Relationship of Biometrics, Biomechanics, Performance, and Sport Ranking in Disc Golf Players: A Pilot Study

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ABSTRACT

Disc golf is one of the fastest growing sports globally, however, little evidence exists examining the influence of player biometrics, sport biomechanics, and individual sport ranking on successful disc golf performance. Furthermore, to our knowledge, no evidence-based, sport-specific training programs are available to improve disc golf performance.

Purpose: To examine the relationship between biometrics, biomechanics, performance, and sport ranking in adult male disc golfers.

Methods: A convenience sample of 13 male disc golfers (mean age =38.5±10.8yrs, mean height=179.8±8.1cm, mean bwt=103.1±21.4kg, mean BMI=31.6±7.1, mean bodyfat percentage=27.1±7.8) competitive disc golfers volunteered for the study. Subjects gave IRB-approved informed consent prior to participation, then completed the PAR-Q+ questionnaire. Subject height and weight were measured with a stadiometer (Seca) and scale (GE), respectively. Body fat percentage was determined by BIA (Omron). Grip strength was measured with a handgrip dynamometer (Jamar). Subjects then performed three maximal-distance forehand and backhand throws each to determine: elbow valgus torque (MOTUS sleeve); arm slot (MOTUS sleeve); arm velocity (LoggerPro); horizontal disc velocity (LoggerPro), and; throw distance (Bushnell). Best-of-3 trials was used for each performance outcome. Means and SDs were calculated for all variables. The Pearson-product moment correlation was used to determine relationships among all variables. A 1-way ANOVA was used to determine if differences existed between groups divided by median Professional Disc Golf Association (PDGA) rating. Significance level was set at p≤0.05.

Results: Several significant positive and inverse correlations were observed, including: bwt and backhand arm velocity (r=0.78, p=0.002), backhand valgus torque (r=0.65, p=0.02), and forehand arm slot (r=-0.65, p=0.02); BMI and backhand arm velocity (r=0.81, p<0.001), backhand valgus torque (r=0.66, p=0.02), forehand arm slot (r=0.68, p=0.01), and PDGA rating (r=-0.60, p=0.05); backhand valgus torque and backhand arm velocity (r=0.90, p=<0.001) and backhand distance (r=0.56, p=0.05); forehand distance and forehand valgus torque (r=0.71, p=0.006) and forehand arm slot (r=0.58, p=0.04). No performance differences were observed between higher and lower rated PDGA groups, though the groups strongly tended to be different in rating itself (880 ± 14 vs, 880 ± 73, p=0.06).

Conclusions: The positive correlation between forehand distance, valgus torque, and arm slot was expected, given that more torque and a higher arm slot (re: longer lever arm) should equate to greater throwing distance. A significant relationship existed between subject biometrics (bwt, BMI) and multiple backhand and forehand performance measures, indicating that larger biometrics may contribute to better performance for some less physically fit amateur players. This conclusion is possibly supported by an inverse relationship of PDGA rating and BMI in the present population. Future research should include a larger, more diversified subject pool, including elite professional disc golfers, to further delineate those kinetic, kinematic, and biometric attributes contributing to better disc golf playing performance.

Practical Application: To our knowledge, there are no evidence-based sport-specific S&C programs available for disc golf athletes. Our data preliminarily indicates that disc golfers should strive to improve thoraco-rotational kinetics, enhance core strength and stability, and utilize constant external resistance training modes specific to the unique neuromuscular coordination characteristics of forehand and backhand disc golf throws.

INTRODUCTION

Disc golf is one of the fastest growing sports globally, however, little evidence exists examining the influence of player biometrics, sport biomechanics, and individual sport ranking on successful disc golf performance and injury risk[1]. Furthermore, to our knowledge, no evidence-based, sport-specific training programs are available to improve disc golf performance or reduce injury risk.

METHODS

A convenience sample of 13 male disc golfers (mean age=38.5±10.8yrs, mean height=179.8±8.1cm, mean bwt=103.1±21.4kg, mean BMI=31.6±7.1, mean bodyfat percentage=27.1±7.8) competitive disc golfers volunteered for the study. Subjects gave IRB-approved informed consent prior to participation, then completed the PAR-Q+ questionnaire. Subject height and weight were measured with a stadiometer (Seca) and scale (GE), respectively. Body fat percentage was determined by BIA (Omron). Grip strength was measured with a handgrip dynamometer (Jamar). Subjects then performed three maximal-distance forehand and backhand throws each to determine: elbow valgus torque (MOTUS sleeve); arm slot (MOTUS sleeve); arm velocity (LoggerPro); horizontal disc velocity (LoggerPro), and; throw distance (Bushnell). Best-of-3 trials was used for each performance outcome. Means and SDs were calculated for all variables. The Pearson-product moment correlation was used to determine relationships among all variables. A 1-way ANOVA was used to determine if differences existed between groups divided by median Professional Disc Golf Association (PDGA) rating. A dependent t-test was used to evaluate backhand and forehand performance for all subjects. The intention-to-treat model was applied for the statistical analysis. Significance level was set at p≤0.05.

Figure 1: Forehand Throw & Follow Through

Figure 2: Backhand Throw & Follow Through

RESULTS

Table 1: Demographic Comparison – By PDGA Rating (Mean ± SD)

Dependent Variable	Higher Rating (n = 4)	Lower Rating (n = 7)	Total (n = 11)
Age (yrs)	39.2 ± 9.6	40.7 ± 12.4	40.2 ± 11.0
Playing Experience (yrs)	7.5 ± 8.3	6.2 ± 8.8	6.7 ± 8.2
PDGA Rating	880 ± 14[a]	800 ± 73	829 ± 70
Height (in)	72.1 ± 3.2	70.0 ± 3.6	70.7 ± 3.4
Weight (lbs)	219.5 ± 21.2	221.7 ± 42.7	220.9 ± 35.1
BMI	29.4 ± 3.7	31.4 ± 5.7	30.7 ± 5.0
Body Fat %	25.7 ± 4.7	28.1 ± 7.0	27.2 ± 6.2

[a] mean difference strongly tended to be significantly greater vs. Lower Rating (p = 0.06)

Table 2: Performance Comparison – By PDGA Rating (Mean ± SD)

Dependent Variable	Higher Rating (n = 4)	Lower Rating (n = 7)	Total (n = 11)
Handgrip Strength (lbs)	121.0 ± 27.3	122.6 ± 19.6	122.0 ± 21.3
Backhand Valgus Torque (Nm)	17.0 ± 8.6	12.0 ± 4.7	13.8 ± 6.4
Backhand Arm Slot (º)	3.7 ± 12.2	4.0 ± 11.6	3.9 ± 11.2
Backhand Arm Velocity (rpm)	273.0 ± 51.1	280.7 ± 43.8	277.9 ± 44.2
Backhand Distance (ft)	280.7 ± 48.8	289.0 ± 92.3	286.0 ± 76.5
Backhand Horizontal Disc Velocity (m/s)	23.1 ± 3.1	24.7 ± 4.3	24.0 ± 3.7
Forehand Valgus Torque (Nm)	28.0 ± 7.2	23.0 ± 9.3	24.8 ± 8.6
Forehand Arm Slot (º)	0.8 ± 4.7	0.3 ± 14.0	0.5 ± 11.2
Forehand Arm Velocity (rpm)	591.5 ± 266.0	529.0 ± 181.9	551.7 ± 205.1
Forehand Distance (ft)	361.2 ± 178.3	330.3 ± 138.5	341.5 ± 145.9
Forehand Horizontal Disc Velocity (m/s)	24.8 ± 3.3	24.0 ± 4.3	24.3 ± 3.8

RESULTS (cont.)

- No performance differences were observed between higher and lower rated PDGA groups, though the groups strongly tended to be different in rating itself (880 ± 14 vs. 880 ± 73, p=0.06).
- Forehand arm velocity (rpm) was significantly greater than backhand arm velocity (525.8 ± 215.6 vs. 298.9 ± 97.5, p=0.01) for all subjects combined.
- Body weight was significantly correlated to backhand arm velocity (r=0.78, p=0.002), backhand valgus torque (r=0.65, p=0.02), and forehand arm slot (r=-0.65, p=0.02).
- BMI was significantly correlated to backhand arm velocity (r=0.81, p<0.001), backhand valgus torque (r=0.66, p=0.02), forehand arm slot (r=0.68, p=0.01), and inversely correlated to PDGA rating (r=-0.60, p=0.05).
- Backhand valgus torque was significantly correlated to backhand arm velocity (r=0.90, p=<0.001) and backhand distance (r=-0.56, p=0.05).
- Forehand distance was significantly correlated to forehand valgus torque (r=0.71, p=0.006) and forehand arm slot (r=0.58, p=0.04).

CONCLUSIONS

The positive correlation between forehand distance, valgus torque, and arm slot was expected, given that more torque and a higher arm slot (re: longer lever arm) should equate to greater throwing distance. A significant relationship existed between subject biometrics (e.g. bodyweight, BMI) and multiple backhand and forehand performance measures, indicating that larger biometrics may contribute to better performance for some less physically fit amateur players. This conclusion is possibly supported by an inverse relationship of PDGA rating and BMI in the present population. Demographic data indicated that subjects are clinically by BMI as Grade 1 obese. According to ACSM standards, subjects have borderline poor/very poor fitness based upon body fat percentage categorized by age and gender[2]. Grip strength, however, is higher than the normative group mean for age and gender[3], so subjects possess good strength despite the poor fitness rating. Future research should include a larger, more diversified subject pool, including elite professional disc golfers, to further delineate those kinetic, kinematic, and biometric attributes contributing to better disc golf playing performance. Furthermore, differences in backhand and forehand metrics should necessitate specific anatomic training emphases to improve each performance type and prevent potential injury.

PRACTICAL APPLICATION

To our knowledge, there are no evidence-based sport-specific strength and conditioning programs available for disc golf athletes. Our data preliminarily indicates that disc golfers should strive to improve thoraco-rotational kinetics, enhance core strength and stability, and utilize constant external resistance training modes specific to the unique neuromuscular coordination characteristics of forehand and backhand disc golf throws. S&C practitioners should utilize creative professional license when determining the appropriate training modes for an effective exercise prescription to improve both forehand and backhand throwing performance, based upon the obvious kinematic dissimilarities between the throw types, while reducing injury risk.

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