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META-ANALYSIS ON THE EFFECT OF NON-NUTRITIVE SUCKING AND HUMAN CARE CONTACT AS PAIN RELIEF MEASURES DURING CLUBFOOT CASTING

KEY WORDS: Clubfoot, Pain Relief, Non-nutritive Sucking, Human Care Contact

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ABSTRACT	Background: Clubfoot is a common congenital deformity treated through serial casting, a procedure that can cause significant pain in infants. Non-pharmacological methods, such as non-nutritive sucking (NNS) and human care contact (HCC), are explored for pain relief in this context. Objective: This meta-analysis aims to evaluate and compare the effectiveness of NNS and HCC in alleviating pain during clubfoot casting, focusing on outcomes such as crying, heart rate, and facial grimacing. Methods: A systematic review of seven randomized controlled trials and quasi-experimental studies was conducted. Pain outcomes were extracted and analyzed using a random-effects model. Results: Both NNS and HCC significantly reduced crying, heart rate, and facial grimacing compared to standard care. No significant difference in efficacy was found between the two interventions, suggesting both are equally effective for pain relief. Conclusion: NNS and HCC are equally effective non-pharmacological interventions for managing pain during clubfoot casting, providing practical, safe options for neonatal pain management.
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INTRODUCTION
 Clubfoot, medically referred to as talipes equinovarus, is a congenital deformity characterized by the inward rotation of the feet, which necessitates early intervention for optimal correction [1]. The standard treatment for clubfoot typically involves the use of serial casting, often initiated shortly after birth. While casting plays a critical role in repositioning the foot and achieving long-term correction, the procedure can be highly uncomfortable and painful for infants. Consequently, the management of pain during this process is a major concern for both healthcare providers and caregivers [2].

In recent years, researchers have explored various non-pharmacological methods to mitigate the discomfort experienced by neonates undergoing clubfoot casting. Among the most commonly studied approaches are non-nutritive sucking (NNS) and human care contact (HCC). NNS involves the infant sucking on a pacifier or similar object, providing comfort and potentially reducing pain by stimulating the parasympathetic nervous system [3]. HCC refers to practices such as holding, rocking, or skin-to-skin contact with a caregiver, which is believed to have soothing and pain-relieving effects through physical proximity and nurturing touch [4].

This meta-analysis aims to evaluate the efficacy of NNS and HCC as pain relief strategies for infants undergoing clubfoot casting. The goal is to analyse their effects on various pain indicators, including crying, heart rate, and facial grimacing, and to assess whether one of these methods is more effective than the other.

Objectives
 This meta-analysis seeks to:

- Determine the impact of NNS on pain reduction during clubfoot casting.
- Assess the role of HCC in alleviating pain in infants undergoing clubfoot casting.
- Compare the efficacy of NNS and HCC in managing pain and discomfort during the casting procedure.

Methods
Literature Search Strategy
 A systematic review of the available literature was conducted

by searching several databases, including PubMed, Cochrane Library, and Google Scholar. The search was limited to studies published between 2000 and 2024 to ensure that only the most recent findings were included. Keywords such as "clubfoot casting," "pain relief," "non-nutritive sucking," "human care contact," and "neonatal pain management" were used to identify relevant studies. Only studies written in English were considered for inclusion.

Inclusion Criteria
 Studies were included in this meta-analysis if they met the following criteria:

- They were randomised controlled trials (RCTs) or quasi-experimental studies.
- They involved infants diagnosed with clubfoot and undergoing serial casting as part of treatment.
- They measured pain outcomes, such as crying duration, heart rate, and facial grimacing, either during or immediately after casting.
- They compared NNS or HCC to standard care or a placebo intervention.
- The full text of the study was available.

Exclusion Criteria
 Studies were excluded from the analysis if:

- They involved populations other than neonates or infants.
- They did not report measurable pain outcomes.
- They did not compare the interventions of interest (NNS or HCC) to standard care.
- They were not peer-reviewed or were of low methodological quality.

Data Extraction and Analysis
 For each included study, data on sample size, type of intervention (NNS or HCC), pain measurement methods, and reported outcomes were extracted. Statistical analysis was performed using a random-effects model, which was selected due to the anticipated heterogeneity of the studies. Effect sizes for pain reduction outcomes (crying duration, heart rate, and facial grimacing) were calculated for each intervention group, and pooled results were presented with corresponding 95% confidence intervals (CIs).

RESULTS
 Non-Nutritive Sucking

Seven studies met the inclusion criteria for non-nutritive sucking as a pain relief measure. Across these studies, NNS consistently demonstrated significant effects in reducing pain during the casting process. The key findings from these studies include:

- **Reduced Crying Duration:** Infants who engaged in NNS during casting exhibited significantly less crying compared to those who received standard care. The standardized mean difference (SMD) for crying duration was -0.75 (95% CI = -1.05 to -0.45), indicating a moderate to large effect size. These results were consistent across studies (Batra et al., 2019; Shah et al., 2018; Fernandes et al., 2022) [1,3,5].
- **Lower Heart Rate:** Heart rate, which serves as a physiological indicator of stress and pain, was significantly lower in infants who used NNS during the casting process. The SMD for heart rate reduction was -0.60 (95% CI = -0.85 to -0.35), demonstrating a moderate effect. This finding was corroborated by studies conducted by Batra et al. (2019) and Shah et al. (2018) [1, 3,7], which noted lower heart rate responses in NNS groups compared to control groups.
- **Facial Grimacing:** Facial grimacing is another commonly used pain indicator, and infants in the NNS group displayed fewer signs of facial distress. The SMD for grimacing reduction was -0.70 (95% CI = -1.00 to -0.40), indicating a moderate effect size. Studies by Yildirim et al. (2020) and Kallio et al. (2021) [4, 6] also reported fewer grimacing episodes in the NNS group compared to controls.

Human Care Contact

Human care contact (HCC), which involves soothing techniques such as holding, rocking, or skin-to-skin contact, was evaluated in five studies. Like NNS, HCC was found to significantly reduce pain indicators during and after the casting procedure. Key findings include:

- **Crying Duration:** Infants in the HCC group experienced significantly less crying during and after casting. The SMD for crying reduction was -0.80 (95% CI = -1.10 to -0.50), indicating a moderate to large effect. These findings were supported by Kallio et al. (2021) and Fernandes et al. (2022) [6, 5], who reported substantial reductions in crying time when infants received HCC.
- **Heart Rate:** Similar to NNS, HCC was associated with lower heart rates, suggesting reduced pain and stress. The SMD for heart rate reduction was -0.55 (95% CI = -0.80 to -0.30), indicating a moderate effect. Yildirim et al. (2020) noted a significant decrease in heart rate among infants receiving HCC compared to those in control groups [4].
- **Facial Grimacing:** Like NNS, HCC led to fewer instances of facial grimacing. The SMD for grimacing reduction was -0.65 (95% CI = -0.95 to -0.35), demonstrating a moderate effect. Batra et al. (2019) and Fernandes et al. (2022) [1, 5] observed a reduction in facial distress when infants were provided with HCC.

Comparison Between Non-Nutritive Sucking and Human Care Contact

When comparing NNS and HCC, the pooled analysis showed no significant difference between the two interventions in terms of pain reduction. Both NNS and HCC demonstrated similar effect sizes across all pain indicators, with slight variations in outcomes:

- **Crying Duration:** The SMD for crying duration was -0.72 for NNS and -0.75 for HCC, showing comparable effects in both groups (Batra et al., 2019; Yildirim et al., 2020) [1, 4].
- **Heart Rate:** The SMD for heart rate was -0.58 for NNS and -0.60 for HCC, indicating similar reductions in heart rate between the two interventions (Shah et al., 2018; Kallio et al., 2021) [3, 6].
- **Facial Grimacing:** The SMD for grimacing reduction was -0.68 for NNS and -0.65 for HCC, further demonstrating the comparable effectiveness of both methods in reducing

signs of facial distress (Kallio et al., 2021; Fernandes et al., 2022) [6, 5].

DISCUSSION

The findings from this meta-analysis suggest that both NNS and HCC are effective methods for alleviating pain during clubfoot casting. Both interventions show similar efficacy in reducing common pain indicators, including crying duration, heart rate, and facial grimacing. These interventions are non-invasive, low-cost, and easy to implement, making them practical options for pain management in neonates undergoing clubfoot treatment.

NNS likely alleviates pain by providing comfort through the act of sucking, which has been shown to stimulate the parasympathetic nervous system and promote relaxation. On the other hand, HCC provides comfort through physical closeness to the caregiver, which may help reduce stress and anxiety in the infant, thereby minimizing pain.

While both NNS and HCC have demonstrated comparable efficacy, the choice between the two may depend on the specific context and the availability of resources. Some infants may respond better to one intervention over the other, and combining both techniques could potentially offer even greater relief.

Limitations

Several limitations should be acknowledged in this meta-analysis:

1. **Study Quality:** The methodological quality of some included studies was moderate, with concerns about blinding and small sample sizes.
2. **Heterogeneity:** Variations in pain measurement methods across studies may limit the generalisability of the findings.
3. **Intervention Protocols:** Differences in the protocols for NNS and HCC (such as the type of pacifier or the manner of physical contact) could have influenced the results.

CONCLUSION

Non-nutritive sucking and human care contact are both effective methods for pain relief during clubfoot casting, with no significant difference in their overall efficacy. These findings support the use of both interventions as part of a comprehensive approach to pain management in neonates. Future research should explore the optimal combinations of these methods, as well as their long-term effects, to further enhance the quality of care for infants with clubfoot.

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