Biomechanical Differences Between Recreational and Collegiate Runners

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INTRODUCTION

- Running is one of the most popular forms of sport and physical activity that people participate in as there are little constraints and it is highly accessible compared to other forms of activity.[1,2]
- All age groups and sexes participate in running at numerous ability levels including recreational joggers and an elite athlete.[1]
- However, running has a very high injury occurrence rate.[3]
- There are various biomechanical characteristics that influence performance and injuries that are present in runners at different levels.

OBJECTIVE

(1) Compare running biomechanics characteristics between recreational and collegiate runners from an existing sample.

(2) Evaluate the association between running biomechanics ground reaction forces and shank angles in each group.

METHODS

Participants

- 62 participants completed this study. (Table 1)

Table 1: Participant Characteristics.

Demographic	Recreational (n=27)	Collegiate (n=35)	P
Sex (n)	6 female, 21 male	10 female, 25 male	0.359
Age (years)	23.6 (3.2)	20.1 (1.5)	<0.001
Ht (m)	1.74 (.09)	1.74 (.09)	.511
Mass (kg)	68.1 (9.1)	61.7 (8.2)	.444
BMI (kg/m²)	22.5 (1.6)	20.4 (1.9)	.228
Running Amount (km/week)	22.1 (9.8)	84.7 (15.6)	.001
Speed (m/s)	3.5 (.46)	4.1 (.33)	.034

Ht: Height, BMI: Body Mass Index.

- Participants were used from an existing sample of a completed study: Running Kinetics and Femoral Trochlea Cartilage Characteristics in Recreational and Collegiate Distance Runners
- A collegiate runner was defined as currently running or running in the preceding year for an intercollegiate team. A recreational runner was defined as running 3 times per week for at least 30 minutes and 10 miles (16 km). All participants were free from lower body injury for 6 months prior to data collection.

METHODS

Running Biomechanics

- Calibration markers were placed on the greater trochanters, iliac crests, ASIS, medial & lateral femoral epicondyles, medial & lateral malleoli, 1st & 5th metatarsals, and calcanei. Marker Clusters were placed on the sacrum, and bilaterally on the thigh, shank, and feet (**Fig 1-A**).
- Gait biomechanics were assessed as participants ran across a 20m runway at a self-selected speed wearing laboratory standard footwear. 5 trials were recorded at ±5% of their self-selected speed (**Fig 1-B**). Marker and force plate data were sampled at 240Hz and 2400Hz, respectively.
- Running outcomes (**Fig 2-4**) were compared between groups using one-way MANOVA. Pearson correlation was used to assess the relationship between shank angle and ground reaction force characteristics.

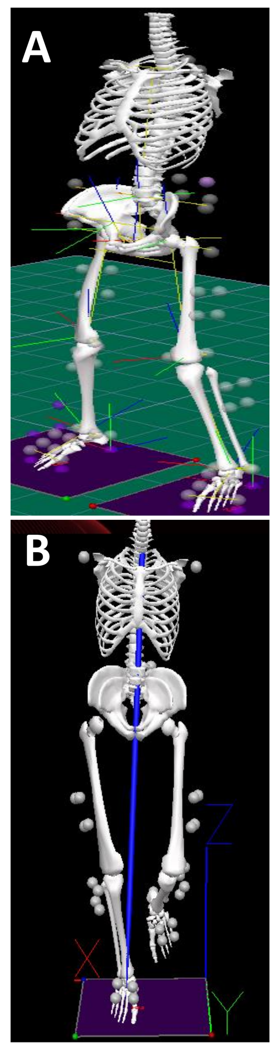

Fig 1: (A) Marker Placement (B) Gait Trial

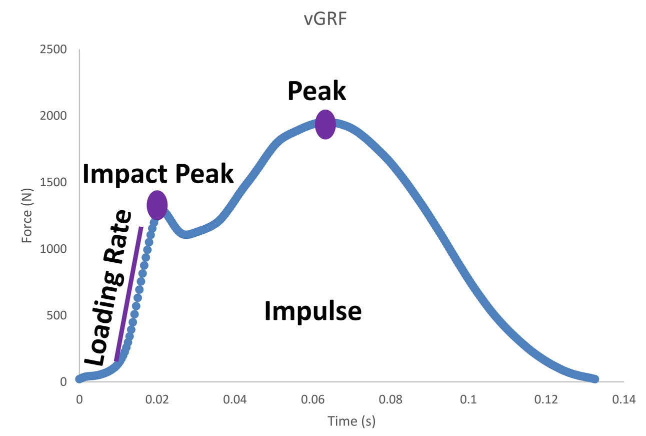

Fig 2: Vertical Ground Reaction Force

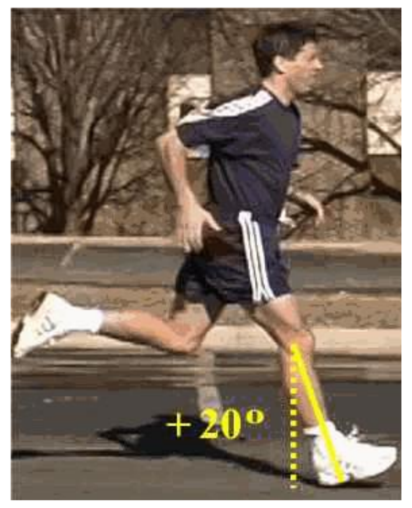

Fig 3: Shank angle

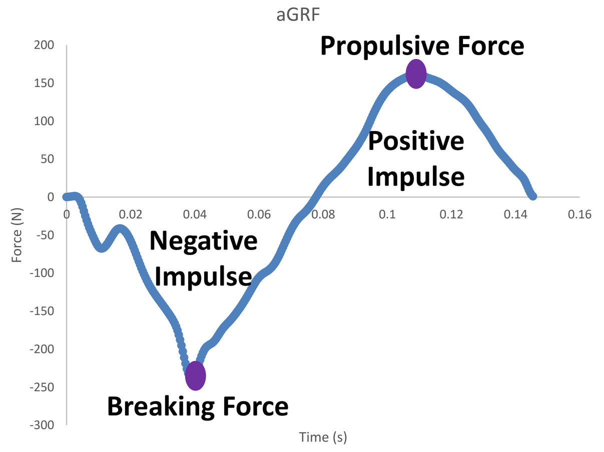

Fig 4: Anterior-Posterior Ground Reaction Force

Table 3: Comparison of Running Outcomes

Variables	Recreational (n= 27)	Collegiate (n=35)	P
Vertical GRF (BW)	2.74 (2.60, 2.89)	2.84 (2.71, 2.96)	0.324
Impact Peak (BW)	1.66 (1.50, 1.82)	1.59 (1.45, 1.73)	0.503
Vertical LR (BW/sec)	194.5* (166.1, 222.9)	111.5* (86.6, 136.4)	<.001
Vertical Impulse (BW·s)	.233* (.209, .256)	.349* (.329, .370)	<.001
Prop Force (BW)	.333* (.307, .360)	.390* (.367, .413)	.002
Breaking Force (BW)	-.405 (-.453, -.357)	-.443 (-.485, -.401)	.239
Negative Impulse (BW·s)	-.013* (-.015, -.011)	-.022* (-.024, -.026)	<.001
Positive Impulse(BW·s)	.014* (.012, .016)	.024* (.022, .026)	<.001
Pos/Neg Ratio	1.05 (.859, 1.24)	1.21 (1.04, 1.38)	.213
Shank Angle (deg)	6.80* (5.48, 8.11)	2.09* (.934, 3.25)	<.001

- A one-way multivariate analysis of variance revealed that there was a significant difference in running biomechanical variables between groups (Pillai's trace = 0.739, $F(51,10) = 14.415$, $p < 0.001$) (Table 3).

RESULTS

- Significant correlations were found between shank angle and positive impulse, negative impulse in collegiate runners, and positive negative impulse ratio in collegiate and recreational runners.
- Generally, the larger the shank angle at ground contact, the more negative impulse and less positive impulse is done.

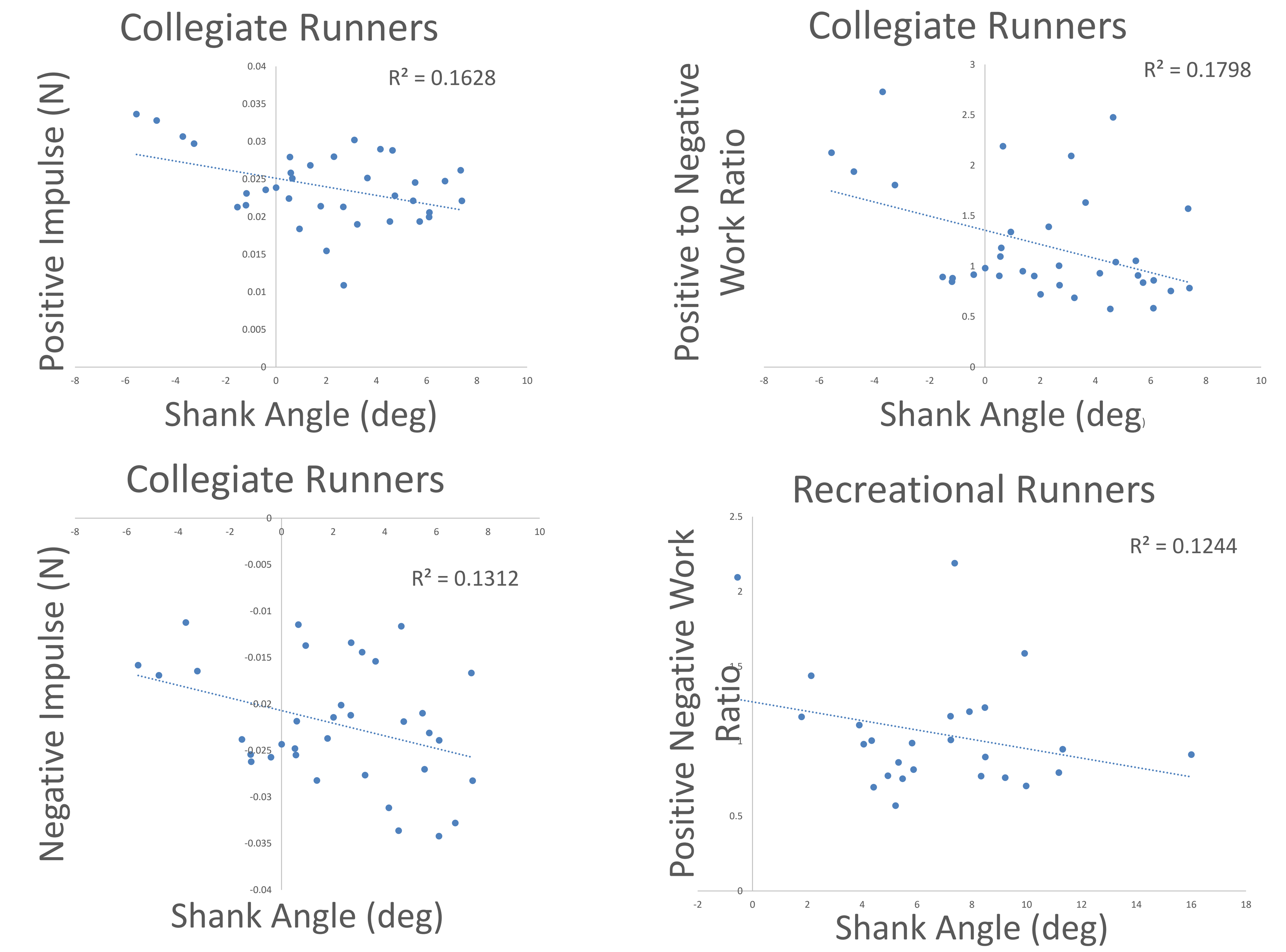

Fig 5: Significant Correlations (all p<0.05) between Shank Angle and Ground Reaction Force Characteristics

CONCLUSION

- Collegiate runners had more perpendicular shank angles and larger ground reaction forces than recreational counterparts. It is speculated that a larger shank angle may contributed to a larger breaking force.
- The breaking force is associated with running-related injuries as it influences more sheering force to be translated through the shank.
- Furthermore, the breaking force has a negative influence on performance as it creates more negative work on each stride, which may reduce propulsion and running speed.
- Higher ground reaction forces observed in collegiate runners were likely due to faster running speeds.

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