

# The Relationship of Infant Sleep and Play Positioning to Motor Milestone Achievement

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## KEY WORDS

- Back to Sleep campaign
- caregiver education
- infant development

**OBJECTIVE.** Limited information is available on how sleep and play positions affect infant gross motor skills and occupational development. The overall objective of this descriptive developmental pilot study was to compare normative and sampled infants relative to sleep and awake positioning using the Denver II Gross Motor Sector.

**METHOD.** A cross-sectional sample of 66 infants 2.0 ( $n = 23$ ), 4.1 ( $n = 26$ ), and 6.0 ( $n = 17$ ) months of age were administered the Denver II Gross Motor Sector. Caregivers identified infants' primary sleep positions and amount of awake-time in prone. Data were analyzed using chi-square goodness-of-fit tests.

**RESULTS.** The sample of 2.0-month-old supine and side sleeping infants differed significantly from the normative population on three gross motor milestones. Two-month-old infants spending 15 min or fewer of awake-time in prone passed the gross motor milestones at significantly lower percentages than the normative population. No significant differences were noted between sampled and normative populations at 4.1 and 6.0 months of age.

**CONCLUSION.** Results suggest that infant gross motor development may be related to sleep and play positioning. Information regarding infants' sleep and awake positioning may be important to occupational therapists when evaluating gross motor development. Implications for caregiver education and future research are proposed.

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Occupational therapists provide services to infants with a wide variety of neurological and developmental disabilities. Services may include evaluation, direct intervention, and family and caregiver education. Evaluation of the infant frequently includes an examination of the acquisition of specific motor milestones needed for successful participation in everyday childhood occupations. The Denver II (Frankenburg et al., 1992) is one screening tool frequently used by occupational therapists and pediatricians to assess infant motor milestone acquisition. This tool was standardized in 1988 when infants were primarily positioned in prone for sleep.

Since that time, the American Academy of Pediatrics (AAP) Task Force on Infant Positioning and Sudden Infant Death Syndrome (SIDS) released a statement recommending that healthy infants

be placed in supine or sidelying rather than prone for sleep to decrease the risk of SIDS (AAP, 1992). Release of this statement was followed by a national public awareness campaign in 1994, "Back to Sleep," to educate caregivers about the importance of supine or sidelying sleep positioning for healthy babies (Willinger, Hoffman, & Hartford, 1994). Reports indicate that concurrent with the decrease in prone sleep positioning, the incidence of SIDS in the United States has decreased by more than 40% since the original 1992 AAP recommendations (AAP, 2000).

In 1995, following the "Back to Sleep" campaign, we began to observe changes in developmental patterns in babies during the first year of life. These observations were made over several years during classroom infant motor development labs for occupational therapy students. Caregivers reported

not placing their babies in prone during awake-time, stating that this position was not tolerated by the infants. Additionally, research was encouraged by several pediatricians who noted similar patterns. Following the "Back to Sleep" campaign, few studies have examined the effects of supine sleep and play positioning on developmental patterns.

Jantz, Blosser, and Fruechting (1997), pediatricians using the Denver II (Frankenburg et al., 1992), conducted a chart review of 343 full-term infants at the 4-month or 6-month well-baby check-up. They determined that infants who slept in supine or sidelying were less likely to roll over at 4 months of age compared with prone sleepers. Additionally, supine sleepers rolled first from supine to prone, whereas prone sleepers rolled first from prone to supine, suggesting that direction of first roll also may be related to sleep position.

Dewey, Fleming, Golding, and the Avon Longitudinal Study of Pregnancy and Childhood Study Team (1998) conducted a study in the United Kingdom using the Denver Developmental Screening Test. Prone sleepers and those with varying sleep positions had better gross motor scores than supine sleepers at 6 months of age. By 18 months of age, no statistically significant differences were found in developmental skills between groups.

Davis, Moon, Sachs, and Ottolini (1998) found that prone sleepers achieved five of eight motor milestones earlier than supine sleepers in a study of 351 infants. These motor milestones included rolling prone to supine, tripod sitting, creeping, crawling, and pulling to stand. The study also found earlier milestone achievement in supine sleepers who spent a greater, though unspecified, amount of awake-time in prone. Following a successful public awareness campaign to promote infant supine sleep position in Australia, researchers found that 26% of parents never placed their babies in prone for play, even though no relationship between awake-time in prone and SIDS has been identified (Mildred, Beard, Dallwitz, & Unwin, 1995). The importance of prone positioning for the development of antigravity extensor control and subsequent development of motor abilities has been cited in the

literature (Bly, 1994; Illingworth, 1984).

Zelazny (1999), an occupational therapist, reported that prone positioning during awake-time was significantly related to both attainment and quality of prone skills and overall motor development in 4-month-old infants. Specifically, she found that 1 1/2 hours per day of prone positioning was critical for promoting normal motor development.

The cited studies examined developmental milestone achievement in infants between 4 months and 18 months of age. This pilot study investigated the following research questions:

1. To what extent did sleep position relate to achievement of specific Denver II gross motor milestones of infants at 2, 4, and 6 months of age?
2. To what extent did pass rates on specific Denver II gross motor milestones of supine and side sleeping infants at 2, 4, and 6 months of age differ significantly from established norms?
3. To what extent did amount of awake-time in prone relate to achievement of specific Denver II gross motor milestones of supine and side sleeping infants at 2, 4, and 6 months of age?

## Method

### Sample

This descriptive developmental pilot study compared a 1998 sample of infants to the 1988 Denver II (Frankenburg et al., 1992) normed infants. Infants were recruited from a Pittsburgh suburban pediatric medical practice and included infants at 2-, 4-, and 6-month well-baby visits. Infants were excluded if they were born prematurely, diagnosed with gastroesophageal reflux or respiratory distress, or both.

### Measures

Demographic information was collected from the caregiver accompanying the child during the well-baby visit through a brief questionnaire. Caregivers were asked to identify their infant's primary sleep position (supine, prone, side); estimate the amount of awake-time that their infant spent in prone per day (0, 1–15, 16–30, 31–60, 61–90, 91–120, > 120 min); and identify

themselves as mother, father, or "other."

The Denver II Gross Motor Sector was used by pediatricians to record pass and fail scores of the sampled population on seven specific milestones: head up 45°, head up 90°, sit–head steady, chest up–arm support, roll over, pull to sit–no head lag, and sit–no support (Frankenburg et al., 1992). Average ages at which 25%, 50%, 75%, and 90% of the normative population passed the milestones are provided as norms. Interrater reliability was reported at 100%, and test–retest reliability (7–10 days, different raters) ranged from 64% to 100% on these items (Frankenburg et al., 1996). No reliability statistics were determined for this pilot study. This screening tool was chosen for its ease and efficiency in administration and its prior use in related studies. Because the norms were established in 1988 before the "Back to Sleep" campaign in 1994, it was assumed that the normative sample of babies were primarily being placed in prone for sleep.

### Procedure

Approval from the institution's Internal Review Board was granted in the summer of 1998, after which two pediatric occupational therapists trained the pediatric group in the administration and collection of both measures. After providing informed consent, the caregiver completed the brief questionnaire, and the physician performed a well-baby visit, which included administration of the Denver II Gross Motor Sector. Questionnaires and gross motor tally sheets were coded numerically and matched to ensure anonymity and confidentiality. Researchers received data during the fall of 1998 and 1999.

## Results

### Demographics

Data sets on 90 infants were collected, of which 66 (73%) were complete and met the inclusion criteria. The majority of infants in each age category slept in supine and sidelying versus prone ( $n = 22$  of 23 at 2.0 months of age, 25 of 26 at 4.1 months of age, 12 of 17 at 6.0 months of age). Primary caregivers' estimates of awake-time in prone were dichotomized as 0–15 min

and greater than 15 min for this sample. The majority of infants at 2.0 and 4.1 months of age spent 15 min or fewer of awake-time in prone. The number of infants who spent greater than 15 min of awake-time in prone increased with age; however, only 5 of the 59 infants spent greater than 60 min of awake-time in prone.

### Research Questions

Too few infants were placed in prone for sleeping to include in the analysis of the first research question: To what extent did sleep position relate to achievement of Denver II specific gross motor milestones? Using a Fisher's exact test, we determined that supine and side sleepers were not statistically different from each other in pass-fail distributions on the gross motor milestones. Therefore, for the remaining research questions, data for supine and side sleepers were combined.

Pass-fail distributions were compared statistically between the normative and sampled populations on the seven gross motor milestones, using a chi-square goodness-of-fit test (see Table 1). Significant differences were noted at 2.0 months of age on all three gross motor milestones for this age group. Although no significant differences were noted at 4.1 and 6.0 months of age, data for direction of first roll were available on 14 of the 25 infants at 4.1 months; 64% rolled first from supine to prone.

Pass-fail distributions were compared statistically between the normative and sampled infants on the seven gross motor milestones for awake-time in prone categories (< 15 min, > 15 min) using the chi-square goodness-of-fit test. Significant differences ( $X^2 \geq 3.84$ ,  $df = 1$ ,  $\alpha = .05$ ) were

noted for those infants who spent 15 min or fewer of awake-time in prone at 2.0 months of age. Head up 45° was passed by 44%, head up 90° by 13%, and sit-head steady by 19% compared with 75%, 50%, and 50%, respectively, of the normative population. Two-month-old infants who spent greater than 15 min of awake-time in prone had statistically similar pass-fail distributions as the normative population on these three gross motor milestones. No significant differences in milestones related to awake-time in prone were noted at 4.1 and 6.0 months of age.

### Discussion

This pilot study found that the majority of sampled infants slept in supine and sidelying (59 of 66), indicating that caregivers followed the recommendations of the AAP. Our study, the first to examine gross motor developmental patterns in a sample of 2-month-old infants following the "Back to Sleep" campaign, resulted in significant differences in milestone achievement in this age group compared with a normative population. This finding may be due to less developed neck extensor and shoulder musculature and is consistent with infant motor development literature (Bly, 1994; Illingworth, 1984). Holt (1960) observed that American babies sleeping primarily in prone showed more advanced prone skills than English babies who slept in supine. However, in the current study, the 2-month-old infants who spent greater than 15 min of awake-time in prone had statistically similar pass-fail distributions to the normative population on items sensitive to antigravity extensor control. This finding suggests that not only sleep position, but

also awake-time in prone may relate to achievement of developmental milestones. These results support the findings of Zelazny (1999) and Davis et al. (1998), although their samples consisted of 4-month-old infants.

Contrary to our expectations, the percentage of sampled 4.1-month-old infants achieving chest up-arm support, a milestone sensitive to antigravity extensor development, was similar to established norms. This similarity may be attributed to an ambiguous definition of this milestone in the Denver II, possibly leading to misinterpretation of the correct test position. This finding differs from that of Zelazny (1999) possibly because of her use of a more sensitive assessment.

Before the "Back to Sleep" campaign, Knobloch and Pasamanick (1974) described developmental data indicating that infants normally rolled first from prone to supine. Similar to Jantz et al. (1997), after the "Back to Sleep" campaign, the majority of our 4.1-month-old infants first rolled from supine to prone, possibly indicating that the direction of first roll is related to sleep position. Rolling from supine to prone requires greater control of flexor rather than extensor muscular development than rolling from prone to supine. As Holt (1960) observed, English infants who slept primarily in supine also had more advanced flexor control. However, unlike Jantz et al., the percentage of our sample of 4.1-month-old infants who had achieved their first roll, regardless of direction, was similar to the normative population.

At 6.0 months of age, there was no statistically significant difference on pass-fail distributions for sit-no support between the sample and normative populations,

**Table 1. Percentage of Normative Versus Sampled Population that Passed Gross Motor Milestones**

Milestone	n	Normative		Sampled		X <sup>2</sup>
		% Pass	Avg. Age (Months)	% Pass Avg.	Age (Months)	
Head up 45°	22	75	1.8	55	2.0	4.91*
Head up 90°	22	50	2.2	18	2.0	8.90*
Sit-head steady	21	50	2.3	24	2.0	5.76*
Chest up-arm support	23	75	4.0	74	4.1	0.01
Roll over	22	75	4.3	59	4.1	2.96
Pull to sit-no head lag	18	75	4.1	61	4.1	1.85
Sit-no support	12	50	5.9	75	6.0	3.00

*Note.* n = number of supine and side sleeping infants within the sampled population for each gross motor milestone. Average age differences between normative and sampled infants varied by -.3 to +.2 months. Norms were established (Frankenburg et al., 1992) by determining average ages at which 25%, 50%, 75%, and 90% of infants passed a given milestone. For the sampled infants, actual pass-fail distributions were reported for each age group.

\*Goodness-of-fit chi-square yielded significant differences in pass-fail distributions between normative and sampled populations at  $X^2 \geq 3.84$  ( $df = 1$ ,  $\alpha = .05$ ).

consistent with Davis et al. (1998). One explanation for this finding is that a child may pass this item by using upper extremities for support. However, because of the small sample size of 6.0-month-old infants, findings are inconclusive.

Results of the current pilot study indicate overall that infants spent very little awake-time in prone. Our findings raise the question of whether caregivers may be misinterpreting the intent of the "Back to Sleep" campaign and as a result, are avoiding prone for their babies during both sleep and awake-time. A subsequent AAP (1996, 2000) recommendation that "a certain amount of 'tummy time' while the infant is awake and observed is recommended for developmental reasons and to help prevent flat spots on the occiput" (p. 654, p. 1217) may not be reaching caregivers effectively.

### Limitations and Directions for Future Research

Future studies using a larger and socioeconomically and culturally diverse sample would be needed to increase generalizability of findings. Additionally, requiring caregivers to keep a daily log of infant awake-time in prone, rather than relying on recall, may yield more accurate data. A more rigorous study, including control and experimental groups, could more conclusively determine the impact of awake-time in prone on infant gross motor development. Consideration should be given to selecting an assessment that is sensitive to both qualitative aspects of motor development and the acquisition of motor milestones. Administration of the assessment by an occupational therapist also is recommended.

### Conclusion

The findings of this pilot study add to the growing data describing a relationship between infant sleep and play positioning and differences in motor development as

compared with previously established norms. As occupational therapists working with infants and young children, we may need to reconsider the accuracy of developmental norms established before the "Back to Sleep" campaign. Information from caregivers regarding sleep and play positioning also may be important to understand developmental patterns. Additionally, caregivers and health care professionals may benefit from education regarding the potential developmental benefits of prone positioning during awake-time.

Finally, it is important that occupational therapists support the "Back to Sleep" campaign. However, while working with infants and caregivers to enhance the everyday occupational development of children, occupational therapists can advocate: "Back to Sleep and Prone to Play." ▲

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### References

American Academy of Pediatrics Task Force on Infant Positioning and SIDS. (1992). Positioning and SIDS. *Pediatrics*, *89*, 1120–1126.

American Academy of Pediatrics Task Force on Infant Positioning and SIDS. (1996). Positioning and sudden infant death syndrome: Update. *Pediatrics*, *98*, 1216–1218.

American Academy of Pediatrics Task Force on Infant Sleep Position and SIDS. (2000). Changing concepts of sudden infant death syndrome: Implications for infant sleeping environment and sleep position. *Pediatrics*, *105*, 650–656.

Bly, L. (1994). *Motor skill acquisition in the first year*. Tucson, AZ: Therapy Skill Builders.

Davis, B. E., Moon, R. Y., Sachs, H. C., & Ottolini, M. C. (1998). Effects of sleep position on infant motor development. *Pediatrics*, *102*, 1135–1140.

Dewey, C., Fleming, P., Golding, J., & the ALSPAC Study Team. (1998). Does the supine sleeping position have any adverse effects on the child? II. Development in the first 18 months. *Pediatrics*, *101*, 5–12.

Frankenburg, W. K., Dodds, J., Archer, P., Bresnick, B., Maschka, P., Edelman, N., et al. (1992). *Denver II training manual*. Denver, CO: Denver Developmental Materials.

Frankenburg, W. K., Dodds, J., Archer, P., Bresnick, B., Maschka, P., Edelman, N., et al. (1996). *Denver II technical manual*. Denver, CO: Denver Developmental Materials.

Holt, K. S. (1960). Early motor development: Posturally induced variations. *Journal of Pediatrics*, *57*, 571–575.

Illingworth, R. S. (1984). *The development of the infant and young child*. Edinburgh, UK: Churchill Livingstone.

Jantz, J. W., Blosser, C. D., & Fruechting, L. A. (1997). A motor milestone change noted with a change in sleep position. *Archives of Pediatric and Adolescent Medicine*, *151*, 565–568.

Knobloch, H., & Pasamanick, B. (Eds.). (1974). *Gesell and Amatruda's developmental diagnosis* (3rd ed.). Hagerstown, MD: Harper and Row.

Mildred, J., Beard, K., Dallwitz, A., & Unwin, J. (1995). Play position is influenced by knowledge of SIDS sleep position recommendations. *Journal of Paediatrics and Child Health*, *31*, 499–502.

Willinger, M., Hoffman, H. J., & Hartford, R. B. (1994). Infant sleep position and risk for sudden infant death syndrome: Report of a meeting held January 13 and 14, 1994, National Institutes of Health, Bethesda, MD. *Pediatrics*, *93*, 814–819.

Zelazny, S. M. (1999, April). *The relationship between infant positioning and motor skill acquisition*. Paper presented at American Occupational Therapy Association Annual Conference, Indianapolis, Indiana.