OPTIMIZING ENERGY TRANSFER IN THE GOLF SWING: INTRODUCING A NEW METRIC BEYOND SMASH FACTOR

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Introduction

Efficient energy transfer is essential for maximizing ball speed and driving distance in golf. Traditional metrics like smash factor overlook key variables resulting in misleading swing data. A more comprehensive approach can better assess strike efficiency and enhance performance (1-3).

PURPOSE

The purpose of the study was to develop a new metric that quantifies the efficiency of energy transfer in relation to driving distance rather than just ball speed.

Methods

Eight female (height 167.9 ± 3.8 cm, weight 64.3 ± 5.5 kg, driver club head weight 198 ± 4 g) NCAA Division I golf athletes. The golfers completed a swing session to assess maximal effort driver club head speed (CHS), ball speed (BS), angle of attack (AoA), smash factor (SF) and total driving distance (TD). Calculations included club head kinetic energy (CHKE), ball kinetic energy (BKE), total kinetic energy (TKE), and TD to TKE ratio (DKE ratio).
Club Head: $KE = 1/2mv$
Golf Ball: $KE = 1/2m(vsin\theta2)$

PRACTICAL APPLICATIONS

Unlike smash factor, the DKE ratio provides golfers with insight into their actual strike efficiency and energy transfer. This ratio can be used by coaches and practitioners for training and injury prevention by identifying instances where high intensity swings produce low energy output, eliminating potential excessive strain or lack of efficiency in force application. Future research should include other ball striking metrics, such as spin rate, club path, face angle, launch angle and spin axis, to enhance the accuracy of measuring energy transfer.

Statistical Significance Testing	
Testing Variables	Paired Samples T-Test
SF : DKE Ratio	$p < .001$

Linear Regression Model		
Model Summary	TD : SF	TD : DKE Ratio
R	0.725	0.981
Adjusted R Squared	0.337	0.947

Figure 1. (SF = Smash Factor, DKE Ratio = Distance to Kinetic Energy Ratio, TD = Total Distance)

Results

A significant difference was found between the DKE Ratio and SF ($p < .001$). Linear regression models were used to predict ball flight, with TD included as the independent variable in each model. The model including TD, Smash Factor, and Total Ball/Club Speed resulted in an r = .725 and an adjusted R^2 = .337. In contrast, the model including TD, DKE Ratio, and TKE produced a much stronger correlation (r = .981) and a higher explanatory power (adjusted R^2 = .947). See figure 1.

Conclusions

The DKE ratio takes into consideration energy loss immediately following contact by calculating the kinetic energy transferred to a golf ball based on the AoA. This results in a stronger predictor for energy transfer and ball flight. Golfers may have an ideal smash factor while still having a poor DKE ratio. The DKE ratio provides a more in-depth analysis of energy transfer into a golf ball, making it great for optimizing performance.

REFERENCES

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