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REFERENCES: 1. Zifchock et al. (2006). J Biomech Vol 39; p.2792-2797. 2. Verrelst R, et al. (2014). BJSM Vol. 48; p.1564–1569. 3. Niemuth PE et al. (2005). CJSM Vol. 15; p. 14-21. 4. Mucha et al. (2017). JSMS Vol. 20; p. 349-355. Other references on poster PDF.

Influence of Gluteus Medius Strength on Interlimb Asymmetry in Female Recreational Runners.

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INTRODUCTION

- Approximately 74% of runners experience an injury each year with women being twice as likely to develop running injuries around the hip and the knee as men. [1]
- Gluteus Medius (GM) plays a significant role in lower limb alignment, especially in the frontal and transverse planes by its influence on the pelvis and the femur. [2] The GM, posterior chain muscles, and pelvis work together to provide stability and allow for forward propulsion in walking and running. [3]
- Previous studies have determined that GM weakness contributes to abnormal lower limb kinematics and kinetics during dynamic tasks like running and jumping. [2] These deficits include increased peak hip adduction angle (HA), hip internal rotation angle (HI), knee abduction moment (KA), and rearfoot eversion angle (RE). [2,4] (Figure 1A)
- Running-related injuries are most often single-sided and are partially attributed to lower limb movement and loading asymmetries. [5]
- Symmetry Angle (SA) is a commonly used, robust measure of determining symmetry.
- Previous studies have suggested that clinicians should consider screening female athletes for hip strength weakness or asymmetry as a means of preventing injuries.
- No study has evaluated the role of unilateral GM strength on interlimb asymmetry for peak HA, HI, KA, and RE during running.

1A

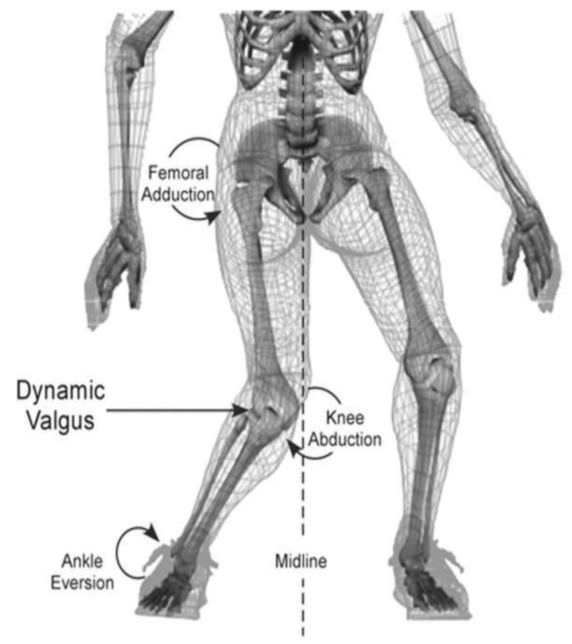


Figure 1A: Demonstrates effect of GM weakness on kinematics and kinetics.

PURPOSE AND HYPOTHESIS

- The purpose of this study was to determine if GM strength has an influence on the interlimb asymmetry calculated using SA during running in female recreational runners.
- We hypothesized that female runners with stronger GM would demonstrate decreased interlimb asymmetry for HA, HI, KA, and RE during running.

SUBJECTS

- Thirty healthy female recreational runners running at least 10 km per week participated in this study. (Table1)

Table 1

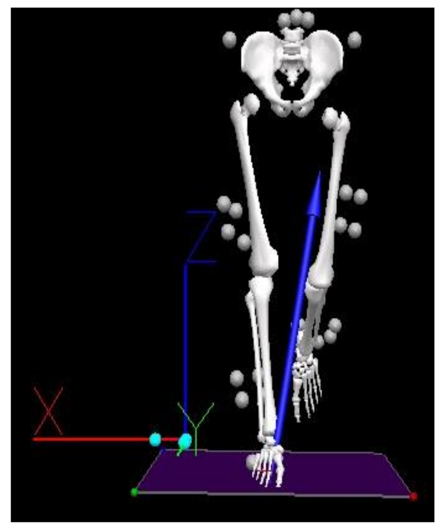
Demographics					
Group	Age (years)	Height (m)	Weight (kg)	Miles/Week (km)	Strength (N/m)
Stronger	32.47±10.13	1.67±0.06	64.68±8.31	21.07±9.64	25.85±2.30
Weaker	38.33±10.09	1.65±0.06	58.44±4.35	25.54±12.19	16.77±1.45

METHODS

- Isometric GM strength was measured using a handheld dynamometer (Lafayette Instrument Co., Lafayette, IN) for the right lower limb (Figure 2A).
- Participants were divided into two groups of stronger and weaker using group mean and standard deviations with 15 participants in each group.
- Retroreflective markers were bilaterally placed on the lower extremity using the modified Cleveland clinic model (Figure 2B).
- Three dimensional (3D) gait analysis was performed during a 30 second treadmill run on an instrumented treadmill (Treadmetrix, Park City, UT) at a speed of 2.98 m/s.
- Kinematic data was collected using a 5-camera motion analysis system (Qualisys, Goteborg, Sweden) at 120 Hz.

2A

2B



2C

$$SA = \frac{45° - \arctan\left(\frac{X_R}{X_L}\right)}{90°} \cdot 100\%.$$

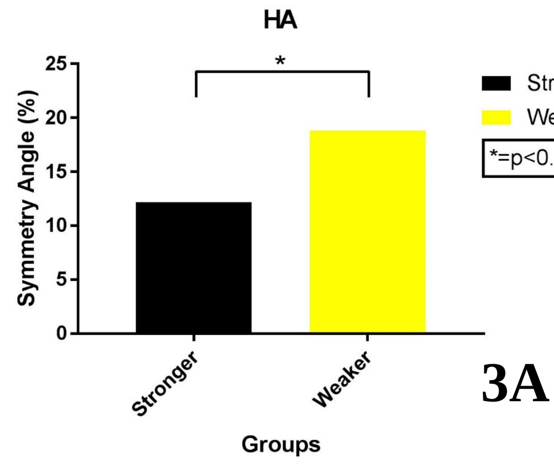
Figure 2A: Nicholas MMT Dynamometer
Figure 2B: 3D model using retroreflective markers
Figure 2C: Calculation of Symmetry Angle

ANALYSIS

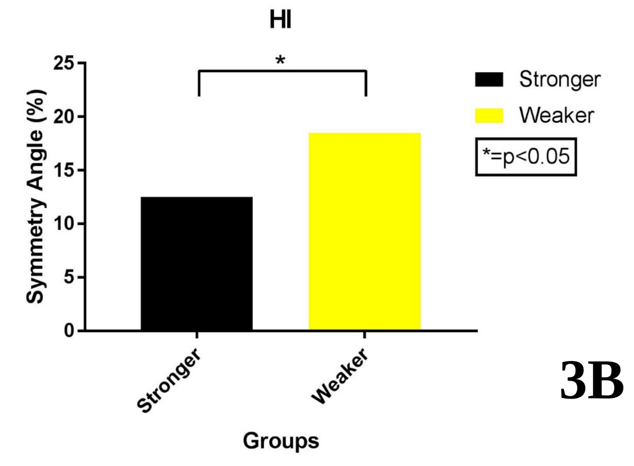
- Visual 3D software (C-Motion, Bethesda, MD) was used to generate peak HA, HI, KA, and RE for the bilateral lower extremities.
- The SA is the angle formed by the vector of two values (left and right) when plotted in a Cartesian coordinate system where values of the right leg are plotted on the x-axis and values of the left leg on the y-axis. [6]
- SA was computed using the peak HA, HI, KA, and RE values from both the limbs. To calculate SA for HA, X_{left} was the peak HA of the left lower limb and X_{right} was the peak HA of the right lower limb during that running trial.
- SAS (Version 9.3 - Copyright © 2014, SAS Institute Inc.,Cary, NC) was used for all statistical analysis with an alpha level of 0.05 being considered statistically significant.
- A Shapiro-Wilk test for normality was conducted and it showed that all variables were not normally distributed.
- Wilcoxon Two-Sample Test was performed to look at differences between the two groups for HA, HI, KA, and RE.

RESULTS

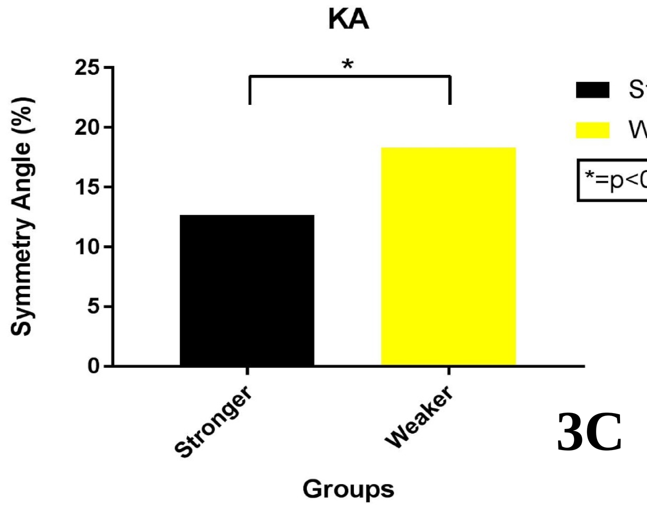
- Female runners with weaker GM demonstrated significantly increased asymmetry for HA (18.80±24.11 vs 12.20±24.11 %, p=0.02), HI (18.47±24.11 vs 12.53±24.11 %, p=0.03), and KA (18.33±24.11 vs 12.67±24.11 %, p=0.04).
- For RE, the weaker group had greater asymmetry (16.13±24.11 vs 14.87±24.11 %, p=0.35), but the relationship was not significant.



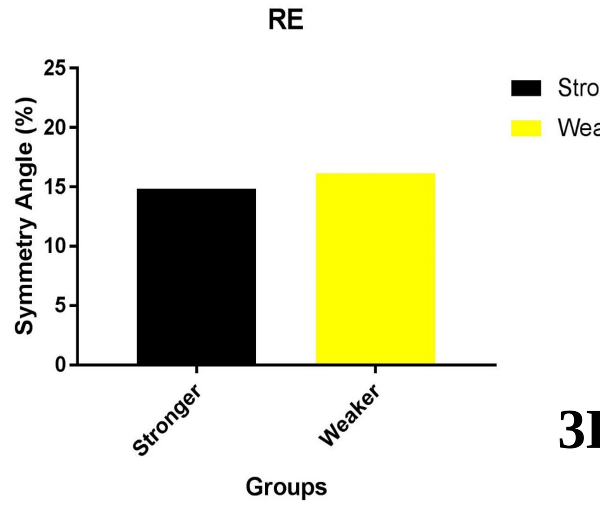
3A



3B



3C



3D

Figure 3A: Means for HA | Figure 3B: Means for HI
Figure 3C: Means for KA | Figure 3D: Means for RE

DISCUSSION AND CONCLUSIONS

- This study suggested that runners with weaker GM exhibit increased interlimb asymmetry during running for certain kinematic and kinetic variables.
- These results could have been observed because of the relationship that the GM has with the pelvis and other musculature down the kinetic chain. The quadratus lumborum and tensor fascia latae compensate for a weak GM.
- During the stance phase, the GM stabilizes the pelvis and controls the motion in the frontal and transverse planes, so if the GM is weaker there could be less stabilization. [3]
- The GM provides acceleration and power for dynamic tasks such as running and jumping, therefore increased strength can improve performance in these activities and potentially decrease the risk of injury.
- Asymmetry may result in excessively high strains on the musculoskeletal structures on a particular side or due to large relative imbalances between sides could contribute to injury.
- Future studies should determine how unilateral and bilateral strength deficits contribute to interlimb asymmetry and running biomechanics in healthy and injured runners.

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