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The Effect of Weight on the Amount of Force on Ankle Joints During a Vertical Jump

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Figure 1. A pig femur bone being crushed in the hydraulic press.

Introduction

Previous studies have concluded that the feet and ankles are the most weight bearing parts of the body and that weight has a substantial impact on these joints.

Objective(s):

- Determine the amount of force it will take to break a bone. This is to see if the amount of force exerted during a jump is enough to actually break a bone.
- To see if a participant's weight determines the angle of the ankle joints during a vertical jump and the amount of force present on the ankle when jumping.

This study also explores the amount of pressure and force a bone can take before breaking. This could not be done on a human, so it will be compared using a pig femur bone.

Hypothesis

Hypothesis 1: When the subject weighs more, the amount of force exerted on their ankles during a vertical jump will increase

Hypothesis 2: The angle of the ankle when performing a vertical jump will be more acute on the subjects who have more force exerted on their ankles

Methodology

Using a metric standard scale, participants were weighed (in Kg) and asked to stand on the PASPORT force plate

Reflective markers were placed on:
- fifth phalange of the foot the lateral malleolus, and peroneus longus

Figure 2. Participant with reflective markings and angle measurement.

Participants performed three jumps following a pre-designated form

Force data was collected using CAPSTONE Software and the angles were pinpointed and calculated using a coding system

Results

1.) Comparing Weight vs. Force:
R^2 = 0.0096
The R^2 value is too small to suggest a correlation

2.) Comparing Angle vs. Force:
R^2 = 0.0093
The R^2 value is too small to suggest a correlation

3.) Force (N) to break femur = 1.1 Metric tons (equivalent to 10787.315 N)

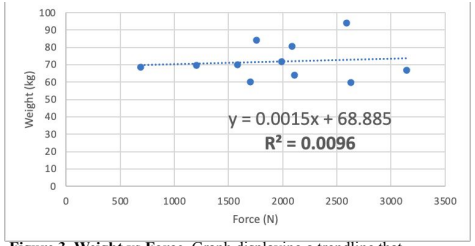

Figure 3. Weight vs Force. Graph displaying a trendline that shows potential correlation between weight of participants and force exerted during jump.

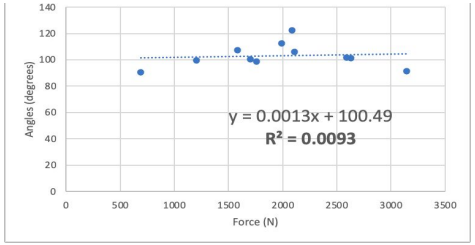

Figure 4. Angle vs Force. Graph displaying a trendline that shows potential correlation between angle of participants ankle and force exerted during jump.

Conclusion

- It can be concluded from the data that there was not enough evidence to support our hypothesis that the heavier someone is, the more force they exert on a vertical jump. This is most likely due to a limited population and small sample size.
- The angles measured did not seem to have any influence of the amount of force in a jump. This is most likely due to the insufficient amount of data points collectd.
- The data collected from the hydraulic press exemplifies that a lateral jump done by humans does not exert enough force to break a bone. The measurement comparison is shown in the figure below.

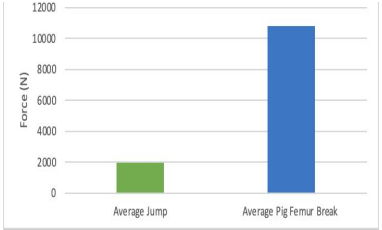

Figure 5. Average Force to Break a Bone. The average force from a jump compared to the force required to break a pig femur.

Acknowledgements

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