COLLEGE OF EDUCATION
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Effect of Speed on Location of Ground Reaction Forces in College-Age Individuals

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Introduction

While ground reaction forces (GRFs) have previously been studied using stationary force plates (Brownjohn et al., 2016; Jung et al., 2016; List et al., 2017), no research has been performed using mobile in-shoe sensors to examine the distribution of GRFs across specific sections of the plantar region. The location of GRFs is an important variable to investigate, as it provides insight into the role of plantar anatomy and suggests possibilities for improving gait (Jung et al., 2016). As a result, this study aims to identify the variation in intensity and location of GRFs with at different walking speeds on a land-based treadmill.

Methods

Each college-age participant (n = 20) was fitted with ASICS GEL-Venture 6 running shoes equipped with the loadsol® GRF sensors (see Figure 1 & 2). After the sensors were calibrated for the individual's body mass, each participant walked on a dry land treadmill for 20 to 30 seconds to become accustomed to the speed. After becoming accustomed to the speed, three 30 second trials of walking at increasing speeds was performed at 1, 2, and 3 mph. The overall GRFs and locations were recorded during the 30 second walking time frame. Statistical analyses were performed using the Statistical Package for the Social Sciences ver. 25 to determine significance ($p < .05$).

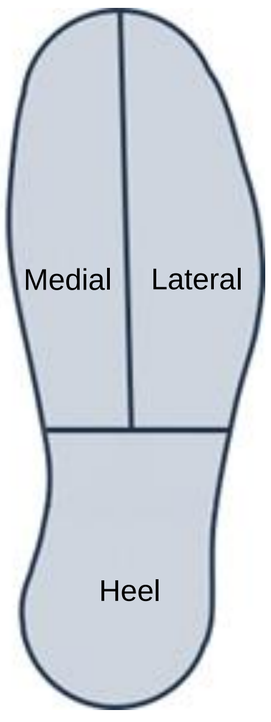

Figure 1 (left): Novel loadsol® sensor compartments. **Figure 2** (right): ASICS GEL-Venture 6 running shoes and loadsol® sensors.

Results

Significant differences in GRFs were found between 1 and 3 mph for all locations, with no significant change between 1 and 2 mph for the heel location or total GRFs (see Table 1). There was no statistically significant difference between the lateral and medial regions at any speeds. In contrast, there was a significant difference between the lateral and heel regions at all three speeds, and between medial and heel regions at 1 and 3 mph (see Table 1).

Table 1. Differences in GRFs at different speeds and locations.

Location	Speed (mph)			p-value	Pairwise comparisons ($p < 0.05$)
	1	2	3		
Lateral	314.2 ± 103.47	395.4 ± 116.03	420.4 ± 134.05	< 0.001	*a*, *b, d, e*
Medial	334.7 ± 120.45	421.9 ± 115.58	531.8 ± 150.93	< 0.001	*a, b*, *c, d*
Heel	536.4 ± 126.74	561.7 ± 169.73	690 ± 130.99	< 0.001	*b, c, d, e*
Total	816.9 ± 196.13	837.6 ± 203.003	942.8 ± 227.81	< 0.001	*b*

Note: *a* = 1 vs 2 mph, *b* = 1 vs 3 mph, and *c* = 2 vs 3 mph, *d* = lateral vs heel, and e = medial vs heel.

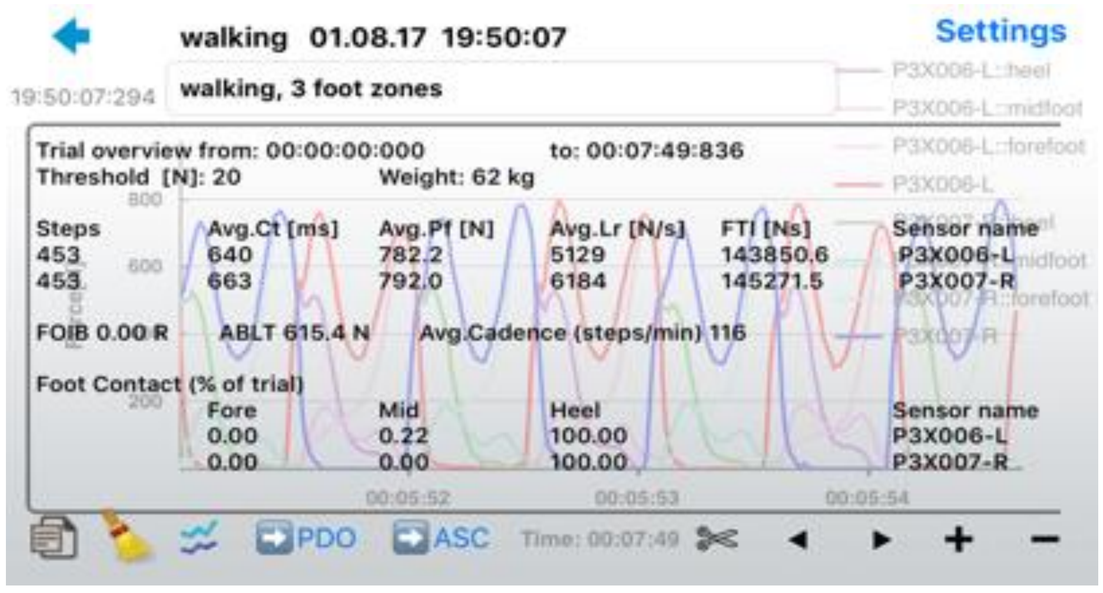

Figure 3. Ground reaction force output from a single walking trial.

Conclusions

- Differences between the various speeds indicate that as speed increases, so do overall GRFs.
- When using walking as part of a training or rehabilitation program, there are small differences in GRFs at lower speeds; individual walking patterns must be considered.
- loadsol® wearable sensors are beneficial for developing and monitoring individualized training and therapy plans.

Acknowledgements

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References

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