RELATIONSHIPS OF HEIGHT AND WEIGHT WITH VERTICAL GROUND REACTION FORCES IN COLLEGIATE MALE RUNNERS: A PILOT STUDY

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Background & Purpose

Background

- Previous research has shown that lower ground reaction force (GRF) magnitudes and shorter impulse times are associated with lower risks of injury and improved performance in distance running, (8).
- There are inconsistent results related to GRF_{vert} and instances of various types of running injuries, (4, 9, 11). Additionally, there are inconsistent results relating body weight (BW) to running injuries, (3, 5, 6, 7).
- Consistent evidence has been shown associating an individual's height (BH) with sustaining running injuries, (3, 5, 6, 10), however the mechanism for this has not been as thoroughly studied.
- Body size and body proportion has also been shown to have a significant impact on GRF and risk of injury, (6, 10).
- Previous research has found a stronger relationship between BH and GRF_{vert} than BW and GRF in high-level female collegiate distance runners, (2).
- No studies had been found to assess the relationship between anthropometric variables and GRF specifically in high-level male collegiate distance runners.
- Due to the intuitive nature of the concept, the authors found no studies assessing the difference in relationships of BW and BH with GRF.

Purpose

- The purpose of this research was to determine the potential relationships of BH and BW with GRF_{vert} in collegiate male runners.

Methods

Subjects

- Retrospective data from ten male Division-I Collegiate Cross-Country runners were analyzed. This data was collected during a non-research gait analysis for the men's cross-country team.

Lab Protocol

- Testing occurred on one day in the Liberty Biomechanics and Motion Analysis Lab. Prior to testing, athletes completed a short running-history questionnaire detailing general demographic information including age, gender, height, weight, training history, and injury history.
- Height and weight were verified via a Seca medical scale.
- Gait analysis was completed on an AMTI Double-Belt Instrumented Treadmill (AMTI, Watertown, MA). Two cameras were used for video analysis, one perpendicular to and the other directly behind the athlete, with distances of 10 ft and 5 ft, respectively.

Lab Protocol cont.

- One viewing screen of the gait was faced towards to technician, while the other was faced towards the runner to allow them to see their gait.
- Subjects then ran two separate trials:
  - "Easy" pace (3.67 m·s-1, 7:19 min·mi-1) for 2 minutes with the last 15 seconds being recorded for analysis.
  - "Fast" pace (5.77 m·s-1, 4:39 min·mi-1) for 45 seconds with the last 15 seconds being recorded for analysis.
  - Pace categories were decided on by the technician and coaches prior to testing based on athlete training and race paces.
- Data was collected at a frequency of 100Hz and was analyzed between frame 400 and 1400 of each recording.
- A single stride was denoted by the time between foot contact and toe-off where GRF_{vert} exceeded or fell below 50N corresponding with video recording.

Results

	Age (yrs)	Height (cm)	Weight (kg)	Mile PB (min)	5K PB (min)	Miles/Wk	GRxF Slow (N)	GRxF Fast (N)
Mean	20.64	179.56	67.27	4.26	15.08	64.55	1879.00	2042.12
St. Dev.	1.91	6.28	6.19	0.09	0.42	13.08	189.94	154.37

Figure 1. Correlation between height and vertical ground reaction force during slow running.

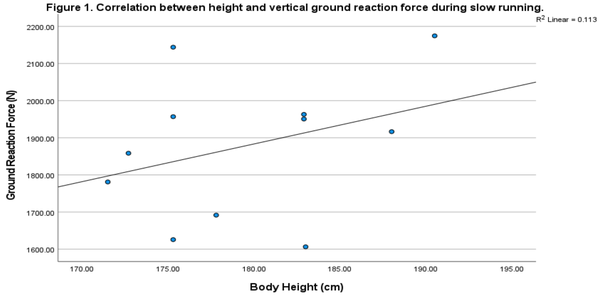


Figure 2. Correlation between height and vertical ground reaction force during fast running.

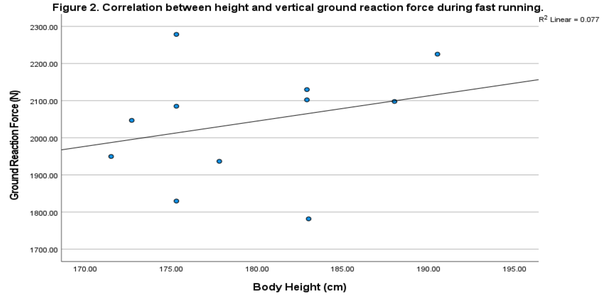


Figure 3. Correlation between weight and vertical ground reaction force during slow running.

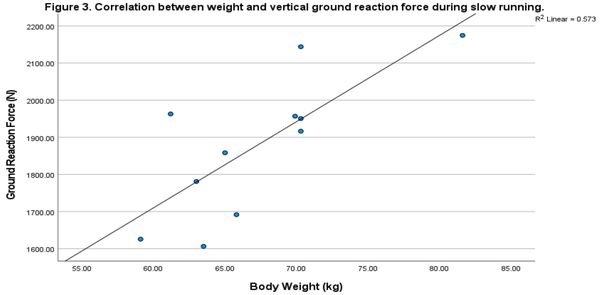
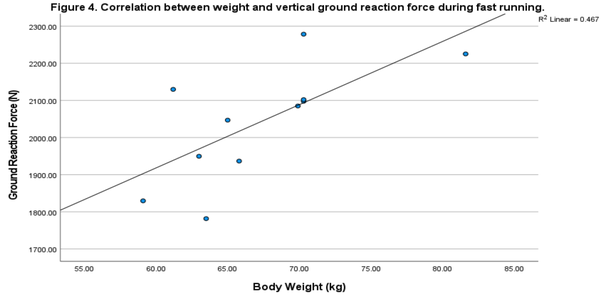


Figure 4. Correlation between weight and vertical ground reaction force during fast running.



Conclusions

- Results showed significant correlations between BW and GRxF but now between BH and GRxF.
- This is inconsistent with previous research that has shown significant relationships between vertical GRxF and injury risk, (3, 5, 6).
- Additionally, these findings are different from the results of a similar study in high-level female collegiate runners, which found significant and stronger relationships between BH and GRxF than BW and GRxF, (2).
- Higher vertical load rates and breaking forces have been found in female recreational runners compared to male runners, (1), which could be of differences in the way height is compensated for during gait.
- It appears that the relationship between anthropometric variables and GRxF may not be consistent between male and female runners.

Practical Applications

- The findings suggest that in high-level male and female cross-country runners, the relationship between body characteristics and ground reaction force may be different.
- Because of this, gender-specific training principles may be necessary to protect athletes against vertical impact-related injuries.

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