The Mother Load: Biomechanics of Lifting Infants Postpartum

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Summary

Infant caregiving requires frequent lifting, yet little is known about the physical demands on postpartum mothers during everyday tasks. This study explored how mothers lift their own 3-month-old infants in three common scenarios: from the floor, within a car seat, and from a diaper changing table. Using 3D motion capture, force platforms, and electromyography, hip and trunk movement and muscle activity were characterized in eleven postpartum mothers.

Lifting infants from the floor was the most physically demanding, requiring greater hip and trunk flexion, increased hip power generation, and greater muscle activity. Lifting an infant in a car seat added weight but reduced hip motion, while lifting from a changing table was least demanding but involved asymmetrical trunk movements. These findings provide critical insight into lifting mechanics, helping to inform interventions that reduce injury risk and support caregiver well-being.

Introduction

Caring for an infant requires constant motion, with lifting and bending involved in nearly every daily task [1]. These physical demands can contribute to or worsen pain in the postpartum population, already vulnerable to musculoskeletal strain [2]. Understanding these movements could help develop ergonomic guidelines and training to reduce the risk of injuries among caregivers. The purpose of this study was to characterize the biomechanics of the hips and trunk of mothers lifting their infants during three everyday tasks.

Methods

Figure 1: Three infant lifting conditions: car seat, floor, and table

11 healthy postpartum mothers (Age: 34.0 ± 2.2 years; Height: 1.66 ± 0.08 m; Weight: 66.5 ±13.3 kg) and their own infants (Age: 14.8 ± 2.8 weeks; Weight: 6.18 ± 0.6 kg) participated in this study. Participants performed 3 lifting tasks (Figure 1) in a semi-continuous manner for 3 trials: 1) lifting infant within car seat from floor, 2) lifting infant off floor, and 3) lifting infant off changing table.

Reflective markers tracked 3D motion (150 Hz), forces were collected with force platforms (1500 Hz) and muscle activity was collected with electromyography (1500 Hz). A one-way MANOVA ($\alpha \leq 0.05$) with post-hoc pairwise tests was used.

Results and Discussion

Significant differences were identified between the tasks ($p \leq 0.05$). When lifting their infant from the floor, mothers exhibited greater hip flexion and abduction angles and greater trunk flexion ($p<0.05$, Figure 2), consistent with other lifting research [3]. Mothers also exhibited greater power generation in all planes and greater gluteus medius and lumbar erector spinae muscle activity ($p<0.05$), suggesting a more demanding task that required a consistent lifting strategy.

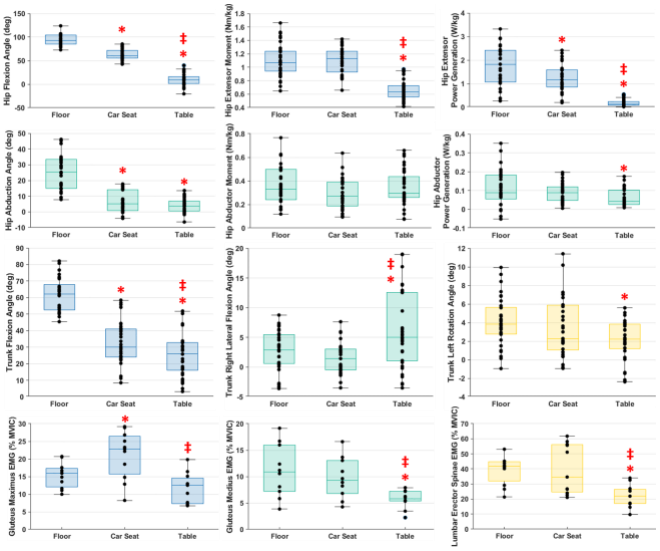

Figure 2: Kinematics (Hip and trunk), Kinetics (Hip), and EMG

Lifting infants from the floor within a car seat added ~4 kg mass, which elicited similar gluteus maximus muscle activity but reduced hip motion ($p<0.05$). The elevated car seat handle height likely allowed mothers to accomplish the lift in a variety of ways without having to get as low. While lifting infants off the changing table was the least biomechanically demanding, mothers asymmetrically sidebent and rotated their trunk, which has ergonomic implications [1].

Conclusions

This study provides critical insights into the biomechanics of infant lifting, an underexplored yet essential aspect of caregiving. Mothers altered their mechanics to lift their infants during these everyday tasks, which can inform interventions for caregiver wellbeing and ensure infant safety.

References

[1] Vincent et al. (2013) *Physiother Res Int* **18**(2) 81-90.
[2] Christopher et al. (2022) *J Womens Health Phys Therap* **46** 11-17
[3] Kim et al., (2002) *Technol Health Care* **30**(1_suppl):441-450.