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Original article

The use of breast-feeding for pain relief during neonatal immunization injections

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Abstract The objective of this study was to examine the pain-relieving effect of breast-feeding during immunization injections in healthy neonates. Sixty-six healthy infants returning to a clinic for their second-, third-, or fourth-month immunization with intramuscular diphtheria, tetanus, and pertussis were randomized to be breast-fed before, during, and after the injection or to be given the injection according to routine clinic procedure (no breast-feeding). To assess the pain responses of the neonates during and after immunization, we noted their heart rates, oxygen saturation levels, and length of crying. The crying time was shorter in the experimental (breast-feeding) group ($M \pm SD$ duration, 35.85 ± 40.11 seconds) than in the control group ($M \pm SD$ duration, 76.24 ± 49.61 seconds; $p = .001$). The heart rate and oxygen saturation levels were almost the same in both groups. We concluded that breast-feeding, maternal holding, and skin-to-skin contact significantly reduced crying in infants receiving an immunization injection for diphtheria, tetanus, and pertussis.

1. Introduction

Routine immunization injections are the most common painful procedures in childhood. Most of these injections are administered early in a child's life (American Academy of Pediatrics Committee on Infectious Diseases, 2003). Unfortunately, despite the increased focus on pain assessment and management, infant injection-related pain remains to be largely untreated. Untreated pain has immediate and measurable negative effects, most notable of which are child distress and parent distress (Reis, Roth, Syphan, Tarbell, & Holubkov, 2003). Preliminary data suggest that untreated pain early in life may also cause deleterious effects on the developing central nervous system (Gradin, Eriksson, Holmqvist, Hastein, & Schollin, 2002; Logan, 1999; Ors et al., 1999; Taddio, Goldbach, Ipp, Stevens, & Koren, 1995, Taddio, Goldbach, Ipp, Stevens, & Koren, 1995 1999). Taddio, Katz, Ilersich, and Koren (1997) showed that newborns circumcised without anesthesia exhibited significantly greater pain responses with vaccination 4 months later as compared with infants who were not circumcised. Similarly, intermittent pain can permanently affect limbic catecholamine levels and reactions to situational or pharmacologic stressors in animal models (Kehoe, Clash, Skipsey, & Shoemaker, 1996). The claim that newborn pain is only temporary and current can no longer be made. The number of painful stimuli needs to be kept at a minimum, and every effort should be made to render these stimuli less painful. Many successful approaches to pain management use pharmacologic and nonpharmacologic strategies. Various simple methods have been shown to effectively reduce the pain response of newborns undergoing routine procedures, such as heel lancing. Swaddling, holding, and providing the oral tactile stimulation of sucking on a pacifier are effective nonpharmacologic approaches (Campos, 1994; Gormally et al., 2001; Johnston & Strada, 1986). Recent studies have reported that pain can be reduced with simple and benign interventions such as sweet oral solutions (sucrose or glucose) and nonnutritive suckling (Blass & Watt, 1999; Carbajal, Chauvet, Couderc, & Martin, 1999; Skogsdal, Eriksson, & Schollin, 1997; Stevens, Yamada, & Ohlsson, 2001), breast-feeding (Carbajal, Veerapen, Couderc, Jugie, & Ville, 2003), and multisensory stimulation (Bellieni et al., 2002).

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Breast-feeding links evolutionary biology and medical practice. This is of clinical interest because pain is routinely experienced in hospital settings, even by healthy newborns, and natural interventions are effective at a time when many pharmacologic interventions are not (Blass & Barr, 2000; Gray, Miller, Philipp, & Blass, 2002). There are several studies showing that breast milk orosensorially affects pain response (Carbajal et al., 2003; Gray et al., 2002). It has been reported that breast-feeding also involves all natural ways of relieving pain, such as skin-to-skin contact, suckling, as well as milk and sweet taste (Gray et al., 2002).

Recent studies have demonstrated that certain tastes and flavors alleviate newborn pain. As little as 2 ml of milk, with its fat and protein components (Blass, 1997a,b) and sweet substances, reduces pain in human and rat infants and eliminates spontaneous crying (Carbajal et al., 1999; Haouari, Wood, Griffiths, & Levene, 1995; Overgaard & Knuden, 1999; Ramenghi, Evans, & Levene, 1999; Stevens et al., 2001). Moreover, in rats, the mechanisms underlying these taste-induced analgesics are opioid mediated (Blass & Fitzgerald, 1988; Blass, Fillion, Weller, & Brunson, 1990; Blass, Fitzgerald, & Kehoe, 1987; Shide & Blass, 1989) and block pain afferents at the level of the spinal cord. Nonnutritive suckling itself is also an antinociceptive in rat and human infants (Blass & Watt, 1999; Campos, 1994), and suckling experience is not required for its manifestation (Blass & Hoffmeyer, 1991). Nociception is defined as the sum of a mixed series of electrochemical events that occur between tissue damage and pain perception (Guyton, 1995). More recently, Gray, Watt, and Blass (2000) reported that 10–15 minutes of skin-to-skin contact between mothers and infants reduced crying, grimacing, and heart rate during heel lance procedures. In their study, contact alone, in the absence of suckling, dulled pain reactivity (Gray et al., 2000). Specifically, crying and grimacing are markedly reduced during blood collection in newborns who are held by their mothers in full-body contact (Gray et al., 2000). Such contact also blocks the substantial increase in heart rate that normally accompanies blood collection (Gray et al., 2000). Corff, Seideman, Venkataraman, Lutes, and Yates (1995) reported that cuddling infants and holding their extremities closely in flexion during heel lancing decrease heart rate, shorten length of crying, and correct sleep–wakefulness periods after the procedure. Fitzgerald, Millard, and Macintosh (1988) also found that tactile and vocal stimulations during heel lancing decreased physiologic stress. Feldman and Eidelman (2003) reported that skin-to-skin contact with newborns helped them adapt better to changes in the environment. Choonara (1999) reported that parents know that crying infants need to be comforted and that they hold close, cuddle, and, even when not hungry, breast-feed their infants to comfort them.

The pain reduction methods used, including the use of the nonpharmacologic approaches of oral tactile stimulation and holding, are theorized to act via the activation of endogenous opioid pathways (Reis et al., 2003; Wong et al., 1999). Because breast-feeding probably is the most potent pleasant stimulation that a newborn infant can experience, we hypothesized that breast-feeding could have analgesic properties in neonates.

The purpose of this study was to unite the different components of breast-feeding (taste, suckling, and skin-to-skin contact), which have been shown to be individually analgesic, by allowing newborns to suckle from their nursing mothers before, during, and after an immunization procedure. The efficacy of this intervention was determined by evaluating audiotaped recordings of infants crying and by assessing blockade of heart rate increases and oxygen saturation decreases that normally accompany the immunization. The hypothesis tested was that breast-feeding would decrease the length of crying time, prevent an increase in heart rate, and prevent a decrease in oxygen saturation during vaccination as compared with the control condition (i.e., no breast-feeding). We explored the clinical efficacy of breast-feeding as an analgesic in the immunization clinic as a supplement to the natural practice of infant soothing practiced by the parents and single nurse practitioner.

2. Materials and methods

2.1. Design

The study, which was a prospective and controlled trial, was performed with neonates who were brought to the Healthy Child Clinic of the Akdeniz University Medical Faculty between June 1, 2001, and July 31, 2002. In the intervention group (n = 33), infants were breast-fed before, during, and after their immunization. The control infants (n = 33) were swaddled in their bassinets during the procedure (standard clinic procedure).

2.2. Sampling

After mothers had given their written informed consent to be included in the study, their infants were randomly assigned to the breast-feeding group or the control group using a system of sealed envelopes. Sixty-six envelopes designating group assignments, 33 for breast-feeding and 33 for control, were mixed and shuffled. After we obtained informed consent from the participants, we opened the top envelope from the stack to identify each infant's group assignment.

2.3. Inclusion criteria

Infants were considered to be eligible for the study if they were between 2 and 4 months old and were brought to the university teaching hospital's Healthy Child Clinic for their second-, third-, or fourth-month immunization, which, according to the Turkish Ministry of Health Program, includes one injection: diphtheria and tetanus toxoids and acellular pertussis vaccine (Infanrix, SmithKline Beecham, Philadelphia, PA, USA). The parents of the infants who met the research criteria were invited to participate in the study.

2.4. Exclusion criteria

Infants were excluded from the study if they had a concurrent illness, were preterm infants (<38 weeks' gestation), were not breast-feeding, or had a diagnosis of cerebral palsy with which their responses to painful stimuli may be altered; infants for whom an informed parental consent could not be obtained were also excluded from the study.

2.5. Informed consent

This study was approved by the university's institutional review board. Parents of all eligible infants were informed about the study in the examination room before the infants' immunization. The benefits and risks of the study were explained to the parents, and their questions were answered. Those who agreed to participate and gave their verbal consent were included in the study.

2.6. Tools

All infants were audiotaped (Sony M-529V microcassette recorder). Crying from onset after the first injection to cessation, up to a maximum of 3 minutes (some newborns continued to cry for >3 minutes), was recorded on an audio tape and later analyzed by the researcher. The decision to use a 3-minute recording was based on the study by Lewindon, Harkness, and Lewindon (1998), who defined length of crying (in seconds) in three ways: (1) the first cry, which is the duration of continuous audible crying from onset until a crying-free interval of more than 5 seconds; (2) the total sum of audible crying within the first 3 minutes after its onset; and (3) the duration from the first cry until the end of the last cry (maximum of 3 minutes). In our study, we only recorded the amount of crying time (in seconds) from the beginning of crying after injection until its cessation for a maximum of 3 minutes. The duration of crying (in seconds) was measured with an electronic timer by the researcher. Total length of crying was defined as the total time during which the subject produced audible distress vocalizations during the 3-minute observation period.

Heart rate and oxygen saturation levels were measured using a pulse oximeter (Nellcor N180) at two occasions: during the injection and after the needle was removed.

The duration of the vaccination procedure (in seconds) from the beginning of the injection to the placement of the bandage was also measured by the researcher.

2.7. Procedure

2.7.1. Intervention group

Mothers were taken to a private examination room where a research nurse explained the study. They were seated and reclined on a comfortable chair with their infants in their arms after the infants' clothes were taken off and soiled diapers were changed. The mothers cradled their infants during breast-feeding to maintain full-body skin-to-skin contact during the entire procedure. All infants were awake at the time of the procedure. A pulse-oximeter probe (Nellcor N180) was placed on the first toe of the right foot. Infant immunizations were given by the same experienced nurse, and data were collected by the research nurse. Injections for diphtheria, tetanus, and pertussis were administered in the right or left thigh. The study was initiated when the infants were observed to have a large amount of areola in their mouth, with flanged lips and active jaw movements. This generally required 30–60 seconds to achieve. At the end of the third minute of breast-feeding, while the infants were still sucking, the immunization injections were performed. The nurse practitioner gave her standard care, which included giving advice, preparing and administering the immunization solutions, and supervising the soothing techniques. The nurse slightly pressed on and cleaned the injection site with alcohol before injection. A dose (0.5 ml) of the vaccine (for diphtheria and tetanus toxoids and acellular pertussis vaccine) was drawn into a 1-ml syringe under the aseptic technique and then administered intramuscularly to the anterior thigh at a 90° angle to the skin with a 26-G 1.59-cm needle. After the nurse had removed the needle, she applied a bandage. The infants were breast-feeding before, during, and after the injection. The mothers were encouraged to continue breast-feeding their infants even if they started to cry during and after the injections. If the infants stopped sucking, the mothers were encouraged to stimulate the infants to continue breast-feeding.

2.7.2. Control group

As with the experimental group, the parents and infants were taken to a private examination room where a research nurse explained the study. The standard clinic procedure for infant injection was implemented. The infants' clothes were taken off, and soiled diapers were changed; the infants were wrapped in a blanket with only the leg that would be used for the injection uncovered and then placed on the treatment table (which has a soft surface). For measurement of research outcomes in the control group, there was the additional procedure of attaching a pulse-oximeter probe (Nellcor N180) on the first toe of the right foot. Each mother stayed next to her infant to help hold the infant's leg during injection and was encouraged to soothe the infant vocally during and after the injection. The infant was cuddled by the mother after the injection. Infants who used a pacifier were provided with one after the injection. After the injections, the infants were allowed to play in the treatment room, which was filled with colorful toys that made noises.

Data on demographic characteristics were collected during the assessment interview for both groups to determine the sex and age of the infants, the method of their delivery (vaginal or cesarean), their gestational age, and their birth weight and length.

2.8. Data analysis

Summary data were obtained for the breast-feeding and control groups by calculating proportions for categorical

Table 1
Infants' demographic data

Group	Age (months; $M \pm SD$)	Gestational age (weeks; $M \pm SD$)	Weight (g; $M \pm SD$)	Length (cm; $M \pm SD$)	Delivery (vaginal:cesarean; n)	Sex (male:female; n)
Control	3.08 ± 1.32	39.12 ± 1.05	3,253.64 ± 576.10	51.35 ± 1.54	9:24	20:13
Breast-feeding	2.79 ± 1.13	37.45 ± 6.66	3,195.94 ± 490.43	50.36 ± 2.91	10:23	17:16

data and the mean values and standard deviations. The duration of crying, vaccination time, heart rate, and oxygen saturation levels were analyzed by a two-tailed Student's t test. A p value of .05 or lower was considered to be statistically significant. Data entry and analysis were conducted using a Statistical Product and Service Solutions Software for Windows 10.0 (SPSS, Chicago, IL).

3. Results

3.1. Demographic characteristics

Sixty-six infants were enrolled in this study: 33 in the experimental (breast-feeding) group and 33 in the control group. The mean age of the breast-feeding infants was 2.8 ± 1.1 months, whereas that of the control infants was 3.1 ± 1.3 months. Table 1 shows details on how the infants were distributed between the breast-feeding group and the control group. Most of the breast-feeding and control infants were delivered via a cesarean section ($n = 23$ and $n = 24$, respectively), with no statistically significant difference found between the two groups for method of delivery ($\chi^2 = .074$; $p = .78$). There were 16 female infants and 17 male infants in the breast-feeding group, whereas there were 13 female infants and 20 male infants in the control group. There was no significant difference between the groups regarding sex ($\chi^2 = .55$; $p = .46$; Table 1).

3.2. Outcome measures

Total crying durations were found to be significantly shorter in the breast-feeding group ($M \pm SD$ duration, 35.85 ± 40.11 seconds) than in the control group ($M \pm SD$ duration, 76.24 ± 49.61 seconds; $t = 3.64$; $p = .001$; Table 2). Heart rate elevation did not differ significantly between the breast-feeding group ($M \pm SD$ during the procedure, 138.85 ± 35.89; $M \pm SD$ after the procedure, 153.36 ± 29.60) and the control group ($M \pm SD$ during the procedure, 129.58 ± 38.32; $M \pm SD$ after the procedure, 146.36 ± 31.06; during the procedure, $t = 1.02$ and $p = .31$; after the procedure, $t = 0.94$ and $p = .35$; Table 3). There was also no statistically significant difference in the oxygen saturation levels of the breast-feeding group ($M \pm SD$ during the procedure, 96.64 ± 2.93; $M \pm SD$ after the procedure, 95.97 ± 3.08) and the control group ($M \pm SD$ during the procedure, 95.85 ± 4.18; $M \pm SD$ after the procedure, 95.33 ± 4.17; during the procedure, $t = 0.89$ and $p = .38$; after the procedure, $t = 0.71$ and $p = .48$; Table 4).

There was no statistically significant difference between the mean vaccination time of the breast-fed group ($M \pm SD$ duration, 9.64 ± 13.26 seconds) and that of the control group ($M \pm SD$ duration, 13.64 ± 22.64 seconds; $t = 0.88$; $p = .39$).

Table 2
Infants' duration of crying

Group	Crying duration (seconds; $M \pm SD$)	t	p
Breast-feeding ($n = 33$)	35.85 ± 40.11	−3.637	.001
Control ($n = 33$)	76.24 ± 49.61		

4. Discussion

Giving immunizations by injection is essential in the provision of primary care to infants, but it is also a distressing experience for them. This was confirmed by our study. The fat, protein, and other ingredients of breast milk stimulate opioids and block pain fibers running down to the spinal cord, which may be the reason why suckling has an antinociceptive effect (Gray et al., 2002).

We detected a reduction in response to pain among infants who were breast-feeding before, during, and after their immunization. Breast-feeding before, during, and after the painful immunization procedure markedly suppressed crying. Indeed, 9 of the 33 breast-feeding infants did not cry at all during the procedure. The remaining breast-feeding infants' length of crying was significantly shorter than that of the control group infants. We believe that this reflects pain blockade, as opposed to suckling producing a behavior that is incompatible with crying. In our study, the pain reduction intervention included breast-feeding, oral tactile stimulation, holding, and suckling in combination. This intervention has been theorized to act via the activation of endogenous opioid pathways (Reis et al., 2003; Wong et al., 1999). The present data do not allow us to evaluate which component of the suckling act contributed the most to the analgesia; neither do they allow for an assessment of interactions among components. The most available comparison is with the contact-induced analgesia. Breast-feeding-induced analgesia was documented in our study, and its component parts of taste, suckling, and contact-induced analgesia are all available to newborns at term and probably before term, judged by the widespread success of breast-feeding-induced analgesia in newborns. Although we cannot say from our study that the infants' pain was reduced, the usual response to pain, crying, was clearly significantly reduced.

Table 3
Infants' heart rates during and after immunization

Heart rate (beats per minute; $M \pm SD$)	Breast-feeding ($n = 33$)	Control ($n = 33$)	t	p
During immunization	138.85 ± 35.89	129.58 ± 38.32	1.015	.31
After immunization	153.36 ± 29.60	146.36 ± 31.06	0.937	.352

The present study used crying as an indicator of pain. The analysis of audible crying is not only a crude tool for the assessment of distress in infants but also an objective measurement. We found that breast-feeding was associated with significantly reduced total crying time in infants receiving an immunization injection ($p = .001$; Table 2). Other studies in the literature have reported similar results with different methodologies. For example, skin-to-skin contact was shown to be effective in reducing the pain experienced during heel lance (Gray et al., 2000). Gray et al. found that 10–15 minutes of skin-to-skin contact between a mother and her baby reduced the infant's response to pain during heel stick. To our knowledge, there have been only two previous reports on the analgesic effect of breast-feeding. Bilgen, Ozek, Cebeci, and Ors (2001) compared the analgesic effects of sucrose, expressed breast milk, and breast-feeding during heel pricks. Breast-feeding was allowed for 2 minutes and then stopped before a heel prick (Bilgen, Ozek, Cebeci, & Ors, 2001). This type of intervention had no analgesic effect, possibly because breast-feeding was not continued during the procedure. Recently, Gray et al. (2002) reported that breast-feeding before, during, and after heel prick markedly reduced crying as well as grimacing and prevented an increase in heart rate in term neonates as compared with swaddled infants in their cots. In that 2002 study by Gray et al., the infants in the breast-feeding group were held in full-body skin-to-skin contact during the entire procedure. In the 2000 study by Gray et al., 8 of 15 infants held by their mothers during the procedure did not cry at all, and their crying was reduced by 83% as compared with the control infants. Our study is very similar to these studies, with 9 of the 33 infants not crying at all during the immunization procedure. Although formal statistical comparisons are precluded across studies, we believe that it is unlikely that the analgesic effect of breast-feeding can be exclusively attributed to skin-to-skin contact. The reduction in crying time is a modest outcome as compared with that in the neonatal study of Gray et al. (2002), in which infants undergoing heel lance and breast-feeding had a 91% reduction in crying time during blood collection. The extensive parallel findings between rat and human infants suggest that the components of these analgesia states are both phylogenetically conserved and robust. Ren, Blass, Zhou, and Dubner (1997) demonstrated that analgesia in suckling rats that received sucrose reflected blockade of spinal afferents at the level of the dorsal horn. When this was studied in newborn rats, it seemed that the milk and sugar stimulated the release of the body's natural painkillers, endorphins. Even just suckling and contact with the mother's skin help slightly reduce pain levels, as newborns who are held in full-body contact with their mothers cry and grimace less when they have blood tests. Parallel findings between the species in behaviorally induced analgesia states and the lack of any indication of discomfort in 9 of the suckling infants make the dorsal horn a reasonable point of impact in the present study as well (Taddio et al., 1997).

Simply holding an infant while preventing access to the breast frustrated the mothers and infants. Uniformly, a period, as much as 3 minutes for some, was required for the infants to relax and settle down. In contrast, infants immediately initiated breast-feeding and the immunization began within seconds after they had established a good suck.

The similarity in heart rate and oxygen saturation levels between the study groups merits discussion. The lack of significant difference in heart rate and oxygen saturation between the two groups may indicate negligible pain caused by the injection. There is a potential discordance between cardiovascular reactivity and behavioral measures of infants' responses to painful events (Oberlander & Saul, 2002). This observation is supported by existing reports of infant procedural pain management in which other investigators found that their interventions were associated with changes in some measures of pain response, such as crying time (Gradin et al., 2002; Lawrence et al., 1993), but not with changes in heart rate. Although it is possible that heart rate elevation is not a primary indicator of the efficacy of an intervention, it is also possible that our heart rate recording methods were not sensitive enough to detect a difference (Gradin et al., 2002; Oberlander & Saul, 2002). The infants' movements during the immunization procedure and the mothers' accidentally touching the probe on their infants' feet probably decreased the sensitivity of the tool. This problem with the probe may have been the reason why we did not find any significant difference between the two groups for heart rate and oxygen saturation in our study (Tables 3 and 4).

Table 4
Infants' oxygen saturation during and after immunization

Oxygen saturation (%; $M \pm SD$)	Breast-feeding ($n = 33$)	Control ($n = 33$)	t	p
During immunization	96.64 ± 2.93	95.85 ± 4.18	0.887	.379
After immunization	95.97 ± 3.08	95.33 ± 4.17	0.706	.483

The breast-feeding infants in our study easily breast-fed and swallowed their mother's milk during and after the immunization injection procedure. None of the infants was seen to have problems with aspiration, vomiting, cyanosis, or respiratory changes during the procedure.

A comment on our control group is necessary. The use of a standard-procedure control group is simultaneously a strength and a limitation of this study. The ability to compare the analgesic properties of breast-feeding with standard care reveals breast-feeding's robust effect. This behaviorally induced analgesia and the similarly effective procedure of skin-to-skin contact (Gray et al., 2000) and orosensory stimulation (Barr et al., 1999; Blass, 1997a; Carbajal et al., 2003; Gray et al., 2002; Potter & Rindfleisch, 2003; Stevens et al., 2001) for alleviating pain during routine immunization add to the growing scientific literature and international consensus (Anand, 2001) of the necessity to provide appropriate analgesia for newborn pain. It has also been reported that skin-to-skin contact between mothers and infants during suckling leads to a decrease in stress and oxygen consumption, strengthens the tie between mothers and infants, helps the maintenance of body temperature, improves cardiorespiratory stability and sleep patterns, and provides behavioral adaptation to new conditions (Carbajal et al., 2003; Gray et al., 2002).

As such, the continued use of no-treatment control conditions is becoming ethically difficult to defend with the numerous safe and effective pain-relieving options available. Indeed, our own university teaching hospital, in reflecting the progress of our discipline, now requires that parents be offered safe and natural ways to combat newborn pain. These options include allowing mothers to stay with and cuddle their infants as well as giving infants a pacifier for routine painful procedures.

Finally, the present findings must be placed in a broader context than relieving immediate newborn pain or stress. The rapidly expanding literature about the subtle stresses experienced by animal and human newborns convincingly demonstrates that even mild stress during this early period can cause permanent changes in limbic catecholamine neurotransmission and exaggerated behavioral and endocrinologic reactivity to mild adult stress (Gray et al., 2002). The American Academy of Pediatrics (1998) promoted breast-feeding for proven "health, nutritional, immunologic, developmental, psychological, social, economic and environmental benefits." The present findings now add the benefits of analgesia and stress reduction.

We found that breast-feeding, which includes the components of breast milk, suckling, skin-to-skin contact, and holding, during immunization for newborns decreased the behavioral sign of pain (crying). Although we should not underestimate the likely analgesic effect of breast-feeding, we should be careful not to consider breast-feeding to be suitable for major analgesia or as a substitute for appropriately planned analgesia in immunization procedures. This is a simple, inexpensive, and convenient approach, allowing it to be adopted easily into practice. It is incumbent for all child health care providers to reduce their patients' pain whenever possible, especially if pain is associated with immunization injections.

This study confirms the effectiveness of breast-feeding, maternal holding, and skin-to-skin contact for the relief of infant crying and shows that these are of significant use in immunization clinics.

5. Implications for practice

Reducing pain during immunization injections in infants is very challenging. To be adopted by busy neonatal practices, pain management approaches must be simple, convenient, fast acting, inexpensive, and effective. Some simple pain reduction methods that have been previously described, such as nonnutritive suckling, sucrose administration, parental holding, and breast-feeding, are effective in relieving pain in infants. This study demonstrates that breast-feeding is associated with reduced crying in young infants during immunization injections. Breast-feeding is very effective, convenient, safe to implement, readily available, and easy for nurses to supervise. This pain reduction approach can be easily adopted as part of standard immunization injections.

6. Limitations

We demonstrated that an intervention combining breast-feeding, skin-to-skin contact, and holding is an effective method for controlling the incidence of crying, heart rate, and oxygen saturation in 2-, 3-, or 4-month-old infants receiving an injection. The generalization of this study's findings is limited by the administration of a single injection. The efficacy of our approach needs to be investigated in the setting of multiple injections, which young infants typically receive in most vaccination visits.

7. Conclusions

Breast-feeding and the component parts of taste, suckling, and contact are associated with significantly reduced crying time in young infants during immunization injections. In addition, this immunization injection technique was found to be very easy for nurses to put it into practice. This simple, effective, and feasible intervention is also popular among parents and can readily be incorporated into the practice of standard infant immunization.

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