Relationship Between Ball Release Parameters and Shooting Performance in Basketball under different constraints

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Summary

This study explores the relationship between ball release (BR) parameters (height, angle, velocity) and shooting performance under different constraints. Eight senior basketball athletes performed 90 shots across three conditions (no constraints, crowd noise, simulated defense). BR height and angle showed weak but significant correlations with precision ($r = 0.107$, $p = 0.013$; $r = 0.105$, $p = 0.015$), though explanatory power was low ($R^2 = 0.011$). BR height significantly influenced efficiency ($p = 0.004$, effect size = 0.125). Results suggest that adjusting BR height could improve shooting efficiency.

Introduction

Basketball shooting performance depends on BR parameters, which directly influence shot success and accuracy [1]. Previous research highlights the importance of optimizing these kinematic factors to improve shooting outcomes [2]. External constraints, such as crowd noise or defensive opposition, also affect motor performance and decision-making during shooting [3]. Despite these insights, the relationship between BR parameters, shot efficacy (scored on a 0–4 scale), and accuracy (scored vs. missed) under different constraints remains underexplored. This study aims to fill this gap by analyzing how BR height, angle, and velocity variations correlate with shot outcomes under different experimental conditions.

Methods

Eight senior-level basketball athletes (13.375 ± 3.839 years federated practice) performed 90 shots each (10 shots from three positions under three conditions: no constraints, simulated audience noise, and simulated defense). The study, approved by the Faculty of Sports Science and Physical Education, University of Coimbra (CE/FCDEF-UC/00812021), adhered to the Declaration of Helsinki. Ball release (BR) parameters (height, angle, velocity) were recorded via a Qualisys Motion System (200 Hz). Shot efficacy (0–4 scale) and accuracy (made/missed) were measured. ANOVA compared BR parameters across conditions, and logistic regression analyzed their relationship with efficacy and accuracy ($p < 0.05$).

Results and Discussion

ANOVA found no significant differences in BR parameters across conditions ($p > 0.05$). Mean release height ranged from 2.078 ± 0.170 m to 2.155 ± 0.230 m, angle from 54.420° ± 3.067° to 56.015° ± 3.738°, and velocity from 6.788 ± 0.705 m/s to 7.972 ± 0.777 m/s. Pearson's correlation indicated weak positive relationships between release height and shot precision ($r = 0.107$, $p = 0.013$) and between angle and precision ($r = 0.105$, $p = 0.015$). Linear regression revealed low explanatory power ($R^2 = 0.011$), indicating minimal impact on precision. Velocity showed no significant correlation with precision ($r = 0.072$, $p = 0.094$, $R^2 = 0.005$), Table 1. Regarding shot efficiency (made/missed), only release height significantly influenced scoring ($p = 0.004$, effect size = 0.125), with angle and velocity showing no significant effect ($p > 0.05$).

Conclusions

Ball release height was the strongest predictor of efficiency, supporting its relevance for shooting performance. The findings, consistent with previous literature, underscore the importance of adjusting shot trajectory, particularly release height, to improve efficiency.

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Table 1: The relationship between ball release parameters, shot precision (0–4 scale), and efficiency (score/miss). Significant level ($p < 0.05$).

VARIABLE	PRECISION (0-4 values system)				EFFICIENCY (score/miss)	
	Pearson	*p*	Correlation	R-squared	*p*	effect size
HEIGHT [m]	0.107	0.013	weak positive	0.011	**0.004**	0.125
ANGLE [º]	0.105	0.015	weak positive	0.011	0.078	0.076
VELOCITY [m/s]	0.072	0.094	very weak positive	0.005	0.194	0.056