human movement [3].

Basic motoric characteristics determine an individual's physical strength and ability, as well as their degree of motoric sports power of a complex nature. These characteristics form the foundation and primary condition of every motoric sports movement performed during training. The order of importance for basic motoric characteristics is strength, endurance, speed, mobility, and skill, with the first three being main characteristics and the latter two being complementary [4].

Basketball requires physical, technical and mental qualities, as well as some branch-specific skills, including tactical knowledge. Athletes' high physical competence facilitates efficient offensive and defensive game strategies. These talents are essential in basketball since triumph is highly coveted [5]. Basic skills such as shooting, dribbling, and passing are crucial factors affecting success in basketball. The technical aspect of shooting, which is a movement towards scoring points, is often included in research. The shooting movement is considered to have commenced from the moment the ball leaves the athlete's hand, and the shooting mechanics must adhere to specific rules from the first movement. The accuracy of a shot relies on various factors, including the shot's height, the velocity at which the ball departs the athlete's hand, and the shot angle [6].

Testing arm movement speeds and skills in basketball with a focus on shooting accuracy is believed to enhance efficiency in the sport. This study aims to evaluate the arm movement speed levels of male and female basketball players in the basketball teams at Diyarbakır Dicle University and examine potential correlations with age, gender, height, weight, arm length, and shooting score.

Materıals and Methods

17 male and 16 female basketball players who had been playing basketball for at least 5 years voluntarily participated in the study. The research implemented the experimental design method, one of the quantitative research techniques.

The study's population comprised male and female basketball players from university teams during the 2021-2022 season. The research group was determined through a typical case sampling method utilizing purposeful (judgemental) sampling, a type of non-random sampling. Specifically,

the research group consisted of male and female athletes aged 18-25 playing for Dicle University's basketball teams.

Before administering the tests to the athletes, the relevant instructions were read and the measuring equipment was introduced. The athletes underwent a single trial for the measurements, and the data obtained from these measurements were recorded on the measurement forms. The measurements were performed at the indoor sports hall of Prof. Dr. Şeref İNALÖZ in Dicle University.

The athletes' height and body weight were measured using a SECA height and weight meter, with an accuracy of 0.1. The full length of each athlete's arm was measured using a Martin Type Anthropometer, which requires two people to operate. The measurers stood on the left side of each subject, with one holding the subject's arm and hand slightly forward and to the side, thereby assisting the subject in attaining the full length of their left arm. The individual conducting the measurement positions the anthropometer's horizontal arm on the subject's acromiale point. The other person helps the arm reach its full length by lightly touching the anthropometer's other horizontal arm to the tip of the subject's longest finger (dactylion point). It is important to ensure that the axes of the arm and the anthropometer are parallel to each other.

The AAHPERD Basketball Speed Spot Shooting Test was used to measure the shooting accuracy of the athletes. The test comprises specific exercises pertaining to dribbling, passing, shooting, and defensive movements. The coefficient of validity for all sections of the test was reported to be 0.65-0.95. Its reliability was tested through a retest study, which indicated a reliability coefficient of 0.84-0.97 [7]. The shooting abilities of youthful basketball players were measured in this research by utilising the quick point shooting section of the test battery. According to this test protocol;

Five shooting points are positioned at equal intervals, 4.57 metres from the centre of the half-court hoop on a basketball court according to international standards. The points are measured from the projection of the hoop's centre and marked with 60 cm clear tape. The athlete begins the shooting test from the starting point. The athlete takes a shot at the hoop from the first point, retrieves the ball, moves to the next shooting location, and continues the pattern until they have shot from each of the five locations. It is required that one foot of the athlete stays behind the marking line while shooting. The athlete is permitted to attempt a lay-up upon retrieving a missed shot but is prohibited from consecutively attempting two lay-ups. During the test, the athlete shoots or completes a lay-up from five different points on the court until the "stop" warning is given. Once 60 seconds have passed, the shooting test concludes. Technical abbreviations will be explained when

initially used. Two points are granted for each successful shot or lay-up, while a missed shot that hits the rim and returns will receive one point. If the lay-up is successfully made after the ball returns from the hoop, two points will be awarded. If two consecutive lay-ups are made correctly, no points will be assigned for the second one. Up to four lay-ups may be attempted within a 60-second time frame, and no additional points will be granted beyond this. Rule infractions, like dribbling, ball handling, and crossing the shooting line, will not earn any points [7, 8].

Hand Quickness Test (Touching Discs); Two plastic discs with a diameter of 20 cm are positioned on the table, with the centre points of the two discs being 80 cm apart (with the edges of the discs being 60 cm apart). A rectangular plate is placed at an even distance from the two discs, measuring 10 x 20 cm. The dominant hand is crossed over the other hand and placed on the disc in the opposing direction to it. The test requires the athlete to move their preferred hand placed on the disc over the other hand and touch the discs as quickly as possible. The test is performed twice, and the best performance is recorded as the final result. Attention is paid to the disc on which the athlete places the preferred hand at the beginning of the test, and the touches made on this disc are counted. The test adheres to objective measures and ensures a logical progression of information. Attention is paid to the disc on which the athlete places the preferred hand at the beginning of the test, and the touches made on this disc are counted. Assuming the test commences when the subject touches disc A, the stopwatch is terminated when the subject touches disc A 25 times. This means that the total number of contacts on discs A and B is 50. The score is a measurement of the time needed for a total of 50 touches in units of 1/10. For instance, finishing the test in 10.3 seconds for 25 cycles gives a score of 103 points [9].

Our research project was reviewed by the Ethics Committee for Social and Human Sciences at Dicle University, in compliance with the Higher Education Institutions' guidelines for Scientific Study and Publication Ethics. The study was found to adhere to scientific ethical standards and received approval on 08.03.2022 with reference number 244973.

Statistical Analysis: The data was statistically analysed using SPSS 22.0. Normality tests were conducted by examining skewness and kurtosis values. For non-normally distributed data, Mann Whitney U test was applied. In addition, Pearson correlation analysis was used to test the relationship between variables [8].

Results

Descriptive statistical analysis was utilised to determine the frequencies and percentages of athletes according to gender. The outcomes obtained are presented in Table 1.

Table 1. *Descriptive Statistics of Athletes by Gender*

Variables	n	%
Male	17	51,5
Female	16	48,5
Total	33	100

n: number, **%**:percentage

The study comprised 33 athletes, 17 of whom were males (51.5%) and 16 of whom were females (48.5%), as our analysis revealed.

Descriptive statistical analysis was conducted to calculate the mean and standard deviation of the age, height, weight, years of experience in sports, arm length, shot accuracy score, and hand quickness score of the athletes. The obtained values are presented in Table 2.

Table 2. *Descriptive Statistics for Age, Height, Weight, Sport Year, Arm Length, Shooting Accuracy Score, and Hand Quickness Score among Athletes*

Variables	Male	Female	Total
Age (years)	21,00 ± 1,00	21,31 ± 1,07	21,15 ± 1,03
Height (cm)	186,00 ± 8,35	170,62 ± 5,71	178,54 ± 10,53
Weight (kg)	76,47 ± 9,95	58,25 ± 5,73	67,63 ± 12,26
Sport Year (years)	10,17 ± 1,55	10,25 ± 1,61	10,21 ± 1,55
Arm Length (cm)	81,11 ± 4,13	72,87 ± 4,11	77,12 ± 5,82
Hand Quickness Score	95,94 ± 8,23	116,56 ± 12,60	105,93 ± 14,76
Shot Accuracy Score	17,35 ± 1,41	13,81 ± 3,14	15,63 ± 2,97

The mean values for age, height, weight, years of sports experience, arm length, shot accuracy scores, and hand quickness scores were compared between male and female athletes using an Independent Sample T Test. The study results are presented in Table 3 ($p<0.05$).

Table 3. *Comparison of Average Age, Height, Weight, Sport Year, Arm Length, Shooting Accuracy Score, and Hand Quickness Score Among Athletes by Gender*

Variables	Male	Female	p
Age (years)	21,00 ± 1,00	21,31 ± 1,07	,394
Height (cm)	186,00 ± 8,35	170,62 ± 5,71	,000**
Weight (kg)	76,47 ± 9,95	58,25 ± 5,73	,000**
Sport Year (years)	10,17 ± 1,55	10,25 ± 1,61	,895
Arm Length (cm)	81,11 ± 4,13	72,87 ± 4,11	,000**
Hand Quickness Score	95,94 ± 8,23	116,56 ± 12,60	,000**
Shot Accuracy Score	17,35 ± 1,41	13,81 ± 3,14	,000**

p<0,05*****, p<0,01******

Table 3 indicates a statistically significant differentiation in height, weight, arm length, hand quickness score, and shooting accuracy score ($p<0.05$, $p<0.01$). However, no statistically significant distinctions were observed between the groups in terms of age and sport year parameters ($p>0.05$).

Pearson's correlation analysis was utilised to ascertain the correlation between the athletes' demographic data, arm length, hand quickness score and shooting score. The results are presented in Table 4.

Table 4. *Exploring the Correlation between Athletes' Demographic Information, Arm Length, Hand Quickness Score, and Shooting Score*

Variables		**Gender**	**Age**	**Height**	**Weight**	**(SY)**	**(AL)**	**(HQS)**	**(SAS)**
Gender	Pearson r	1	,153	-,740**	-,754**	,024	-,718**	-,709**	-,604**
	p		,394	,000	,000	,895	,000	,000	,000
Age	Pearson r		1	-,045	-,109	,814**	-,138	-,267	-,195
	p			,803	,547	,000	,444	,134	,278
Height	Pearson r			1	,807**	,120	,955**	,616**	,402*
	p				,000	,505	,000	,000	,020
Weight	Pearson r				1	,034	,830**	,629**	,665**
	p					,853	,000	,000	,000
Sport Year (SY)	Pearson r					1	-,020	,050	-,010
	p						,911	,783	,957
Arm Length (AL)	Pearson r						1	,532**	,395*
	p							,001	,023
Hand Quickness Score (HQS)	Pearson r							1	,743**
	p								,000
Shot Accuracy Score (SAS)	Pearson r								1
	p								

******. Correlation is significant at p<0.01 level.
*****. Correlation is significant at p<0,05 level.

There was a statistically significant, negative correlation between gender and various scores including height, weight, arm length, hand quickness, and shooting accuracy (p<0.05, p<0.01). However, other parameters did not show a statistically significant difference between gender (p>0.05).

There was a significantly strong positive correlation between age and years of participating in sports (p<0.01). However, no statistically significant difference was observed between age and other assessed parameters (p>0.05).

There was a positive correlation between height and weight, arm length, hand quickness score and shooting accuracy score, which was statistically significant (p<0.05, p<0.01). However, there was no statistically significant difference between height and other parameters (p>0.05).

There was a significant, positive correlation between weight and arm length, hand quickness score and shooting accuracy score ($p<0.01$).

However, the difference between sport year and other parameters was not statistically significant ($p>0.05$).

There was a statistically significant and positive correlation observed between arm length, hand quickness score, and shot accuracy score ($p<0.05$, $p<0.01$). However, no significant correlation was found between arm length and other parameters ($p>0.05$).

A statistically significant and positive difference was found between hand quickness score and shot accuracy score, with a strong effect size ($p<0.01$).

Pearson correlation analysis was used to determine the relationship between demographic information and arm length, hand speed score and shooting score of male athletes. The results are presented in Table 5.

Table 5. *The Correlation Between Demographic Information of Male Athletes and Arm Length, Hand Quickness Score, and Shooting Score.*

Variables		**Age**	**Height**	**Weight**	**(SY)**	**(AL)**	**(HQS)**	**(SAS)**
Age	Pearson r	1	,195	,169	,806**	,076	,342	,443
	p		,454	,516	,000	,773	,180	,075
Height	Pearson r		1	,691**	,367	,890**	,618**	,329
	p			,002	,148	,000	,008	,198
Weight	Pearson r			1	,286	,807**	,371	,579*
	p				,266	,000	,143	,015
Sport Year (SY)	Pearson r				1	,143	,709**	,569*
	p					,585	,001	,017
Arm Length (AL)	Pearson r					1	,376	,314
	p						,137	,220
Hand Quickness Score (HQS)	Pearson r						1	,407
	p							,105
Shot Accuracy Score (SAS)	Pearson r							1
	p							

******. Correlation is significant at $p<0.01$ level.
*. Correlation is significant at $p<0,05$ level.

There was a significant and positive correlation between age and duration of sport participation among male athletes ($p<0.01$). However, the relationship between age and other variables did not demonstrate statistical significance ($p>0.05$).

A statistically significant and positive correlation was found between height and weight, arm length and hand speed score in male athletes ($p<0.01$). However, there was no statistically significant distinction between height and other parameters ($p>0.05$).

There was a significant and positive difference found between male athletes' weight, arm length, and their shooting accuracy score ($p<0.05$). However, there was no statistical significance found between weight and other parameters ($p>0.05$).

There was a statistically significant positive correlation between the hand quickness score and the shooting accuracy score of male athletes with years of sport involvement ($p<0.05$).

In male athletes, a moderate positive correlation was also observed between the hand quickness score and the shot accuracy score. However, this correlation was not statistically significant ($p<0.05$).

Pearson correlation analysis was employed to ascertain the correlation between the demographic data and arm length, hand quickness score, and shooting score of female athletes. A summary of the results is presented in Table 6.

Table 6. *The Correlation Between Demographic Data of Female Athletes and Arm Length, Hand Quickness Score and Shooting Score*

Variables		**Age**	**Height**	**Weight**	**(SY)**	**(AL)**	**(HQS)**	**(SAS)**
Age	Pearson r	1	-,023	-,262	,834**	-,156	-,600*	-,394
	p		,933	,328	,000	,564	,014	,131
Height	Pearson r		1	,225	-,025	,968**	-,211	-,397
	p			,402	,926	,000	,434	,128
Weight	Pearson r			1	-,281	,369	,055	,428
	p				,291	,160	,841	,098
Sport Year (SY)	Pearson r				1	-,156	-,314	-,253
	p					,564	,236	,344
Arm Length (AL)	Pearson r					1	-,180	-,260
	p						,504	,332
Hand Quickness Score (HQS)	Pearson r						1	,618*
	p							,011
Shot Accuracy Score (SAS)	Pearson r							1
	p							

******. Correlation is significant at $p<0.01$ level.
*****. Correlation is significant at $p<0,05$ level.

Conversely, a significant negative correlation was noted between hand quickness score and age ($p<0.05$).

Significant positive correlations were observed between the age and years of sport, as well as between the height and arm length of female athletes ($p<0.05$).

The disparities between weight and other factors in female athletes failed to attain statistical significance ($p>0.05$).

Similarly, the variances between years of sport and other parameters in female athletes did not display any statistical significance ($p>0.05$).

There were no statistically significant differences between arm length and other parameters in female athletes ($p>0.05$).

However, there was a moderate positive and statistically significant difference discovered between female athletes' hand quickness scores and shot accuracy scores ($p<0.05$).

Discussion and Conclusion

The study revealed a significant negative correlation between gender and height, weight, arm length, hand quickness scores, and shooting accuracy in basketball players ($p<0.05$, $p<0.01$). Additionally, there was a strong positive correlation found between age and years of sport ($p<0.01$). There were statistically significant positive correlations between height and weight, arm length, hand quickness score, and shooting accuracy score ($p<0.05$, $p<0.01$). Similarly, statistically significant positive correlations between weight and arm length, hand quickness score, and shot accuracy score were found ($p<0.01$). Additionally, a statistically significant positive difference was observed between arm length and hand quickness score and shot accuracy score ($p<0.05$, $p<0.01$). There was a noticeable and significant distinction between hand quickness scores and shooting accuracy scores, with a strong positive correlation ($p<0.01$).

A study by Abdullah (2019) investigated the correlation between vertical jump, shooting, and balance tests and anthropometric factors such as age, weight, sports age, height, and AAHPERD quick shooting test among 24 male and female basketball players in two groups of equal size. The findings revealed a highly significant correlation between shooting and gender, as well as a moderately significant correlation between height and weight. Our study revealed that a negative correlation and a statistically significant gender-based difference were present in relation to shooting accuracy scores ($p<0.01$) [11]. Conversely, no statistically significant difference was found between age and shooting accuracy scores ($p>0.05$).

Professional basketball players strive to attain specific shooting percentages. These goals include 99% for lay-ups, 70% for free throws, 50% for 2-pointers, and 33% or higher for 3-pointers

among professional athletes. These targets may be lower for young basketball players [12]. In our study, we discovered no significant statistical variance concerning shooting accuracy and age ($p>0.05$). The findings suggest that the research groups exhibit a homogeneous structure and demonstrate similar developmental periods when age groups are taken into account.

According to research, the number of years an athlete spends in a particular sport has a linear impact on their performance [13]. Uzun and Pulur (2011) found that basketball players significantly improved their free throw percentage by 106.8% after 10 weeks of training ($p<0.01$), and their accuracy improved in proportion to the duration of the training [14]. Our study found a positive correlation and a statistically significant relationship between the number of years participating in sports, hand quickness scores, and shot accuracy in male athletes. As the athlete's sports history increased, the number of shots taken increased, and shot accuracy improved as expected.

A basketball shooting test was conducted on 24 university students who have actively engaged in basketball for a minimum of 3 years [15]. The participants' upper extremity length, muscle strength, vertical jump reaction time, and Nelson hand reaction time were measured. The group, with an average age of 25, completed a 5-minute warm-up period, after which their dominant hand, total arm length, hand length, forearm, upper arm, and finger lengths were measured in centimetres. Muscle strength, pinch grip, palm grip, and hand grip strength were measured using a hand dynamometer. Reaction time was assessed using the Nelson scale. The study highlights the significance of enhancing free throw performance for achieving match victory. Players exhibited positive results in hand reaction time, vertical jump duration, reaction time, upper extremity extensor strength, and grip strength. After these studies, exercises to improve the upper extremities' coordination, grip strength, and reaction time all contributed to increased shooting accuracy. Our study findings showed a moderate positive correlation between hand quickness score and shot accuracy score in male athletes. However, this relationship did not reach statistical significance ($p<0.05$). A moderate positive and statistically significant difference was found in the data collected from female athletes, between the score for hand quickness and the score for shot accuracy ($p<0.05$).

Shooting is a crucial aspect of basketball. According to Morgan and Dave's (2003) study, shooting accuracy in basketball can be improved by enhancing athletes' self-confidence and training muscle groups responsible for shooting via specially designed regimes [16]. In addition, physical abilities are also essential for a good shooter [14]. A statistically significant positive correlation between weight, arm length and shooting accuracy score ($p < 0.05$) was observed in male athletes

participating in our study. Additionally, a significant positive correlation ($p < 0.01$) was found between height, weight, and arm length of male athletes.

When considering existing literature, Teramoto et al. (2018) investigated the correlation between hand length and 2-point shooting percentage in their analysis of how anthropometric characteristics impact shooting performance, utilizing measurements from the NBA Draft Combine [17]. Following Barut et al.'s (2008) findings, it was concluded that hand length had a significant correlation with two-point shooting performance [18]. However, no significant relationship was found between hand length and 3-point shooting percentage in the same study. The study conducted hand length measurements and analyzed their impact on 2-point shooting results, leading to the observation of a weak correlation between hand length and 2-point shooting percentage. Our study findings indicate a positive and significant correlation between arm length, an anthropometric characteristic of basketball players, and shooting accuracy among male athletes ($p<0.01$). In contrast, the effect of arm length on shooting accuracy was not statistically significant in female athletes ($p>0.05$).

Conclusion

Based on the findings obtained, this study posits that further research investigating the impact of arm length and hand quickness on basketball shooting accuracy could enhance the existing literature. It can be argued that the arm lengths of athletes, particularly with regard to hand quickness, have an impact on shot accuracy. This is a significant factor which coaches must consider when selecting athletes and conducting further research to enhance the reactive abilities of athletes through existing training methods.

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