

The Relationship Between Maximum Ball Throwing Speed and Shooting Accuracy and Expert Assessment of Basic Shot Technique in Handball

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Abstract: The aim of this study was to examine the relationship between anthropometric characteristics, handgrip strength, ball exit speed, shooting accuracy, and expert assessment of the basic handball shot technique. The research was conducted on a sample of 88 first-year students at the Faculty of Kinesiology. Measurements included ball speed (radar-based), shooting accuracy (goal segment scoring system), handgrip strength (dynamometer), and expert technique assessment (video evaluation). The results showed a significant correlation between expert assessment and ball speed, as well as a moderate correlation between certain anthropometric measures and ball velocity. No significant relationship was found between handgrip strength and shooting accuracy. In conclusion, technical execution and body characteristics play an important role in generating a powerful and effective handball shot, while shooting accuracy appears to rely on additional specific qualities beyond physical abilities alone.

1 INTRODUCTION

Handball is a complex, high-intensity team sport characterized by explosive actions, speed, precision, and situational decision-making (Rogulj, 2020; Žakula & Jovanović, 2018). Shot velocity is a crucial performance determinant, as faster shots reduce the goalkeeper's reaction time and increase scoring potential (Marczinka, 1993; Zapartidis et al., 2009). Technical execution of the shot, particularly the basic standing shot, involves a complex sequence of coordinated movements known as the kinetic chain, including trunk rotation, arm swing, and timed weight transfer (Rogulj & Foretić, 2007; Wagner et al., 2011). The efficiency of this chain significantly influences both ball velocity and shooting accuracy. In addition, grip strength is recognized as a proxy for upper body strength and plays a role in ball control and release mechanics (Visnapuu et al., 2007; Koley, Gandhi & Singh, 2008). While previous studies have explored the relationship between shot speed and technique (Bjelobrk Menčik et al., 2014; Van den Tillaar, 2020), less attention has been given to how anthropometric traits and grip strength relate to expert-assessed technical quality and shooting

precision, especially in untrained or novice players. This study aims to address that gap by investigating these variables in the context of the basic handball shot.

The objective of this study was to examine the relationships between selected anthropometric characteristics, handgrip strength, ball release speed, shooting accuracy, and expert assessment of shot technique in handball. The focus was placed on evaluating how these variables contribute to the performance of the basic handball shot, including both standing and jump shots. Although all participants were kinesiology students, their sporting backgrounds varied. Some had experience in ball games such as football, volleyball, and basketball, while others practiced combat sports or cyclic activities such as swimming and athletics. This variability provided a diverse sample in terms of technical proficiency and familiarity with handball techniques. This research aimed to determine to what extent physical attributes and technical proficiency influence shot velocity and accuracy among kinesiology students.

Considering the aim of the study the hypotheses were formulated - that (H1) there is a statistically

significant correlation between expert assessment of shot technique and both ball release speed and shooting accuracy, (H2) there is a statistically significant correlation between individual anthropometric characteristics and maximum ball release speed, and (H3) there is a statistically significant correlation between handgrip strength and shooting accuracy.

2 MATERIALS AND METHODS

The research was conducted on a sample of 88 male first-year students of the Faculty of Kinesiology, University of Zagreb, with an average age of 19.45 years, body height 182.63 ± 6.15 , body weight 76.95 ± 8.06 . Participants were engaged in various sports at different levels and voluntarily agreed to participate in the study.

The study aimed to determine the relationship between anthropometric characteristics, handgrip strength, ball release speed, shooting accuracy, and expert assessment of shot technique in handball. Ball release speed was measured using a Stalker ATS II radar gun in four shooting conditions: seated shot from 4 meters, standing shot from 6 meters, standing shot with approach from 9 meters, and jump shot from 9 meters. Participants were instructed to prioritize maximum ball speed while still attempting to maintain accuracy. Each 1

Expert assesment of shooting technique (basic jump and shot jump) was based on video recordings taken from the side view. Three experienced handball experts independently evaluated each participant's best attempt using a predefined set of criteria. The assesment included the following parameters: ball control, stance, movement phases, gross coordination, fine coordination, execution speed/power and situational applicability (Gruić, Vrbik, 2018).

Data was processed using Statistica software. Normality of distributions was checked with the Kolmogorov-Smirnov test, and relationships between variables were analyzed using Spearman's correlation coefficient. A significance level of $p < 0.05$ was adopted.

3 RESULTS

The results showed significant positive correlations between expert assessment of shooting technique and ball release speed across all shooting types. The

strongest relationship was observed between the standing shot rating and ball speed ($\rho = 0.49$, $p < 0.01$), followed by seated shot ($\rho = 0.35$, $p < 0.01$) and jump shot ($\rho = 0.34$, $p < 0.01$). These findings suggest that technically better-executed shots tend to result in higher ball velocities.

Table 1: Descriptive statistics.

Variable	Mean $\pm$ SD
Arm Span	182,81 $\pm$ 7,75
Thumb-Small Finger Span (cm)	22,96 $\pm$ 1,32
Thumb-Ring Finger Span (cm)	23,02 $\pm$ 1,44
Thumb-Middle Finger Span (cm)	22,54 $\pm$ 1,50
Thumb-Index Finger Span (cm)	19,93 $\pm$ 1,57
Handgrip Strength (kg)	44,30 $\pm$ 8,53
Ball Speed (Seated shot) (km/h)	48,17 $\pm$ 6,14
Ball Speed (Stance shot) (km/h)	64,21 $\pm$ 8,08
Ball Speed (Basic shot) (km/h)	71,03 $\pm$ 7,81
Ball Speed (Jump shot) (km/h)	66,87 $\pm$ 7,39
Accuracy (Stance Shot)(points)	1,83 $\pm$ 0,69
Accuracy (Basic Shot)(points)	1,54 $\pm$ 0,71
Accuracy (Jump Shot)(points)	1,93 $\pm$ 0,66
Expert rating (Stand shot)(points)	4,96 $\pm$ 1,48
Expert rating (Jump shot)(points)	5,02 $\pm$ 1,45

Handgrip strength (first trial) demonstrated a moderate correlation with ball speed in all four shooting variants, with values ranging from $\rho = 0.37$ to $\rho = 0.49$ ($p < 0.01$). The strongest association was found between handgrip strength and ball speed in the seated shot ($\rho = 0.49$), indicating that upper body force transmission is crucial in this isolated condition. Similarly, body mass and arm span were moderately correlated with ball speed, especially in standing and jump shots (e.g., body mass and standing shot: $\rho = 0.40$, $p < 0.01$; arm span and jump shot: $\rho = 0.35$, $p < 0.01$).

In contrast, shooting accuracy showed no statistically significant correlation with expert technique ratings, handgrip strength, or anthropometric characteristics. For instance, the correlation between expert rating and standing shot accuracy was only $\rho = 0.16$ ($p > 0.05$), while handgrip strength and accuracy were weakly and inconsistently related (e.g., $\rho = -0.05$). Some hand span measures showed negative correlations with accuracy (e.g., thumb to middle finger span and jump shot accuracy: $\rho = -0.26$), but these were not statistically significant. These results suggest that shooting accuracy may depend on perceptual-motor coordination and

cognitive factors, rather than physical or technical parameters alone.

Table 2: Spearman (ρ) Correlation between expert ratings from basic stance shot and ball speed from different setups.

Variable	ρ	p
ER - Standing shot ball speed	0.49	< 0.01
ER- Seated shot ball speed	0.35	< 0.01
ER - Jump shot ball speed	0.34	< 0.01

Table 3: Spearman (ρ) Correlation between physical attributes and ball speed.

Variable pair	ρ	p
Handgrip Strength–Seated Shot	0.49	<0.01
Handgrip Strength–Stance Shot	0.45	<0.01
Body Mass –Basic Shot	0.40	<0.01
Arm Span – Jump Shot	0.35	<0.01

Table 4: Spearman (ρ) Correlation with shooting accuracy (non-significant).

Variable pair	ρ	p
Expert rating (Basic shot)- Accuracy	0.16	>0.05
Handgrip Strength-Accuracy (Basic Shot)	-0.05	>0.05
Body Mass- Accuracy (Jump shot)	0.11	>0.05
Thumb- Middle Finger Span- Accuracy (Jump shot)	-0.26	>0.05

4 DISCUSSION AND CONCLUSIONS

The results of this study indicate that the technical quality of handball shooting, as assessed by expert evaluators, is significantly associated with ball release speed in all shooting conditions. This finding underscores the key role of proper technique in generating higher shot velocity. Physical attributes such as handgrip strength, body mass, and arm span also showed moderate positive correlations with ball speed, particularly in power-dependent shooting variants. In this context, standing and jump shots can be considered power-dependent variants, as they require coordinated whole-body force transmission, while the seated shot isolates the throwing arm and minimizes contribution from the lower body.

In contrast, shooting accuracy did not significantly correlate with physical or technical variables, suggesting that precision depends more on

perceptual-motor abilities, decision-making, and game awareness than on physical strength or biomechanical form alone.

These insights are particularly relevant for coaches working with younger age groups, where shooting technique is still being developed. The findings emphasize the importance of prioritizing technical skill acquisition in early training phases, as well as distinguishing between exercises aimed at improving shot power versus those intended to enhance accuracy. By understanding which factors most strongly influence shot performance, coaches can better structure training sessions to support long-term player development.

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