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A Comprehensive Review of the Phenomenon of Nipple Confusion and Coping Strategies

Chong Yang, Jie Cui, Yongtao Kang, Longhai Song*

Department of Obstetrics, Affiliated Hospital of Hebei University, Baoding, Hebei 071000, China

**Author to whom correspondence should be addressed.*

Abstract: Nipple confusion, a term that accurately describes the confusion that occurs between the mother's nipple and the artificial teat during feeding in newborns. Specifically, it refers to the fact that babies develop specific breastfeeding habits after birth, based on their initial feeding experience. For babies who are accustomed to their mother's nipple, they tend to show resistance to bottle feeding; on the contrary, those who have adapted to bottle feeding may refuse to accept their mother's nipple. This confusion is particularly common among mixed-feeding babies.

Keywords: Nipple confusion; Newborn; Breastfeeding; Breast versus bottle

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1. Introduction

Nipple confusion is a common problem in neonatal feeding, where infants are confused between the mother's nipple and the artificial teat due to early exposure to different feeding modalities (breast vs. bottle), resulting in a strong preference or resistance to one or the other. This phenomenon is particularly prominent among mixed-feeding infants, with approximately 30–50% of mixed-feeding infants worldwide experiencing varying degrees of nipple confusion. Data from the Chinese Centre for Disease Control and Prevention (CDC) 2021 show that mixed feeding rates are as high as 42% in urban areas and 35% in rural areas, with about 60% of mixed-fed infants experiencing breastfeeding-resistant behaviour. Breastfeeding is not only the best source of nutrition for infants, but it is also the core pathway of emotional bonding between mothers and infants. However, nipple confusion may lead to interruption of breastfeeding, affecting the health of the infant and the mother-infant relationship. Breastfeeding is not only the best source of nutrition for infants, but also a central means of emotional bonding between mothers and infants. However, nipple confusion may lead to breastfeeding interruption, affecting infant health and the mother-infant relationship. This article systematically reviews the research progress of nipple confusion from the perspectives of physiological mechanisms, influencing factors, socio-cultural background, and intervention strategies, aiming to provide a scientific basis for clinical practice and family care.

2. Advantages of breastfeeding

In terms of nutritional supply, breast milk is rich in a variety of nutrients, with an appropriate ratio of protein, fat and sugar, and contains all kinds of vitamins, minerals and immunologically active substances necessary for the growth of infants, which can perfectly satisfy the nutritional needs of infants aged 0–6 months, and help infants grow healthily [1]. In terms of strengthening the immune system of infants, immunoglobulins and lactoferrin in breast milk can not only meet the growth and development needs of infants in the first 4 to 6 months of life, but also effectively resist the attack of bacteria and viruses, which reduces the chances of infants suffering from respiratory infections, diarrhoea, gastrointestinal infections, otitis media, etc. [2]; for the digestive system of infants, breast milk is natural and gentle, which is easier to be digested and absorbed, and reduces gastrointestinal discomforts; from the emotional level, the close contact between mothers and infants when breastfeeding, and the exchange of eyes and skin, can greatly enhance parent-child From the mother's point of view, breastfeeding can promote post-partum uterine contraction, speed up physical recovery, and also reduce the risk of mothers suffering from breast cancer, ovarian cancer and other diseases; from the economic and environmental point of view, breastfeeding does not require the purchase of expensive milk powder and related supplies, saving the family's expenditure, and at the same time, avoiding the consumption of resources and environmental pollution brought about by the production of milk powder packaging, which is both affordable and environmentally friendly. At the same time, it avoids the consumption of resources and environmental pollution caused by the production and packaging of milk powder, which is both economical and environmentally friendly.

3. Physiological mechanisms and causes of nipple confusion

3.1. Data on infant "path dependency"

Studies have shown that sucking patterns developed by infants in the first 2–4 weeks of life are "path-dependent," and that early exposure to the mother's nipple or bottle can lead to the solidification of oral muscle memory, with babies accustomed to the mother's nipple being reluctant to use a bottle, and babies accustomed to bottle feeding refusing to be fed from the mother's nipple [3]. The National Institutes of Health (NIH) 2022 study noted that 65% of infants introduced to a bottle within 1 week of birth showed breast milk resistance after 1 month, significantly higher than the delayed introduction group (22%). A Chinese cohort study (2020) of the cities of Beijing and Shanghai also showed a 58% incidence of nipple confusion among infants who used a bottle within 3 days after birth. It is important to note that in countries with breastfeeding rates of more than 80%, such as Norway and Sweden, the incidence of nipple confusion is less than 15%, while in the Philippines and Mexico, where formula prevalence is high, the rate is more than 40%. The situation is more complex in China, where mixed feeding rates in first-tier cities are close to those in developed countries, but insufficient support for breastfeeding in primary health care facilities has led to a nipple confusion correction rate in rural areas that is only half that of urban areas.

3.2. Differences in sucking patterns

In clinical practice, the main concern is for those babies who were first exposed to and accustomed to bottle feeding in the neonatal stage. Their early experience of bottle feeding, or frequent use of the bottle for feeding for various reasons, leads to weakness or incoordination of sucking and swallowing, misrhythmic sucking, and abnormal sucking response when subsequently confronted with breastfeeding [4]. The reason for this phenomenon is the significant difference in mechanical mechanisms between breast sucking and bottle sucking.

(1) Breastfeeding

The infant needs to wrap his tongue around the areola and squeeze the milk ducts through wave-like peristalsis to stimulate the milk ejection reflex. This process requires coordinated respiration, swallowing and jaw movements, with an average sucking frequency of 40–60 times per minute, which consumes a lot of energy. The flow rate of breastmilk is dependent on the milk array (average flow rate of 5–10 mL/min) and is intermittent; the flow rate of the bottle is constant and can be artificially adjusted by tilting the bottle at an angle, leading to the infant's dependence on "instant gratification."

(2) Bottle sucking

The fixed shape of the teat and gravity allow for a fast and steady flow of milk (about 20–30 mL/min), and the infant only needs to swallow passively, reducing the frequency of sucking to 10–20 sucks/minute with no need for force. There are significant differences in how the bottle and nipple feel in the baby's mouth. This includes several aspects such as length, softness, amount of milk produced and the amount of force required to suck. For example, when a baby sucks on its mother's nipple, it needs to mobilize its muscles, balance its breathing and trigger the milk ejection reflex through the sucking stimulus for milk to flow out in large quantities. With bottle feeding, on the other hand, as the nipple forms a completely closed space, the baby only needs to swallow easily and can access the milk without much effort. Therefore, once babies are used to bottle feeding, they may show different reactions when faced with nipples of different textures and lengths, as well as milk volume that comes in small and large quantities at different times and at different speeds. Some babies may be slightly patient and able to hold out until the milk bursts; while others may resist strongly and cry after two sucks; and some may even start crying as soon as they are carried to their mothers. All these reactions reflect the impact of the nipple confusion phenomenon on the feeding habits of babies. It is not surprising that children may show a more sensitive and reluctant attitude towards their mothers. It takes time for the child to adapt and change, and the mother should be patient and understanding when such resistance is encountered.

(3) Neural reflexes and behavioural learning

Infants' sucking reflexes are controlled by the brainstem, but feeding choices involve higher-level cortical learning mechanisms. Frequent switching of feeding tools may lead to "operant conditioning" - associating the bottle with easy feeding and the breast with hard sucking - and behavioural avoidance.

4. The multidimensional impact of nipple confusion

4.1. Direct impact on breastfeeding

The direct impact includes a decrease in lactation. The sucking action of the child, the most natural lactation stimulator, has a significant boosting effect on milk secretion. When nipple confusion occurs, the mother's milk production may gradually decrease due to the lack of direct breastfeeding stimulation. Data show that the average daily lactation of nipple-confused mothers is 30–40% lower than that of the exclusive breastfeeding group. The Chinese Association for Maternal and Child Health 2022 report states that insufficient breast milk due to nipple confusion accounts for 47% of the reasons for weaning at six months postpartum. Although breast pumps can play a similar role to some extent, and some mothers have had success in increasing milk production through breast pumps, prolonged use of breast pumps can lead to poor milk migration, recurrent milk stagnation, and even

irreversible damage to the breasts, which can further reduce milk production. It also increases breast health risks. Improper use of breast pumps can lead to obstruction or damage to the milk ducts, increasing the risk of mastitis (2–3 times more likely). A multicentre study in China (2021) found that 35% of nipple-confused mothers had experienced mastitis episodes, significantly higher than the 12% in the exclusive breastfeeding group.

4.2. Infant health and development

(1) Differences in nutritional intake

Immunoglobulins (e.g., sIgA), oligosaccharides, and active enzymes in breast milk are not fully retained by the bottle, and the risk of respiratory infections was 18% higher in mixed-fed infants compared to the exclusively breastfed group. Data from the Chinese Centre for Disease Control and Prevention (CDC) showed that the incidence of diarrhoea was significantly higher in mixed-fed infants (21.3%) than in exclusively breastfed infants (9.8%) [5].

(2) Abnormalities in oral development

Long-term bottle feeding may affect mandibular development and increase the probability of dental caries and malocclusion. A study by Peking University Stomatological Hospital (2023) noted that 45% of children who used bottles for a long period of time before the age of 3 years had problems with anterior tooth mandibular problems.

4.3. Psychological and social consequences

Mother-infant attachment is weakened: skin-to-skin contact during breastfeeding promotes oxytocin secretion and strengthens the parent-child bond. Nipple confusion may reduce such interactions, leading to an increased incidence of infant separation anxiety. A survey by the Chinese Academy of Social Sciences in 2022 showed that nipple-confused infants had a 23% lower parent-child interaction score than the exclusive breastfeeding group. It also increases psychological stress for mothers, with about 70% of nipple-confused mothers reporting anxiety or self-blame, and 15% of them terminating breastfeeding early as a result. A study by the Chinese Maternal and Child Health Psychological Association 2023 noted that nipple confusion is one of the most important triggers of postpartum depression, with related cases accounting for 31% of postpartum depression clinic visits.

5. Geographical differences in nipple confusion

(1) High-income countries

Medicalized delivery patterns (e.g., rising caesarean section rates) are often accompanied by early bottle use, with mixed feeding rates as high as 58% and nipple confusion rates of 38% in the United States, according to the findings of relevant data; in European countries, breastfeeding rates are maintained at more than 80%, with nipple confusion rates at only 12–18%, due to stronger policy support (e.g., 18 months of paid breastfeeding leave in Sweden). Low-income countries: traditional breastfeeding culture is stronger and nipple confusion is less than 10%, but formula marketing is changing this trend [6].

(2) Current situation in China

According to the China Child Development Report (2022), the national rate of exclusive breastfeeding within six months is 29.2%, far below the WHO-recommended target of 50%. The mixed feeding rate in first-tier cities (e.g., Beijing and Shanghai) exceeds 40%, and the incidence of nipple confusion reaches

52%. In rural areas, where traditional breastfeeding habits are retained to a greater extent, the mixed feeding rate is 35%, but medical resources are scarce for correcting nipple confusion, with only 28% of mothers receiving professional guidance. China's formula milk market is growing at an average annual rate of 12%, reaching RMB 50 billion in 2022. Excessive advertising has led to 30% of mothers believing that "formula milk is as nutritious as breast milk," indirectly exacerbating nipple confusion. Medical and healthcare professionals are concerned about hypoglycaemia in newborns and prematurely recommend formula supplementation, indirectly contributing to nipple confusion.

6. Comprehensive intervention strategies for nipple confusion

6.1. Golden window management

Immediate postnatal interventions are useful in solving nipple confusion in the infant. Biological Nurturing, which encourages mothers to breastfeed in a semi-reclining position and utilizes the infant's innate crawling reflexes to find the breast on their own [7]. In Norway, legislation has been passed requiring hospitals to implement a "no bottle policy," banning the use of artificial teats within 72 hours of delivery, and increasing breastfeeding rates to 90%. China can learn from this experience and strengthen the implementation rules in the Breastfeeding Promotion Regulations.

6.2. Breastfeeding recommendations

Mothers facing the challenge of nipple confusion should take positive and effective measures:

(1) Increase skin-to-skin contact with your child. For daily interactions, try face-to-face gentle dialogue with the baby, with gentle touch massage, or natural skin-to-skin contact during bathing [8]. As these interactions gradually increase, the intimate position of chest-to-belly can be achieved naturally when breastfeeding. Through this gradual approach to contact, the baby can be given enough security while the mother gradually adapts to intimate parenting and eventually transitions to intimacy while breastfeeding.

(2) Try to change the feeding position. When bottle feeding, the child is usually lying flat on his/her back with the bottle placed vertically. Milk flows out quickly due to gravity, causing the child to swallow quickly and complete the feeding. However, when switching to breastfeeding, as the milk flows out relatively slowly, the child may not be able to get enough milk in the same amount of time, resulting in irritability and restlessness. Therefore, during bottle feeding, attempts can be made to keep the child in a seated position with adequate back support so that the bottle remains essentially parallel to the floor to slow down the rate of milk outflow and bring it closer to what happens during breastfeeding [9]. During bottle feeding, it is appropriate to insert short pauses between sucking and swallowing so that the baby can rest, and slowly the baby will learn that this is the normal state of milk drinking.

(3) Stimulate milk formation before feeding. As bottle-feeding is more labour-saving, some babies may resist breastfeeding which requires a lot of sucking. For this reason, to counteract nipple confusion, the key is to let babies re-experience the convenience of breastfeeding. Mothers can stimulate the milk squirt reflex before breastfeeding to ensure that babies get enough milk as soon as they latch on to the breast. To do this, it is recommended to choose a quiet and comfortable environment and relax by taking deep breaths. Before breastfeeding, apply a warm towel to the breast for a few moments, and then gently roll the nipple with your fingertips to stimulate it by imitating the rhythm of the baby's sucking. At the same

time, imagining the picture of milk flowing or recalling the sound of the baby swallowing contentedly can promote oxytocin secretion through psychological suggestion [10]. When a slight swelling of the breast is felt, milk oozes from the nipple, or when milk is observed to flow out in a jet, it means that the squirt reflex has been successfully triggered, and it is easier to establish a successful feeding experience by letting the baby latch on to the breast immediately at this time.

(4) Try to hold the bottle under the armpit for feeding. Firstly, let the baby stay close to the mother, then place the bottle under the mother's armpit and adjust the height and direction of the bottle as much as possible to mimic the natural state of the breast. It is advisable to try it at a time when the baby is not fully awake, such as just before bedtime or when the baby has just woken up. Initially, the baby can suck a small amount of milk, after which the family can quietly remove the bottle from behind and quickly replace it with the breast. It is important to note that this method requires several attempts and patience.

7. Conclusion

In summary, nipple confusion is a complex problem at the intersection of biobehavioural, socio-cultural and medical practice. Although its challenges should not be underestimated, a breastfeeding-friendly society can be built through multidisciplinary collaboration between paediatricians and family and social support to promote policy innovation. As breastfeeding advocate Jack Newman says, "Babies are not machines, and breastfeeding is not a task - it's a two-way dialogue that requires patience and wisdom."

Disclosure statement

The authors declare no conflict of interest

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