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Repository citation: Brillinger, Elsa; Song, Yeageon; and Vicente, Regina, "Variation of Lumbar Rotation During Asymmetric Patient Handling Tasks" (2024). *23rd Annual A. Paul and Carol C. Schaap Celebration of Undergraduate Research and Creative Activity (2024)*. Paper 11.

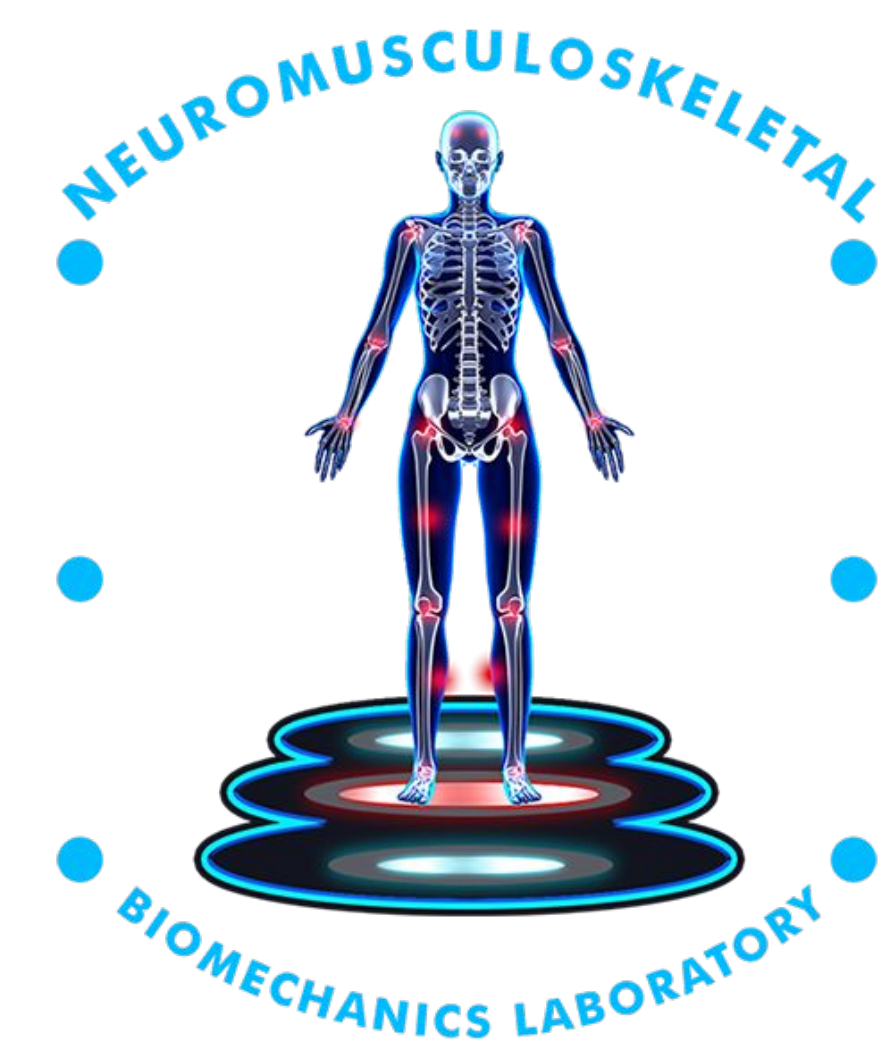
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Variation of Lumbar Rotation During Asymmetric Patient Handling Tasks

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Introduction

Musculoskeletal injury to the lower lumbar vertebrae is among high prevalence in nursing personnel. Many patient handling tasks (PHT) require nurses and other caregivers to lift and reposition patients of a variety of weights in varying postures, causing low back pain in nurses to range from 50-80% globally [1]. Currently, lumbar rotation during PHT is not widely studied. This work specifically investigated lumbar rotation in asymmetric PHT tasks- tasks where the arms or shoulders are used to reach to different parts of a patient, causing the trunk to rotate. In addition, task performance was also analyzed with respect to patient weight.

Methods

Subjects: 5 able-bodied volunteers, 4 males and 1 female, between the ages of 18 and 24

Experimental Setup:

- Three tasks were analyzed:
 - 1.) sliding a patient towards the head of the bed (2-slide)
 - 2.) lifting a patient's leg up to vertical (leg-lift)
 - 3.) sitting a patient up in bed (situp)
- Each task was performed with three manikin weights (44lb, 66lb, 110lb) at three table heights (knee, mid-thigh, and hip height)
- For a single trial, 3 repetitions were completed of the selected task. Each task was completed 2 times with each table height and manikin weight

Data Collection:

- OpenCap [2] was used to record kinematic data and analyze lumbar rotation during these PHT at a frequency of 60 Hz
- Four iPhones mounted onto tripods were used to record the movements

Data Processing:

- Butterworth filter with a cutoff frequency of 12 Hz
- The peaks of each repetition were manually selected
- The absolute value of the negative values was computed and averaged with the positive values to determine the mean deviation from upright posture

Results

In Figures 1 and 2, as the table height decreases, lumbar rotation angles increase. This trend was not observed for the situp trials (Figure 3).

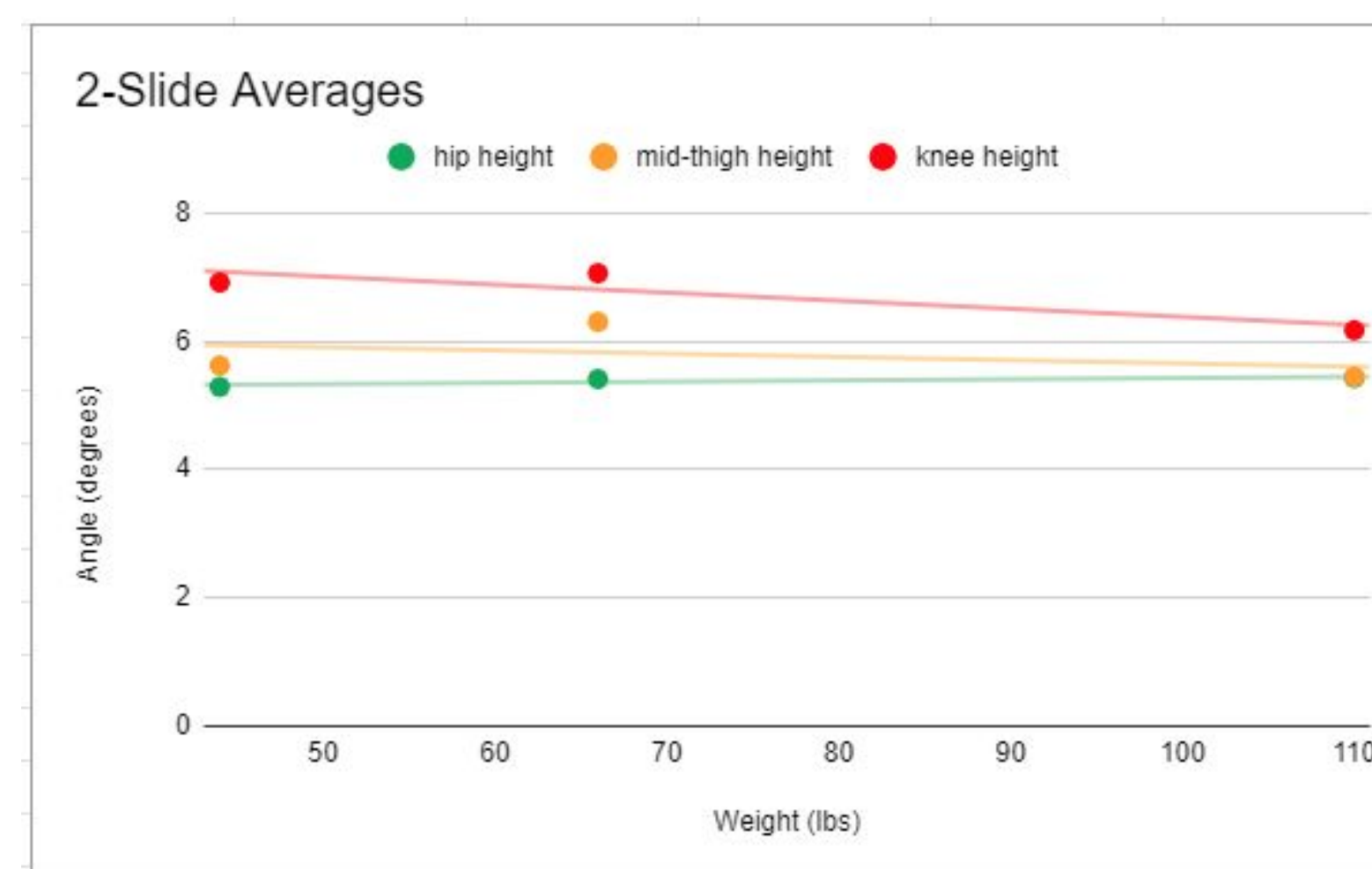


Figure 1: Lumbar rotation averages for the task involving sliding the patient towards the head of the bed.

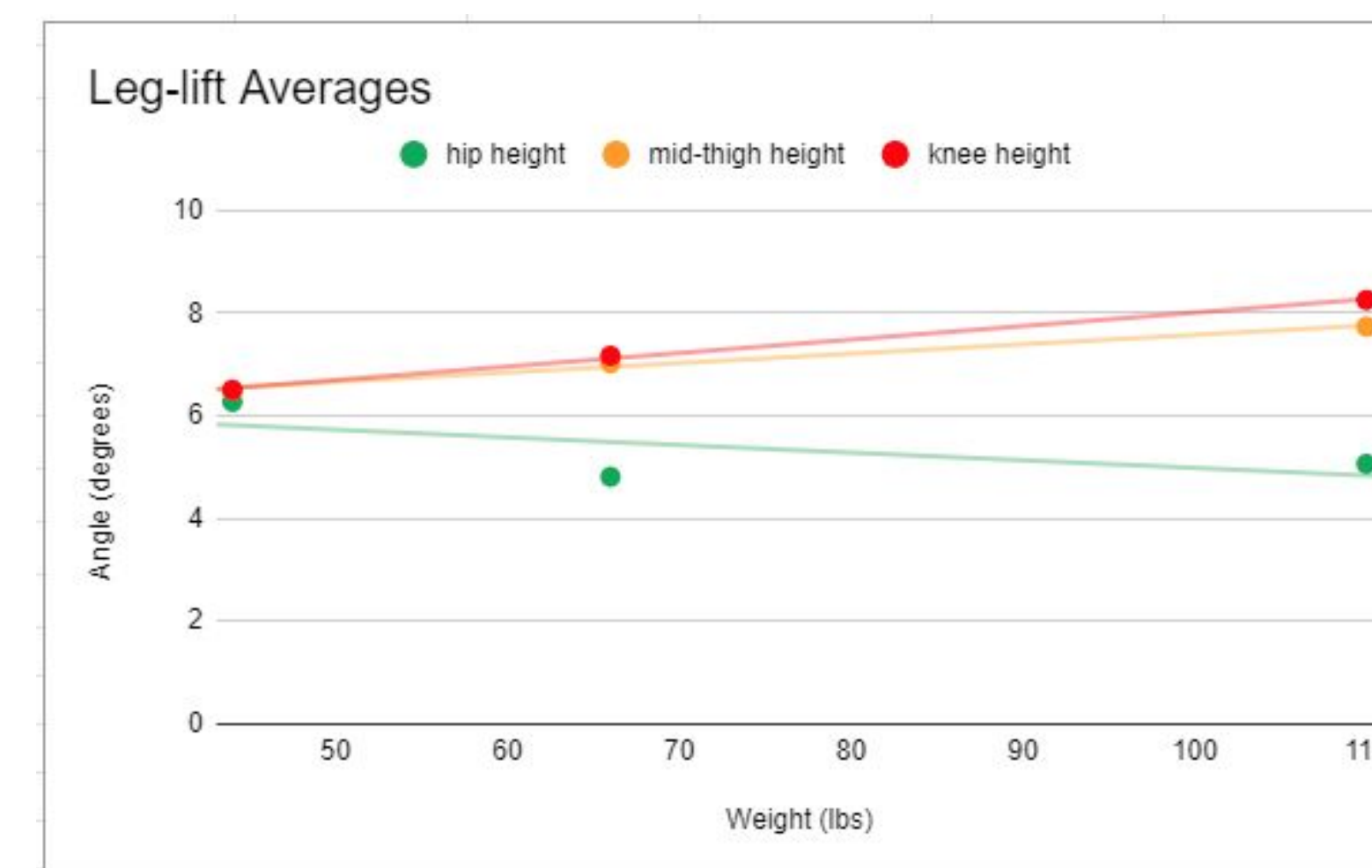


Figure 2: Lumbar rotation averages for the leg-lift task.

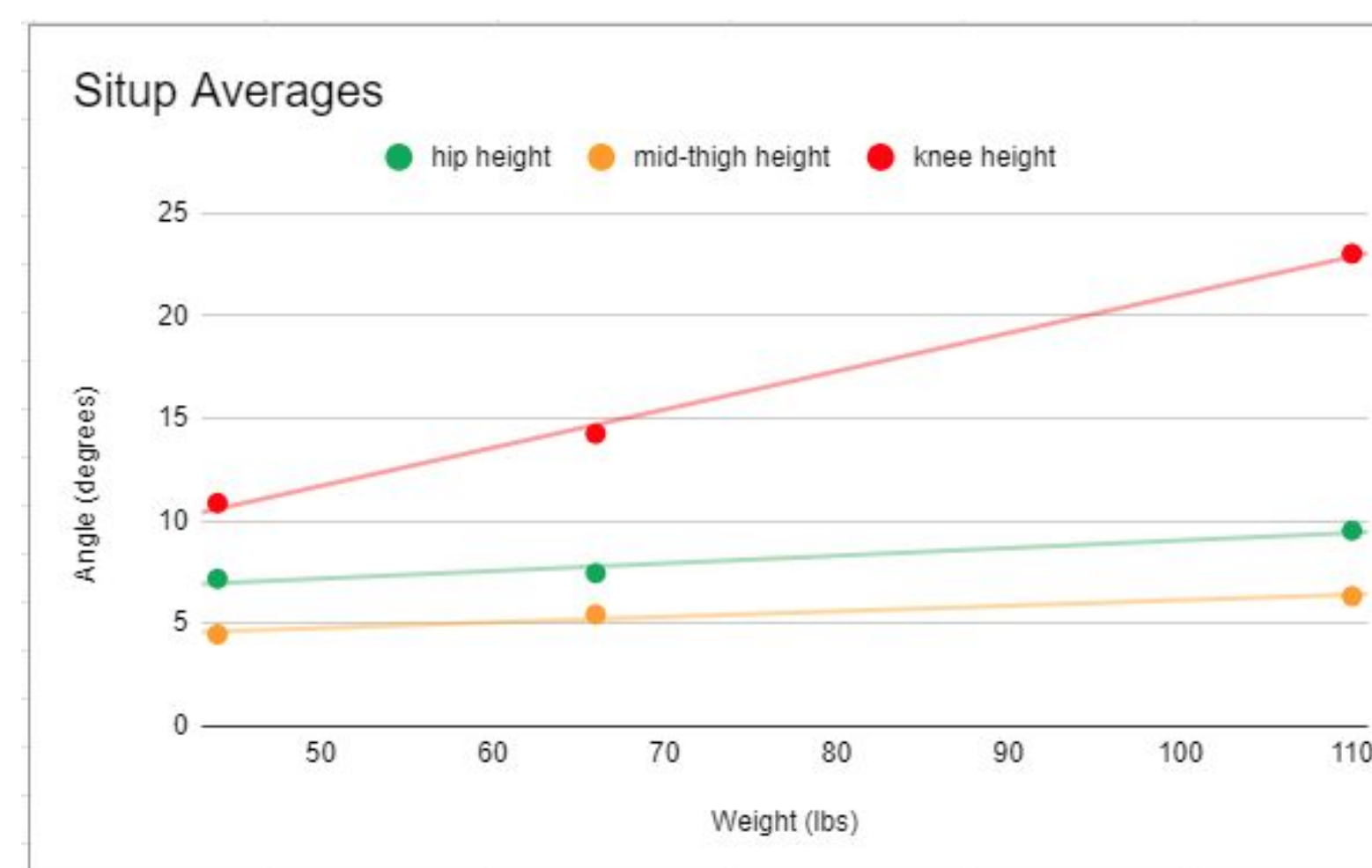


Figure 3: Lumbar rotation averages for the situp up task.

Discussion

Due to glitches within the data, some repetitions and trials were discarded. For both the 2-slide and leg-lift trials, lumbar rotation angles increased as the table height decreased. This was the expected trend because as table height decreases, the subject must reach further down. When analyzing the effect of manikin weight on the 2-slide and leg-lift tasks, no correlation was observed. The situp trials do not follow the same trend as the previous tasks. This is likely due to glitches in the data. Glitches made it difficult to select accurate peaks. When looking at the low table trials (knee height), lumbar rotation angles increased as the weight of the manikin increased. Although this was not a trend for other tasks or table heights, it suggests that for specific PHT, lumbar rotation angles may increase with an increase in manikin weight.

Conclusion

Pilot experiments and data analyses demonstrate that trunk rotation is evident in asymmetric PHT and that it may increase or decrease depending on the table height or weight of the patient.

Limitations: Limitations of this work include glitches contained within the data that made it difficult to select joint angle peaks. Also, the same table heights were used for all subjects regardless of their height.

Future Work: Future work will explore additional PHT that require more trunk rotation. With additional PHT, the correlation between table height, patient weight, and lumbar rotation may be further studied.

Acknowledgments: This work was supported by funding from the RESTORE Center and Clare Boothe Luce Program. We would like to thank Nathan Ceja and Grant Seyller for their assistance during data collection sessions.

References:

- [1] Budhrani-Shani, P, et al. National Library of Medicine. 2016. 38(3);
- [2] Uhlich, S. et al. 2022. [biorxivhttps://doi.org/10.1101/2022.07.07.499061](https://doi.org/10.1101/2022.07.07.499061)