

## Review Paper:

## Effect of Body Position on Physiological Alteration While Feeding Infants: A Systematic Review



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**ABSTRACT**

**Background:** An infant should be able to coordinate sucking, swallowing, and breathing to have a safe and effective feeding, which is developed with the increasing gestational age. Any problem in each of these functions can lead to the risk of aspiration, pneumonia, decreased oxygenation saturation, apnea, and bradycardia. The changed body positions may cause changes in the physiological efficiencies of the preterm infants. The objective of this review is to determine the impact of body position on the physiological alternations in the preterm infants while bottle feeding.

**Methods:** In order to review the previous studies, we referred the related resources from existing databases such as Scopus, Ovid, Science Direct, ProQuest, Pub Med, Wiley Cochrane Library, Magiran, Medlib, SID, and Google Scholar. Both English (from 1997 to 2016) and Persian studies (from 2010 to 2016) were reviewed.

**Results:** Four clinical trials with eligible criteria were used as a crossover while the infants were bottle fed. The body positions that are considered in this study include elevated side-lying position vs. semi-upright position, upright position vs. cradle position, side-lying position vs. cradle position, and semi-elevated supine position vs. semi-elevated side-lying position to determine the effect of the physiological parameters while bottle feeding the premature infants.

**Conclusion:** It seems that there is still not enough evidence to determine the positions affecting the physiological parameters of an infant while bottle feeding. Thus, it seems necessary to have further studies to analyze the impact of proper body position on the infant's physiological alternations.

**1. Background**

According to WHO, one in every ten infants are born prematurely all over the world with a gradual increase in the number nowadays (World Health Organiza-

tion 2012; World Health Organization 2014). Of all, low birth weight infants are at greater risk. It is, therefore, necessary to pay more attention to their feeding position to monitor their growth in a better way (World Health Organization 2016).

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Generally, an infant should be able to coordinate sucking, swallowing, and breathing to have a safe and effective feeding, which is developed with the increasing gestational age. Any problem in each of these functions can lead to the risk of aspiration, pneumonia, decreased oxygenation saturation, apnea, and bradycardia (Sabrina Lopes et al. 2014; Clark et al. 2007). Coordination of sucking and swallowing occurs when the infant shows no symptoms of aspiration, decreased oxygenation saturation, apnea, or bradycardia in the proportion of 1:1:1 or 2:2:1 for sucking: swallowing: breathing, respectively (Barlow 2009). According to Gewolb and Vice, there are 9 patterns of breathing and swallowing. The pattern 5 (apnea-swallow-apnea) is a dominant pattern for premature infants of 32-34 weeks post-menstrual age, which changes to pattern 7 (inhale-swallow-exhale) after maturation (Park 2012).

A termed infant is capable of sucking and breathing simultaneously. While sucking, breathing is interrupted for a short while oxygen saturation ( $SpO_2$ ) is still high. But, it is less in bottle feeding compared to breast feeding because milk comes in variable flow from breast and compressibility is less (Sakalidis et al. 2012). Feeding problems of preterm infants have been reported in lots of studies including those with increased physiological instability, weak sucking pattern, low coordination between sucking and swallowing, insufficient absorption, and increased duration to complete the oral intake (Park et al. 2014).

Nutritional support, which includes even the tracing of the minimum drop in oxygen during feeding, is one of the major aspects of care for those who take care of the preterm infants. It is also believed that sufficient oxygenation helps in maintaining the body tune; oral - move control; coordination of sucking, swallowing, and breathing during feeding. Infants with more oxygen drop during their feeding, make a less effort for sucking as a result of which it takes a long time to attain the complete oral feeding (Thoyre & Carlson 2003a). In response to the increased impact of breathing, cardiac output of supplying blood, oxygen, and adequate food increases during feeding. In the heart of a mature person, cardiac contractility increases to enhance cardiac output, but in the preterm heart it causes more impulses. Therefore, the heart rate can be a good indication of physiological function to maintain an infant's stability (Park 2012).

Following the improvements in the care of infants, it resulted in the promotion of the survival of premature infants with more attention towards the importance of feeding strategies (Clark et al. 2007). Positioning is a

simple strategy that is applicable while taking care of the infants. There are no definite guidelines for health care providers, according to the prior clinical evidences, about the infant's position during feeding (Park 2012). There is, therefore, a review of the impact of positioning during bottle feeding infants over their physiological stability in order to determine a better position in feeding infants to help in their growth in a non-invasive manner.

## 2. Materials and Methods

All published articles based on randomized and quasi-randomized clinical trial, and also crossover studies with proper conditions were included in this study through an electronic search. Databases such as Scopus, Ovid, Science Direct, ProQuest, Pub Med, Wiley Cochrane Library, Magiran, Medlib, SID, and Google Scholar were referred. English keywords, i.e., position nutrition newborn from 1997 to 2016, and Persian keywords including *Vaz'iyat-e qarar-giri* (position) *Taqzia* (nutrition) *Nowzad* (newborn) from 2010 to 2016 were searched. At the first step, each article was scanned and then selected for analysis after meeting all the required criteria. The quality of previous studies was decided by using the Cochran bias search tool.

## 3. Results

Total 4 clinical trials with crossover eligible criteria were selected to study the impact of the positioning of preterm infants while bottle feeding (N = 57) (Clark et al, 2007) (N = 6); Stevens (2007) (N = 20); Dawson et al. (2013) (N = 25); and Park et al. (2014) (N = 6). There was no Persian study in this concern. All four crossover studies reviewed the impact of different positions on physiological parameters during bottle feeding, as mentioned in Table 1.

Clark et al. (2007) in their review of elevated side-lying vs. semi-upright showed that there is no significant statistical difference between two positions, but the heart rate increased in the first 3 minutes of feeding and returned to the normal state in the mid 3 minutes, and thus, the elevated side-lying position was more preferred. There was a significant interaction between nutrition and feeding positions, with the decreased rate of  $SpO_2$  during the first 3 minutes of feeding in both the positions, which later increased to mid 3 minutes in the elevated side-lying position while decreased in the semi-upright position.

Stevens (2007) indicated there is no significant difference in feeding in an upright position (head and body in

**Table 1.** List of the studies conducted on the effect of body position on physiological stability of infants during feeding

| No. | Study Title   | Author               | Study Type                                  | Study Place   | Sample Size  | Intervention  | Results  |
|-----|---|----------------------|---|---|--|---|--|
| 1   | Improving bottle feeding in preterm infants: Investigating the elevated side-lying position | Clark et al. (2007)  | A pilot study                               | Neonatal unit at the Royal London Hospital  | Six infants were included who were born at less than or at 29 weeks gestational age.                                     | Each infant was fed in both semi-upright and Elevated Side-Lying (ESL) positions. Oxygen saturation and heart rate were analyzed before feeding and for the first 3 minutes in the beginning and followed by 3 more minutes at mid-point of each feed.  | In all six study infants, SpO <sub>2</sub> decreased during the first 3 min of bottle feeds, regardless of position. However, during the following 3 min, SpO <sub>2</sub> continued to decline in the semi-upright position but rose in the side-lying position. No significant effects of variation in heart rate were found in this analysis. The variation in heart rate increased during the first 3 minutes of feeds, and then returned to close proximity to the baseline level in the middle 3 minutes. This trend towards baseline levels was more marked with the ESL feeds. |
| 2   | Preterm infant feeding and cardiorespiratory stability                                      | Stevens (2007)       | A randomized, two-period, cross-over design | Level 3 NICU at the Magee-Women Hospital of the University of Pittsburgh                    | 20 Preterm infant within 32 to 40 gestational age  | Upright (45 degree head up) and Cradle (15 degree head up) feeding positions on cardiorespiratory stability   | Findings indicated that neither the Cradle nor the Upright feeding positions had a statistically significant effect on the preterm infant's cardiorespiratory stability.   |
| 3   | A randomized trial of two techniques for bottle feeding preterm infants                     | Dawson et al. (2013) | Randomized pilot study of cross-over trial  | Newborn Intensive and Special Care unit at The Royal Women's Hospital, Melbourne, Australia | 25 Infants including those who were at <34 weeks' gestation age and 34 weeks' postmenstrual age at the time of the study | Each infant received two study feeds. One feed was given in the cradle-hold position and the other in the side-lying position. The order of the first feed was randomized with the second feed that was given within the next 24 h in an alternate position. SpO <sub>2</sub> and Heart Rate (HR) before, during, and after 30 mins of feeds. The respiratory rate was recorded before the feed, every 5 min during the feed, and every 10 min after the feed was completed | There was no clinically significant physiological instability in SpO <sub>2</sub> , respiratory rate, or in the frequency of bradycardia between the two feeding positions.  |

| No. | Study Title  | Author             | Study Type                    | Study Place  | Sample Size   | Intervention   | Results   |
|-----|--|--------------------|-------------------------------|--|---|--|---|
| 4   | Efficacy of semi-elevated side-lying positioning during bottle-feeding of very preterm infants | Park et al. (2014) | Cross-over design pilot study | Level III Neonatal Intensive Care Unit in North Carolina | 6 Very pre-term infants (≤ 30 week gestational age) | Each infant was bottle-fed twice within a 9-hour period of time on a single day in both the semi-elevated side-lying (ESL) and semi-elevated supine (ESU) positions. Physiological stability (heart rate, SpO <sub>2</sub> , and respiratory characteristics) and feeding performance (percent intake, proficiency, efficiency, and duration of feeding) were measured before and/or during feeding, when the infant was calm and quiet. | Very preterm infants fed in the ESL position demonstrated significantly less variation in heart rate, less severe and fewer decreases in heart rate, respiratory rate that was closer to the pre-feeding state, shorter and more regular intervals between breaths, and briefer feeding-related apneic events. No significant differences for SpO <sub>2</sub> or feeding performance were found. |

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45°) vs. cradle position (head and body in 15°). However, the results showed that heart rate was slightly lower, and SpO<sub>2</sub> and the feeding time were shorter in semi-upright position vs. cradle position.

Dawson et al. (2013) tried feeding each infant twice in 24 hours gaps in both side-lying and cradle positions; and measured their heart rate, SpO<sub>2</sub>, and respiratory rate prior to, during, and after 30 minutes of being fed. There was a small difference in oxygen saturation between the cradle position (94%) and side-lying (95%). The drop in oxygen saturation was recorded in 68% of infants in the cradle position, and 56% in the side-lying position. There was a very small difference in the heart rate prior to, during, and 30 minutes of being fed between two positions, whereas the infants fed in cradle position experienced a less number of symptomatic bradycardia (100 beat/min). There was no significant difference between two positions for respiratory rate. The resulted time to complete feeding was found to be 27 minutes for cradle position, and 23 minutes for side-lying. It was also found that the milk consumed in cradle position was comparatively less.

Park et al. (2014) tried feeding each infant twice in 9 hours gaps in both semi-elevated side-lying and semi-elevated supine positions; and measured their heart rate,

SpO<sub>2</sub>, and respiratory rate prior to and during being fed. There was a small difference in oxygen saturation for cradle position (94%) and side-lying (95%), whereas the drop in the oxygen saturation was recorded in 68% of infants in the cradle position, and 56% in the side-lying position. There was a very small difference in heart rate prior to, during, and after 30 minutes of being fed between two positions. The infants fed in cradle position experienced a less number of symptomatic bradycardia (100 beat/min). There was no significant difference between two positions for respiratory rate.

#### 4. Discussion

These two cases, among all the selected studies, tended to obtain a better stability in side-lying during feeding (Clark et al. 2007; Park et al. 2014); where two other studied deduced that there is no significant difference between two positions (Stevens 2007; Dawson et al. 2013). It was further observed in two studies that milk consuming was more when the infants were in side-lying position, but their head angles were different in these cases (Dawson et al. 2013; Park et al. 2014). It was also shown that semi-elevated supine position was more efficient and needed less skill compared to the side-lying position (Park et al. 2014). In a systematic review studied by Gillies, Wells, and Bhandari (2012), there was no sig-

nificant difference in arterial oxygen saturation for both side-lying and supine positions. They also observed that the direction of infant's placement, either in right or left, had no impact on the physiologic stability of the infants.

Findings of this study are in accordance with the results obtained by Balaguer et al., (2013). They reviewed seven studies, which were conducted on the impact of the infants' positioning on physiological stability under mechanical ventilation, and found that there was no significant difference. They suggested about the prone position, whose effects on infants' physiological parameters during feeding are not yet studied. However, this position is also suggested by Kallet (2015) to facilitate infants' tolerance of enteral nutrition. Raiten et al., (2016) evaluated the evidence for feeding premature infants and indicated that none of these evidences suffice for preparing of the infants' clinical guidelines.

Regarding the quality of the studies, it can be said that there is not enough evidence for the importance of the role of preterm infants' positioning on their physiological parameters while being fed. In all cases, the infants were placed in a selected position for a short period of time resulting in the inappropriate blinding and randomization of the small sample size. The lack of considering the long-term effects of positioning is also another constrain for such a study. It is evident that there is not enough evidence and sample to define the role of an infant's positioning on its physiological stability while feeding. It is, therefore, necessary to study such impacts and the related angle more deeply by implementing better methodologies in future studies.

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## Conflict of Interest

The authors declared no conflicts of interest.

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