Impact of Commercial Infant Products on Posture and Muscular Development

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DESCRIPTION

The musculoskeletal and motor development of infants is greatly influenced by their interactions with both their caregivers and their environment. In early infancy, this environment includes being held, lying on firm, flat surfaces and spending time in various nursery products. In the U.S., infants younger than five months spend an average of 5.7 h daily (ranging from 0 h to 16 h) in seated nursery products such as car seats, strollers, bouncers and swings. Although these products are designed for short-term use (30 min-60 min) during supervised activities like transportation, feeding or play, they are often used for longer periods without continuous supervision. Prolonged time spent lying supine in seated products, especially car seats, has been associated with negative outcomes such as deformational plagiocephaly, delayed motor development and decreased oxygen saturation levels. Despite their widespread use, limited research exists on the biomechanical effects of placing infants in supine-lying commercial products, highlighting the need for more studies to understand how these products influence infant movement, motor development and physical capabilities.

To address concerns about safe sleep, the American Academy of Pediatrics (AAP) issued recommendations in 1992 to reduce Sudden Infant Death Syndrome (SIDS) risks. These guidelines include placing infants in a supine position on a firm, flat and separate sleep surface, while avoiding soft bedding. Additionally, our prior biomechanics research on inclined sleep products demonstrated increased suffocation hazards when infants lie supine or prone in inclined products. These findings contributed to the enactment of the prohibits the marketing of infant sleep products with an incline greater than 10. However, many caregivers continue to use seated products for extended periods, often as crib or bassinet alternatives to improve infant sleep.

Our research on awake infants placed in inclined positions has identified significant biomechanical changes. Specifically, we observed altered muscle activation in the erector spinae and abdominal muscles, along with modifications to rolling maneuvers compared to a flat surface. These changes suggest that inclined environments may enable infants to roll

prematurely, placing them at risk of unintentionally ending up in a prone position. This prone positioning significantly increases the risk of suffocation, particularly if the infant cannot maintain their nose and mouth clear of the inclined surface.

Injuries associated with seated nursery products further highlight these risks. In 2022, the National Electronic Injury Surveillance System (NEISS) recorded approximately 12,000 infant injuries treated in emergency departments due to the use of car seats outside of motor vehicles (e.g., as carriers), bouncers, rockers and swings. Many injuries occurred when infants rolled over within or completely out of these products. Infants aged zero to six months are particularly vulnerable to breathingrelated injuries, including suffocation, due to their immature respiratory systems and limited arousal responses.

Head-neck flexion is a key factor in these risks, as it is associated with increased pulmonary resistance in both supine and semisitting positions. Studies have shown that excessive head-neck flexion can interrupt airflow, even leading to complete pharyngeal closure. Additionally, a bent position can significantly reduce lung capacity, expiratory flow, rib cage structure and chest wall motion. An infant's disproportionately large head, combined with underdeveloped cervical spine musculature and joint laxity, makes them more susceptible to uncontrolled cervical spine movements. This means that an infant's posture and positioning depend heavily on the design features of the product they are placed in. In some seated products, infants are forced into positions with excessive headneck flexion or slouching, further increasing the likelihood of breathing difficulties.

The purpose of this study was to investigate the effects of four commercial infant products (carrier, bouncer, rocker and swing) on muscle activation and body positioning in both supine and prone positions, compared to a firm, flat surface. We hypothesized two outcomes: (1) Infants would exhibit greater head-neck, torso-pelvis and trunk flexion/extension in all seated products compared to the flat surface and (2) In the supine position, infants would demonstrate increased activation of the erector spinae muscles and decreased activation of the abdominal muscles at higher inclines, while the opposite would occur in the prone position.

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Received: 19-Nov-2024, Manuscript No. LDAPR-24-36437; Editor assigned: 21-Nov-2024, PreQC No. LDAPR-24-36437 (PQ); Reviewed: 05-Dec-2024, QC No. LDAPR-24-36437; Revised: 12-Dec-2024, Manuscript No. LDAPR-24-36437 (R); Published: 20-Dec-2024, DOI: 10.35248/2385-4529.24.11.092

Citation: Caroll M (2024). Impact of Commercial Infant Products on Posture and Muscular Development. Adv Pediatr Res. 11:092.

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CONCLUSION

In conclusion, commercial infant products, while widely used, can significantly impact infant posture, muscle activity and safety. Prolonged use of these products, particularly in inclined or seated positions, has been associated with risks such as altered muscle activation, premature rolling and increased vulnerability to suffocation due to improper positioning. Despite safety recommendations and legislation like the "Safe Sleep for Babies Act," many caregivers continue to rely on these products, often beyond their intended purpose. This study highlights the need for further research to better understand the biomechanical and developmental effects of the infant products, promoting safer use and improved designs.