



# From Head to Heel: Quantifying Force on the Body While Head-Loading



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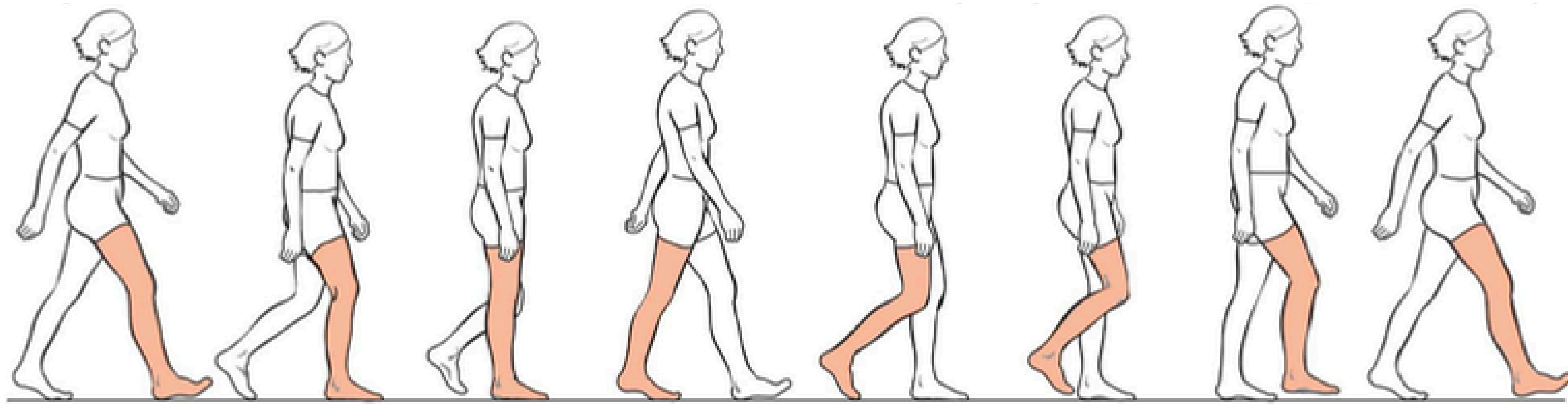
2.671 Measurement and Instrumentation

## Abstract

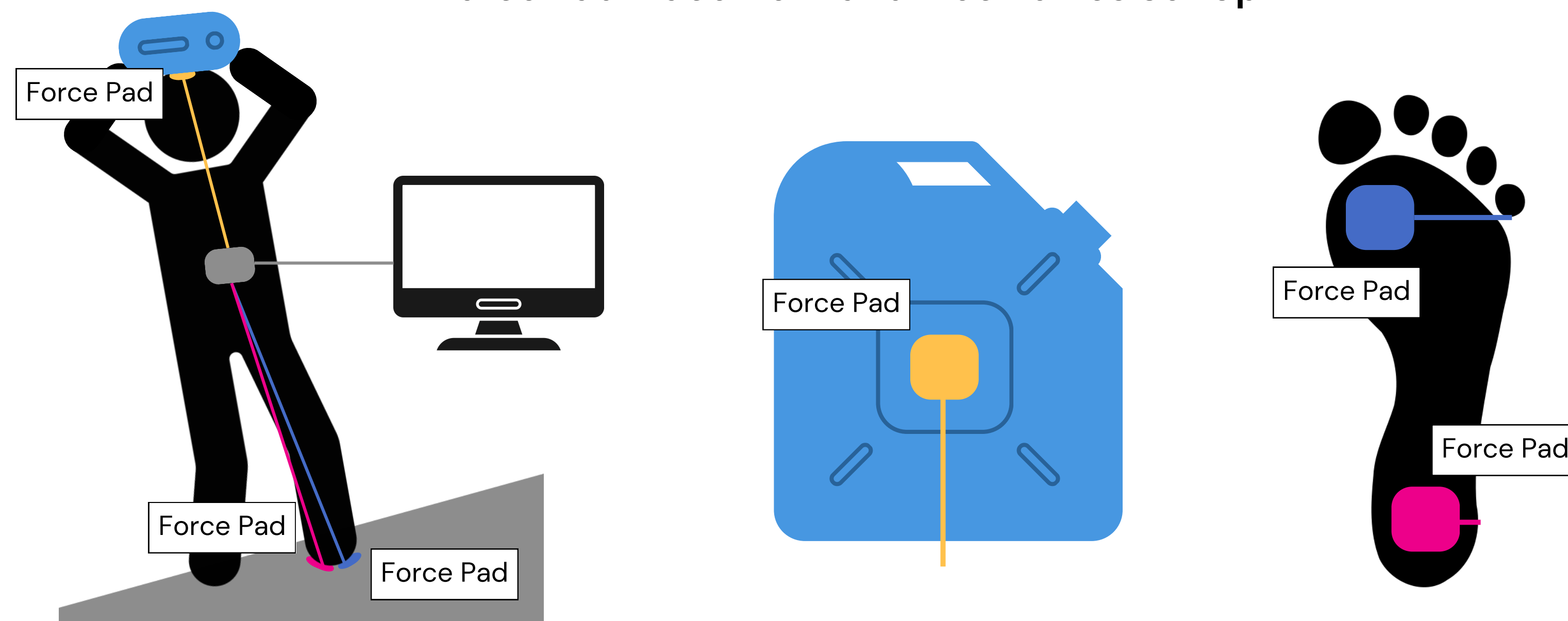
Roughly 17 million women and children in Sub-Saharan Africa are responsible for traveling over 30 minutes to collect clean drinking water for them and their families, making understanding the biomechanics and potential health impacts of head-loading vital [2]. Forces on the foot and head while head-loading a 20L jerry can filled with water at speed and incline conditions of 2.4 to 3.9 km/h and 0 to 10 degrees were measured utilizing force pads attached to the heel of the foot, ball of the foot, and underside of the jerry can. An increase in speed also increased loading on the heel of the foot. A net increase in loading on the ball of the foot was observed with an increase in incline from 0 to 10 degrees, but net decreases in loading on the top of the head and heel of the foot. A shift in primary loading from the heel to the ball of the foot can be expected at about 8.5 degrees.

## Experimental Set Up

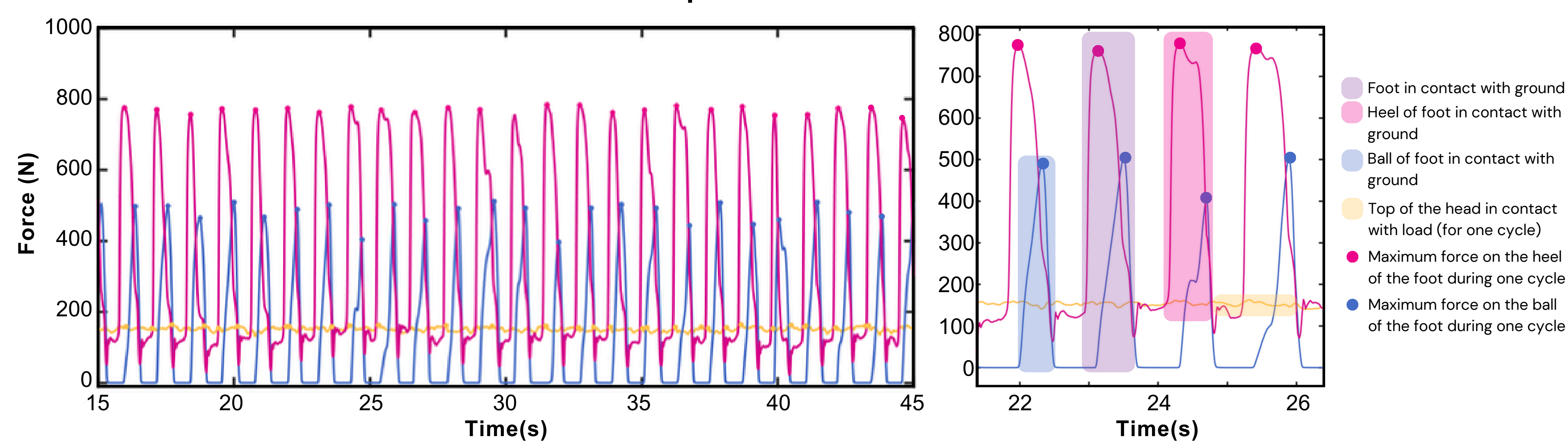
The Human Gait Cycle [3]



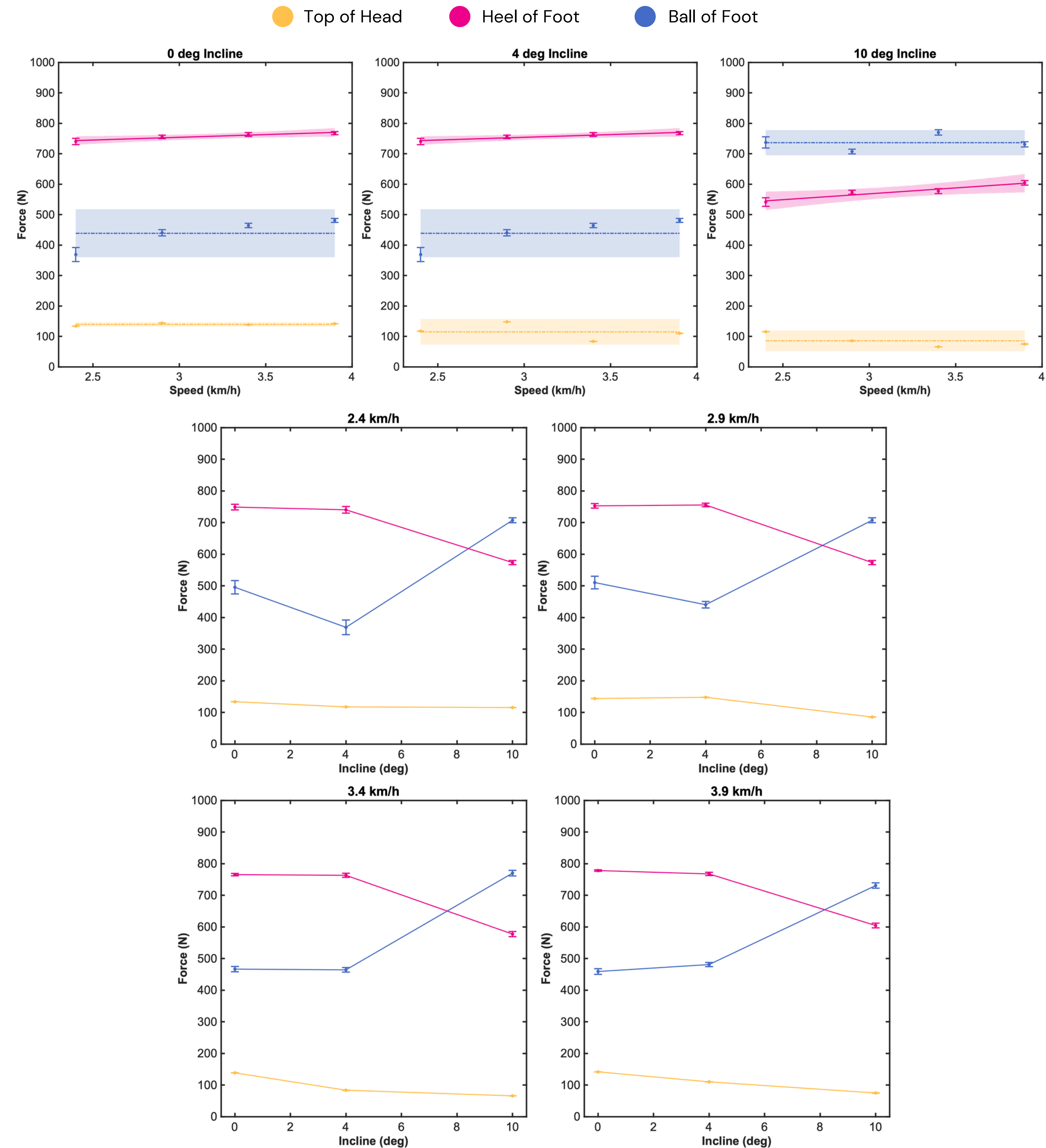
Force Pad Placement and Electronics Set Up



Sample Force Pad Data



## Results



## Conclusions

- Increases in speed increased loading on the heel of the foot with no measurable impact on loading on the top of the head or ball of the foot.
- An increase in incline from 0 to 10 degrees from the horizontal led to a net increase on loading on the ball of the foot, but a net decrease in loading on the heel of the foot and top of the head.
- A reversal of primary loading from the heel to the ball of the foot can be predicted to occur at about 8.5 degrees above the horizontal.

References:

[1] Massachusetts Institute of Technology, "MIT Logo." [Online] Available: <https://brand.mit.edu/>. [Accessed 07-Nov-2024].  
 [2] George Washington University Milken Institute School of Public Health, "17 Million Women/Children Tasked with Household Water Collection in 24 African Countries." [Online]. Available: <https://www.sciencedaily.com/releases/2016/06/160601151920.htm>. [Accessed: 24-Sep-2024].  
 [3] Shenzhen Xingzheng Technology Co., Ltd., "Gait cycle." [Online]. Available: <https://gaitanalysisitraining.wordpress.com/>. [Accessed: 01-Nov-2024].

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