

# Prone positioning and motor development in the first 6 weeks of life

**Dorothy C Russell, Masters in Occupational Therapy**

Senior Occupational Therapist at Department Pediatrics and Child Health, UFS

**Helena Kriel, M.Sc. Physiotherapy**

Head: Department of Physiotherapy, UFS

**Gina Joubert, BA, MSc**

Associate Professor and Head: Department of Biostatistics

**Yolande Goosen, M. Soc. Sc. (Advanced Midwifery)**

Research assistant at Department Pediatrics and Child Health, UFS

## ABSTRACT

*Supine sleeping positions for infants lead to a decrease in Sudden Infant Death Syndrome (SIDS), but inadequate time spent in prone position may lead to developmental problems during infancy. This cross-sectional developmental study was an attempt to determine whether the back to sleep campaign had an effect on the development of babies in South Africa. One hundred and twenty six week old infants were evaluated at a community centre in Mangaung, Bloemfontein, Free State to determine differences in motor development between infants who spent more than 30 minutes awake in a prone position and infants who spent less than 30 minutes. Comparisons with regard to their gross motor development and postures were made.*

*There was a significant difference between the two groups with regard to their gross motor development, the prone infants being more advanced than those who were never, or only short periods, in the prone position. It therefore seems that exclusive use of the supine position may lead to problems with motor development and parents must be encouraged to place their babies in the prone position during waking hours.*

**Key words:** Prone position, motor development, 6 weeks infants

## Introduction

In an effort to decrease the incidence of sudden infant death syndrome (SIDS), the American Academy of Pediatrics in 1992<sup>1</sup> published a recommendation that babies should preferably be positioned on their side or back when sleeping. This recommendation led to a decrease in infants sleeping in prone in the United States<sup>2</sup>. This trend was also noted in South Africa at the Bloemfontein Child Information Centre. As few as 16% of 6 week old babies evaluated, were placed in a prone position at any time<sup>3</sup>. The *back to sleep* campaign resulted in a 40% decrease in SIDS in the United States<sup>2</sup>. This change in sleep position thus seems beneficial. It did, however, bring about a new set of concerns, namely the slower achievement of motor functions such as rolling over, sitting up, crawling and pulling to the standing position<sup>2</sup>. A solution for these problems is to place a baby in the prone position while awake during the first year of life, as the prone position facilitates normal neuro-motor development<sup>4</sup>.

It is documented that infants who sleep in supine, but regularly play in a prone position, achieve motor functions more rapidly than children that do not play in prone<sup>5</sup>. Jennings, *et al.* documented that infants who play in the prone position from birth had significantly higher scores on the PDMS-2 locomotion at 6 months and 18 months of age<sup>6</sup>. The prone position encourages the development of extensor control of the head and neck<sup>7</sup>, and in fact the motor development of infants<sup>8</sup>. It appears that lack of exposure to the prone position may result in decreased opportunities to learn motor skills that require antigravity extension, such as crawling or pulling to the standing position<sup>4</sup>.

Supine positioning with inadequate time spent in the prone position (tummy time), may lead to developmental problems with rolling over, sitting up, crawling and pulling to the standing position during infancy<sup>2</sup>. Although many of these problems will improve or even be resolved within the first few years of life, the potential impact of preventing an infant's exploration during these early months of learning may be a cause of concern.

For the purpose of this study *tummy time* is defined as the supervised prone positioning of an infant specifically when awake. This is especially applicable to babies up to 6 months of age. If tummy time is inadequate, certain areas of development can be undermined, e.g. the normal extension motor patterns and the balance of flexor and extensor patterns. This leads to infants often holding their arms in a "W" position when placed in prone, which causes the centre of gravity to be displaced forward with the result that the body weight is centered on the sternum. This is an uncomfortable and nonfunctional position<sup>9</sup>. According to Hunter and Malloy this will also interfere with the infant's exploration and play, which is needed for optimal and timely cognitive development<sup>9</sup>.

No South African data were available regarding the length of time that babies spend in the prone position. The aims of our study were therefore to determine the length of time that 6 week old babies in Bloemfontein spend in the prone position and to determine the association between prone positioning when awake and motor development.

## Methodology

### Sampling

In this cross-sectional developmental study 120 black healthy infants were recruited at a community clinic over a period of twelve months (researchers visited the clinic one day a week), when brought for their 6 weeks' routine check up visit booked by the clinic. Six weeks were chosen for practical reasons since infants are routinely brought to the clinic at this age. This ensured that the population consisted of healthy babies. Infants were eligible for inclusion if they were born at full term, were six weeks of age (a deviation of 6 days was allowed) and accompanied by their mother. Children with fever, visible anomalies and orthopedic problems were excluded. Only one infant with fever had to be excluded.

### Location

The infants were recruited from the Mangaung-University of the Free State Community Partnership Programme (MUCPP) Clinic.



This is a community clinic which runs an off-campus learning site in one of the local communities.

## Procedure

The mothers gave written informed consent before a brief questionnaire was completed by interviewing by the researchers in English or Afrikaans. The questionnaire was available in SeSotho, and a clinic professional nurse would have acted as interpreter if needed. This was however not necessary. The questionnaire covered demographic information, as well as information regarding the infants' positioning during sleep, on awakening and during the day. They were asked to quantify the length of time in minutes spent in the prone position when awake. They were also asked for their reasons for preferring a specific position for their babies. Although the sleeping position was not the focus of the study, we included it to obtain more data on the infants' positions.

After the completion of the questionnaire, a three minute video clip was recorded by one of the researchers. We requested the mother to place her baby in supine, and after the first part of the recording, the mother was requested to turn her baby to prone, where after the second recording was made. Pull to sit was done by one of the researchers. These clips were evaluated afterwards according to the criteria mentioned in Lois Bly's normal development guidelines<sup>7</sup>. Our focus was not the achievement of milestones, but the motor developmental patterns. The specific criteria of these patterns for 6 week old babies were described in depth by Bly and were listed on our data sheet. On the data sheet the developmental patterns were categorised according to supine, prone and pull to sit. The specific positions of the head, trunk, upper extremities and lower extremities were observed and graded (see Measurements below). Questionnaires and video clips were matched and coded numerically to ensure anonymity and confidentiality.

Ethical permission to conduct the study was received from the Ethics Committee of the Faculty of Health Science, University of the Free State (ETOVS 85/01).

## Measurements

The criteria mentioned in Lois Bly's normal development guidelines are as follows<sup>7</sup>:

The position of the infant's head in the prone position was observed and documented during:

- active turning of the head,,
- lifting of the head momentarily to 45°,
- whether the weight displacement was on the upper trunk or thorax.

The upper extremities of the infant in the prone position were also observed, graded and documented:

- during spontaneous active movement,
- when pushing up on arms.

The following was also recorded:

- the position of the elbow in relation to the shoulder,
- the position of the fore-arm with weight bearing on the hands and forearms in mid position, and
- whether the hands were open or not.

The following positions of the lower extremities of the infant in the prone position were also recorded:

- the anterior thigh in relation to the surface, and
- the knee extension less than 180°.

In the "pull-to-sit" the following aspects were evaluated:

- head control
- the presence of shoulder girdle elevation
- any activity of the legs
- and the presence of hip flexion resistance.

"Pull-to-sit" time frame was three seconds from supine to the vertical position of sitting.

These video clips were evaluated together by the primary authors, an occupational therapist and physiotherapist both of whom are experienced in the field of early child development. In the few cases of difference the video clips were re-assessed until consensus was reached. The evaluators were uninformed of the positioning of the babies at home.

Those infants who spent less than 30 minutes in total per day in the prone position were classified as non-prone infants and those who spent 30 minutes in total and more in the prone position as prone infants. Information from the Bloemfontein Child Information Centre suggested the 30 minute cut off point.<sup>3</sup>

Descriptive statistics, namely means and standard deviations, or medians for numerical data (mainly demographic information), and frequencies and percentages for categorical data (mainly developmental patterns) were calculated by the Department of Biostatistics at the University of the Free State. Infants who had tummy time were compared with infants who did not have tummy time using the chi-squared of Fisher's exact test as appropriate.

## Results

A hundred and twenty babies who met the inclusion criteria were enrolled into the study, 59 were male and 61 female. This effectively eliminated a gender bias in the study.

The sleeping positions of the infants varied. According to the mothers the majority of the infants (60%) slept on their sides only, 9% on their sides and supine and 3% in supine. 17% slept on both their sides and in the prone position (see Figure 1). Thus a total of 72% of all the infants did not use the prone position for sleeping at all.

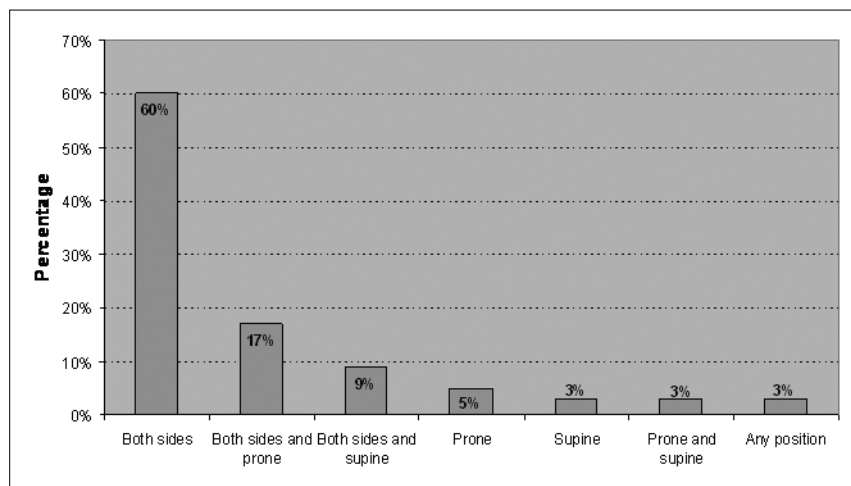


Figure 1: Sleeping positions of infants when put to sleep

Even when the infants were awake, the majority of the mothers still preferred to put their infants on their sides. As depicted in Figure 2, 17.5% of the infants were never placed in the prone position when awake, 42.5% were placed in the prone position

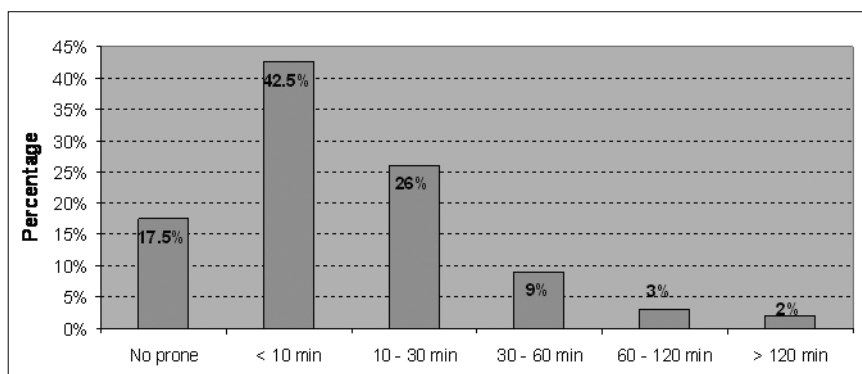


Figure 2: Time infants spent in prone while awake (n=120)



for less than 10 minutes per day and only 14% were placed in the prone position for more than 30 minutes per day. Thus there were 103 infants who were classified as non-prone infants, and only 17 infants who could be classified as prone infants.

In comparing the motor ability of the non-prone infants with that of the prone infants the following was found. There was a statistically significant difference between the prone infants and non-prone infants regarding head control (Figure 3), with prone infants having more control than non-prone infants ( $p < 0.0001$ ). The prone infants (94%) could also turn their heads when placed on their tummies, whilst only 32% of non-prone infants could do the same. The head lifting action had the same tendency as the turning of the head. Sixty percent of prone infants could lift their heads 45° compared to the 14% of non-prone infants.

More prone infants (29%) could displace their weight on the upper trunk or thorax while only 2% of the non-prone infants could perform the same action. Weight displacement of non-prone infants was still predominantly on the head.

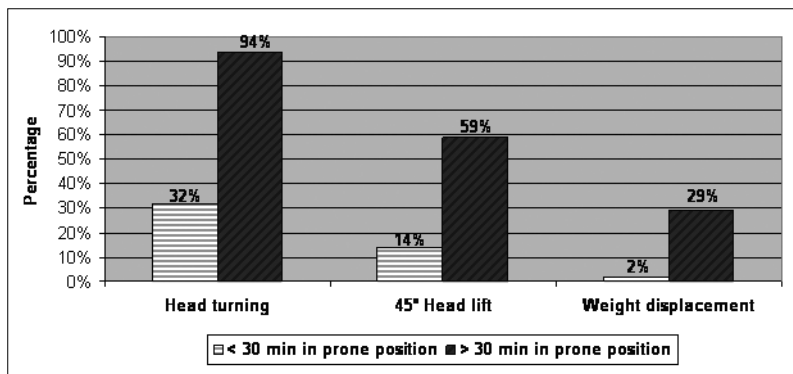


Figure 3: Head control of prone and non-prone infants ( $n = 120$ )

Significant differences were found in the upper extremities between prone and non-prone infants (see Figure 4). Both the active movements of the arms and the pushing up on the arms showed highly significant differences ( $p < 0.0001$ ). Only 3% of the non-prone infants showed active movements of their upper extremities when put in a prone position, compared to 35% of the infants who were used to the prone position. When comparing pushing up on the arms, the same tendency was found as forty-one percent of prone infants tried to lift their thoraxes by pushing up on their arms compared to only 3% of the non-prone infants. Regarding the elbow position in relation to the shoulder ( $p = 0.0039$ ) and the position of the forearm with weight bearing on the hands in the mid position ( $p = 0.0002$ ), the activities of the prone infants were better than those of the non-prone infants. Less than half (45%) of non-prone infants placed their elbows behind their shoulders, while 82% of prone infants were able to do this. Almost all prone infants (88%) put their forearms in the mid-position with weight bearing on forearms and hands whilst 39% of non-prone infants managed to do the same. There were no significant differences regarding whether the hands were open or not.

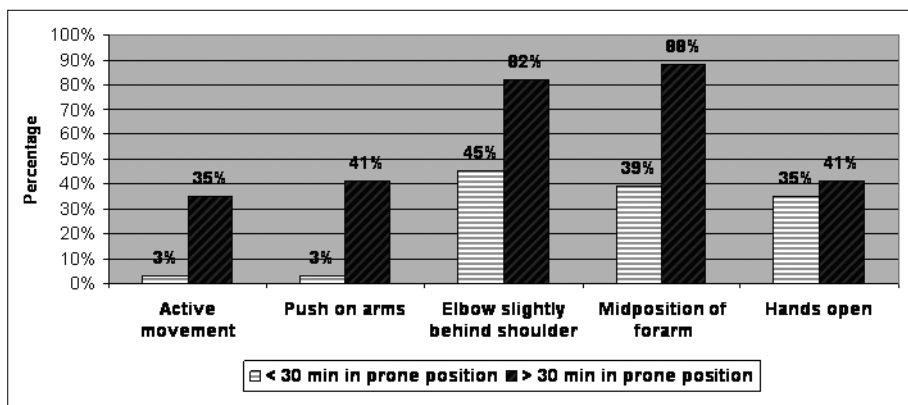


Figure 4: Upper extremity activities of infants ( $n = 120$ )

A significant difference was found also in the position of the anterior part of the thigh in relation to the floor ( $p = 0.0008$ ) (Figure 5). Only 24% of the non-prone infants' anterior thigh was on the floor, compared to 65% of the infants in prone. A significant difference ( $p = 0.0334$ ) could also be seen between the knee extension of the infants. Only 68% of non-prone infants had knee extension less than 90°, compared to 94% of prone infants.

In "pull-to-sit" action there were no significant differences within the group. This included head control, shoulder girdle elevation, activity of the legs and hip flexion resistance (Figure 6).

## Discussion

As we had to rely on mothers reporting on the time spent in the different positions the times recorded may not have been accurate and may impact on the results of the study. The use of a non standardised evaluation test made comparison to other studies difficult.

### Sleeping positions

In a recent study done in Canada by Majnemer and Barr, which included infants in the age group 4 to 6 months, it was determined that 95% of all infants never slept in a prone position<sup>8</sup>, although the age group of their study was not the same as our study and was performed in a developed country. No data comparable to our study was found. Our study was performed in a developing country with black participants, of which 76% did not sleep in a prone position.

### Awake positions

Recent research and clinical evidence indicate that parents are not well educated regarding the value of placing their infants in the prone position during the early stages of infancy<sup>6</sup>. In the research done by Majnemer and Barr,

32.7% of the 4 month old group never had tummy time and only 25% had more than 20 minutes of daily exposure to the prone position<sup>8</sup>. In our study, although the age group is different, the tendency is the same, but with lower percentages. Only 14% of the infants were in the prone position for more than 30 minutes per day, whilst 17.5% of the infants were never placed on their tummies while awake.

The preferred positions while awake were side lying and supine. In this study 37% of mothers had no specific reason for the preferred position when awake. Eight percent stated that it was the baby's own preference, while in 6% of the group it was the grandmother who gave the advice on positioning. Those mothers in favour of the prone position gave the following reasons such as: "The baby must have confidence and advanced development", "Lifting head at an earlier stage".

### Head control

Regular prone positioning gives infants the opportunity to develop head control at an early stage of life. Neck muscles are strengthened as they attempt to lift their heads to look around<sup>10</sup>. Salls et al. found that at two months of age only 55% of infants, who were not used to the prone position, could lift their heads, while of the children who were frequently placed in a prone position, 75% could lift their heads to 45 degrees<sup>2</sup>. In our study the infants were two weeks younger, but the results are comparable to that of Salls et al.<sup>2</sup> (Figure 3).

### Upper extremities

In this study there were significant differences in the active movements of the arms and in the pushing-up on the arms between the prone and non-prone infants. If one considers that prone is important for the development of postural control of both flexion and extension, it is clear from the results of this study



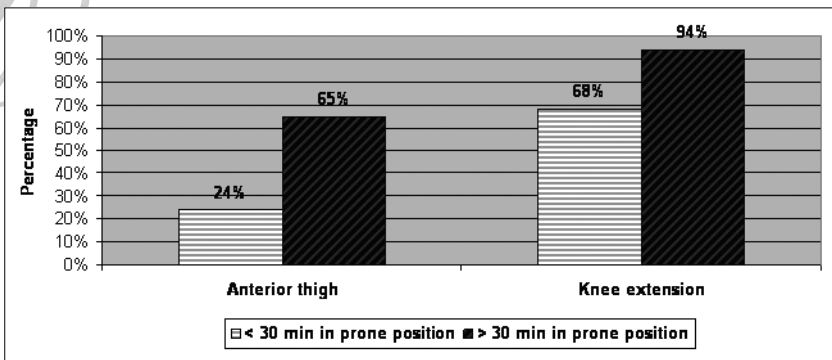


Figure 5: Lower extremity activities of prone and non-prone infants (n = 120)

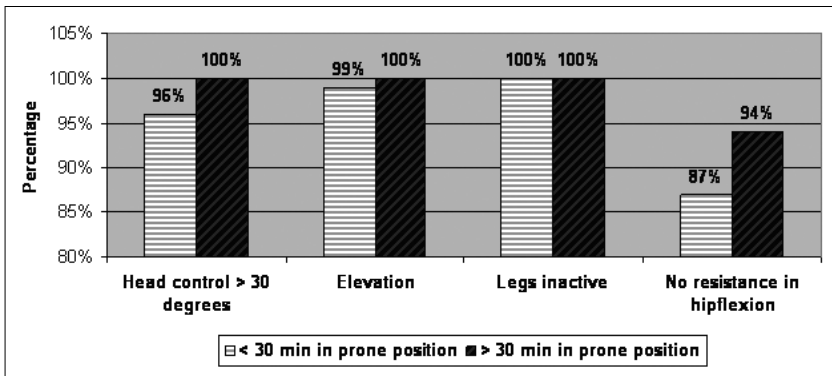


Figure 6: Pull to sit position evaluation in prone and non-prone infants (n=98)

that non-prone infants lacked postural control<sup>7,11</sup>. Non-prone infants lacked the control for displacing their weight to their thoraxes to be able to push up on their arms.

Contrary to our findings, according to a study done on 4 month old infants, there were almost no differences in these variables between the infants who spent awake time in a prone position or not<sup>2</sup>.

### Lower extremities

In all the criteria observed in the upper extremities, i.e. the position of the anterior thigh in relation to the surface and knee extension, the prone infants performed significantly better than the non-prone infants (Figure 5). This indicates better postural flexion control in the trunk allowing the hips to be less flexed.

### “Pull-to-sit”

According to the study done by Salls, *et al.* on 4 month old infants with reference to the “pull-to-sit” action, the infants who spent more time in a supine position had better head control than the infants who slept in a prone position<sup>2</sup>. In this study there were no significant differences between the prone and non-prone infants when the “pull-to-sit” action was performed. This was expected since the babies were only 6 weeks old.

### Conclusion

This study adds to the growing body of evidence which describes the relationship between infant development and the prone positioning when awake. Although few black South African women put their infants in a prone position to sleep, they also do not seem to have tummy time while awake. At 6-weeks of age there are significant differences between infants who spend 30 minutes and more per day in a prone position compared to infants who spend less than 30 minutes per day in a prone position, such as head control, turning of the head, weight displacement towards the thorax, active movement of the arms especially pushing up on the arms and position of the lower extremities.

Although Jennings, *et al.* found that most infants walk independently at a time close to their first birthday whether they sleep in prone or supine<sup>6</sup>, it still remains our question whether positioning may have an effect on quality of movement, especially with regards to fine motor patterns at a later stage of life. This issue needs to be explored.

It is important for all medical professionals who work with mothers and infants, to support the “back to sleep” campaign to prevent SIDS, but it is just as important to inform the parents and caregivers about the advantages of “tummy time” when awake.

More research is needed to determine the long-term effects on the total developmental patterns and the quality of movement related to length of time spent in the prone position.

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### Author’s address

Dorothy C Russell  
 Department Pediatrics and Child Health, PO Box 339(G69),  
 University of the Free State BLOEMFONTEIN, 9300, RSA  
 gnpddcr.md@ufs.ac.za

