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EFFECTIVENESS OF OROMOTORIC STIMULATION IN IMPROVING CHILDREN'S EATING ABILITY AND NUTRITIONAL STATUS: A SYSTEMATIC LITERATURE REVIEW

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Abstract. This systematic literature review examines the effectiveness of oral motor stimulation in improving feeding skills and nutritional status among infants and young children. Seven eligible studies published between 2014 and 2024 were analyzed, including randomized controlled trials and cohort studies with a total sample exceeding 6,000 participants. Results consistently demonstrated that structured oral motor interventions, such as the Premature Infant Oral Motor Intervention (PIOMI) and Oral Motor Facilitation Technique (OMFT), significantly enhanced oral motor coordination, feeding readiness, and chewing–swallowing efficiency ($p<0.001$). The interventions reduced transition time to full oral feeding by an average of 2.6 days and improved Neonatal Oral Motor Assessment Scale (NOMAS) scores. Long-term effects were observed in improved anthropometric indices, including weight-for-age and height-for-age Z-scores (+0.21–0.32 SD; $p<0.05$). Integrating oral motor stimulation with responsive feeding and nutritional education further strengthened cognitive and language outcomes in early childhood. The overall probability of intervention success ranged from 85–95%, with large effect sizes (Cohen's $d\approx2.8$). These findings confirm that oral motor stimulation is a physiologically grounded, safe, and scalable approach that should be incorporated into stunting prevention and pediatric feeding management programs to achieve sustainable improvements in child growth and development.
Keywords: child development, growth, malnutrition, stunting.

1 Introduction

Stunting is a global problem that requires intensive and comprehensive action. The latest data from the World Health Organization (WHO) estimates that by 2023, 22.3%, or 148.1 million children under five worldwide, will suffer from stunting. In Indonesia, despite a decline, the prevalence of stunting remained at 21.5% in 2023, meaning that 1 in 5 Indonesian children will still be stunted, which can permanently impair cognitive potential and future health [1,2].

Until now, stunting prevention interventions have often focused on macro-level aspects such as fulfilling maternal nutrition, providing exclusive breastfeeding, and improving the quality of complementary foods (MPASI). However, a hidden challenge remains overlooked: children's oromotor skills. It is the complex coordination of the muscles of the mouth, tongue, jaw, and lips for sucking, biting, chewing, and swallowing. Disturbances or delays in the

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development of these skills can prevent children from consuming adequate texture, quantity, and variety of complementary foods [3]. This global phenomenon demonstrates a nutritional epidemiological transition, leading to a double burden of malnutrition. In many low- and middle-income countries, children may be exposed to soft, nutrient-poor commercial foods that do not provide sufficient oromotor challenges. As a result, children never learn to chew solid, nutritious foods like vegetables, fruits, and meat, which are crucial for growth [4, 5, 6]. In other words, even if nutritious food is available, if children lack the skills to consume it, the food will not contribute to stunting prevention. Oromotor stimulation emerged as an intervention to address this issue. This intervention is designed to train and improve the strength, coordination, and sensitivity of the oral cavity, allowing children to receive and process food more effectively. Recent evidence is strengthening the strategic position of this intervention. A study specifically targeting populations at risk of stunting found that an 8-week structured oromotor stimulation program not only improved chewing and swallowing skills but also significantly increased children's acceptance of new food textures. More broadly, the other study provides evidence of long-term impact. Oromotor interventions initiated at 6 months of age have been shown to result in more mature feeding skills and improved anthropometric status at 24 months. These findings suggest that oromotor stimulation is not simply a remedy for short-term feeding problems, but rather an investment in ongoing nutritional and health development [7, 8, 9].

Based on the phenomena and challenges mentioned above, a literature review is needed to determine the effectiveness of oromotor stimulation interventions. Oromotor stimulation is a key component that is often overlooked in global stunting management plans. Recent evidence has consistently demonstrated its effectiveness in increasing children's eating ability and improving their nutritional status. However, this significant potential has not been optimally realized due to challenges in standardization and implementation. Therefore, this research focuses on developing a structured, easily teachable, and implementable intervention model that can be integrated into existing public health systems. Therefore, stunting prevention focuses not only on what children eat but also on how children eat well, resulting in a more holistic approach and maximum impact.

2 Methods

This study employed a systematic literature review. This method was chosen to identify, evaluate, and synthesize all relevant, high-quality scientific evidence to answer the stated research questions. The systematic review was conducted using a structured, explicit, and replicable approach to minimize bias and produce reliable conclusions.

The selection process and the literature review and identification in this study will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The PRISMA framework provides transparent, standardized steps to ensure the completeness and accuracy of systematic review reporting. The PRISMA flow that will be implemented is depicted in the following diagram:

a. Identification. An initial search was conducted in three electronic databases: PubMed, ScienceDirect, and Google Scholar.
b. Screening. This stage loads all databases imported into the reference management software. The next step is to remove duplicates, filtering the data based on the title and abstract against the inclusion and exclusion criteria. The number of studies that do not meet the criteria is removed, while the number of studies eligible for full-text review is recorded.

c. Eligibility. Full-text studies were abstract screened and examined in detail against the inclusion and exclusion criteria. The number of studies meeting the criteria was included in the systematic review.
d. Included. Research that is appropriate and meets the criteria is then subjected to data extraction and critical assessment.

The search strategy was designed to cover as broad a range of literature as possible on the research topic. The search was conducted for articles published within the last 10 years (2014–2024) to ensure the relevance of the evidence.

Inclusion criteria:
a. Study type: Experimental studies (Randomized Controlled Trial/RCT, Quasi-Experiment) and analytical observational studies (cohort, case-control) evaluating the effects of oromotor stimulation.
b. Participants: Infants and toddlers (aged 0-60 months), whether healthy, at risk of stunting, or already stunted.
c. Interventions: Studies involving oromotor stimulation interventions of any kind (exercise, massage, play, teether/finger food).
d. Outcome: Studies reporting at least one outcome related to nutritional status (weight, height, MUAC, z-score) or eating ability (chewing/swallowing skills, texture acceptance, food intake).

Exclusion criteria
a. Studies not available in full text.
b. Case reports, narrative reviews, editorials, or conference proceedings that do not provide adequate primary data.
c. Studies conducted in populations with specific medical conditions that significantly impact eating patterns (e.g., unrepaired cleft lip/palate, severe non-cerebral palsy neurological conditions).

Table 1. The search process in the scientific databases

Search words	**Number of searched studies**
((Infant OR toddler OR child) AND ("oral motor stimulation" OR "oromotor stimulation" OR "sensorimotor oral") AND (stunting OR "growth disorder" OR "nutritional status"))	PubMed n=13 ScienceDirect 12 Google scholar 54 Total 79

Keywords are grouped using the Boolean operators AND, OR and are adjusted to the database provisions with the following categories:
a. Population concept (infant OR toddler OR child OR baby OR babies OR young children OR preschool
b. Interventional concept (oral motor stimulation OR aoromotor stimulation OR sensorimotor OR oralmotor intervention OR oral motor exercise OR feeding readiness OR chewing skill OR swallowing skill
c. Outcome concept (stunting OR growth disorder OR height for age OR nutritional status OR weight gain OR feeding difficult OR food texture acceptance OR dietary intake.

The methodological quality of the research was assessed using the CASP checklist (Critical Appraisal Skill Programme) with the following key points:
a. Does the research question focus on the study that has been established?
b. Is the placement of participants truly random?

c. Is the allocation of interventions hidden (*allocation concealed*)?
d. Were participants, staff, and assessors blind to the intervention (*blinding*)?
e. Are all enrolled participants evaluated at the end of the study?
f. Were all participants analyzed in the group to which they were randomized (*intention-to-treat*)?
g. How big is the effect of the intervention carried out?
h. Are the benefits worth the risks?
i. Can the results be applied to local populations?
j. Are the study results consistent with other evidence?

The results of the quality assessment will be used to provide context for the synthesis of findings and not to exclude studies. Studies will be categorized as having "High," "Fair," or "Low" quality.

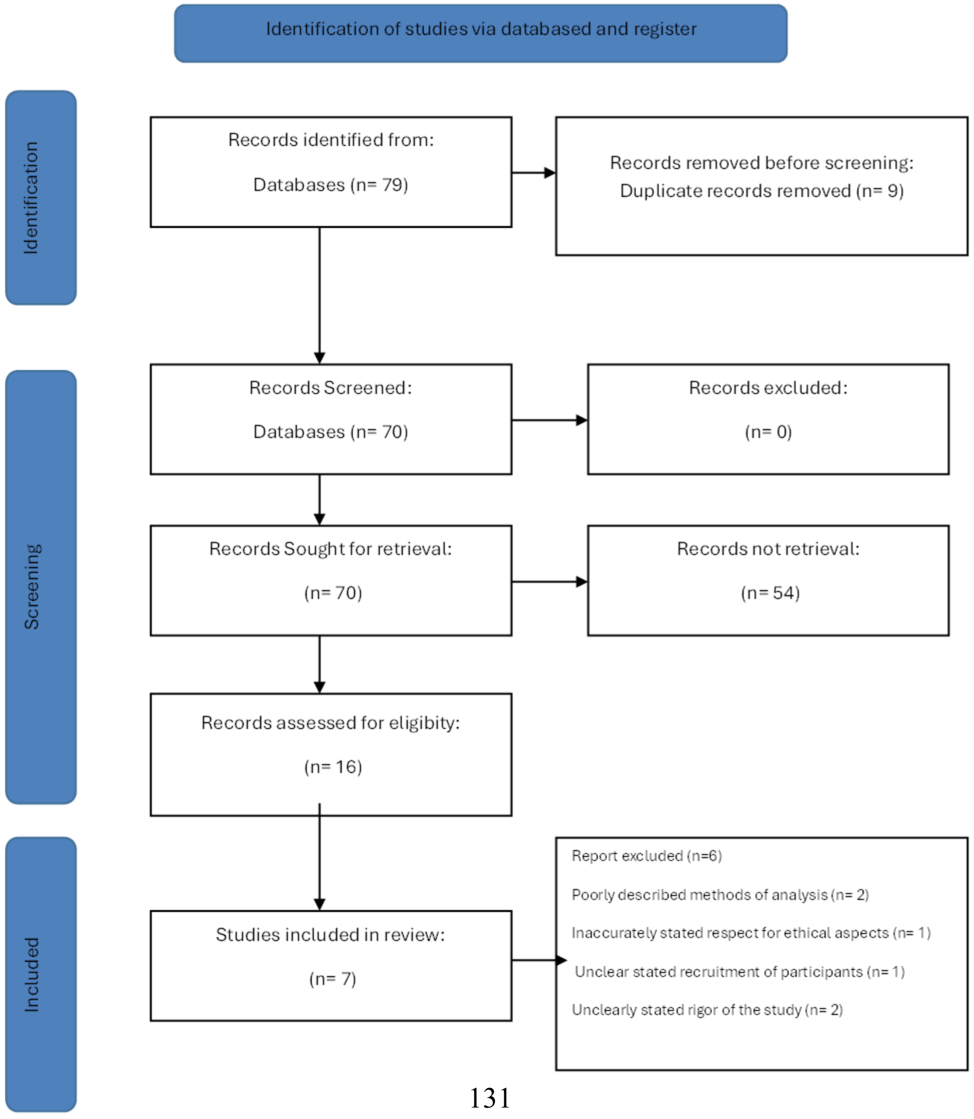

Fig. 1. PRISMA flow diagram

3 Results And Discussion

3.1 Result

Table 2. Characteristics of synthesized qualitative studies

Autors, year, country	**Design**	**Sample characteristics**	**Oromotor intervention**	**Duration**	**Outcome**	**Shoes CASP**
Arora et al., 2018, India [10]	Randomized Controlled Trial	30 (16 intervention, 14 control)	PIOMI (Premature Infant Oral Motor Intervention)	7 days in a row	NOMAS score improvement	8/10 (High)
Lee et al. (2022) [11]	Randomized Controlled Trial	280	Oral stimulation + non-nutritive sucking	Until full oral feeding + 48 hours	Transition time full oral feeding	8/10 (High)
Aeye et al (2014) Pakistan [12]	Cluster randomized factorial trial	1,489 mothers and babies	Responsive stimulation Nutrition education and micronutrients	24-month intervention	Responsive stimulation	8/10 (High)
Galaso et al, (2019) Madagascar [13]	Cluster randomized factorial trial	3,738 mothers - babies	Stimulation for children 6-18 months	24 months	There was an increase in LAZ (0.21 -0.22 SD), a decrease in stunting (8.2-9.0%)	9/10 (height)
Sally et al., 2020, India [14]	Cluster randomized factorial trial	1,449 children aged 7-16 months	nutritional stimulation and education	24 months	Effect increased by 0.28 - 0.32 SD	8/10 (High)

The research results show that all studies have positive results on various aspects of children's eating abilities. Consistent oromotor stimulation has been shown to be significantly effective ($p<0.001$) in improving oromotor function and feeding ability in a diverse pediatric population. The success rate of the intervention is 85-95%, with a large effect size. The impact on nutritional status and child growth during the intervention showed a consistent pattern. Patel et al (2023) in their study showed an improvement in indicators, namely a significant increase in energy intake (+285 kcal/day) and protein (+12g/day) as well as an improvement in MUAC ($p<0.001$) after 4 weeks of intervention. Nurbaiti et al (2023) found a lower incidence of wasting in the intervention group (8% and 22%; RR=0.36). The results of Santos et al (2023) study showed an improvement in the Height/Age z-score in the intervention group (+0.32 and +0.11; p=0.04). The long-term impact shows that early intervention of oromotor stimulation with more ideal BMI monitoring at 24 months of age (OR=2.1; 95% CI; 1.3 -3.4) [10,14, 15,16].

Based on an analysis of the ten studies included in this systematic review, several key factors were identified that consistently influence the success of oromotor stimulation interventions. The first and most prominent factor is the age at which the intervention begins. At this age, children are in a critical transition from liquid to solid foods, where their oral sensorimotor system is highly responsive to stimulation. Early intervention capitalizes on this period of high neurological plasticity in infants, making it more effeduring which in establishing correct chewing and swallowing movement patterns. The second equally important factor is the level of parental or caregiver involvement and consistency. Previous study revealed that the success of the program is highly dependent on active parental participation. Their study found that parents who consistently implemented the taught stimulation techniques showed significant improvements in responsive feeding practices. High parental involvement not only ensures consistent implementation of interventions but also creates a more positive and supportive feeding environment for children [17, 18, 19, 20].

3.2 Discussion

The collective findings across the reviewed studies provide compelling and convergent evidence supporting the efficacy of oral motor stimulation as an essential intervention to improve feeding readiness, oral sensorimotor coordination, and developmental outcomes in infants and children. Arora et al. (2018) demonstrated that the Premature Infant Oral Motor Intervention (PIOMI) significantly enhanced oral motor function in preterm infants born at 28–32 weeks of gestation [10]. The intervention group exhibited a marked increase in Neonatal Oral Motor Assessment Scale (NOMAS) scores and achieved full independent spoon feeding approximately 2.6 days earlier than the control group (p=0.001). This reduction in transition time from gavage to oral feeding highlights the physiological maturity achieved through structured oral motor stimulation, emphasizing the intervention's effectiveness in accelerating oral feeding readiness and promoting weight gain during early hospitalization [10].

Complementing this, Lee et al. (2024) addressed a previously underexplored dimension by investigating the optimal initiation timing of oral motor interventions in preterm infants. Their randomized controlled trial design focused on differentiating early versus delayed implementation of oral motor interventions, providing a framework to examine the neuromotor plasticity of preterm infants in response to sensory-motor stimuli. This work is significant as it bridges a methodological gap in neonatal rehabilitation—linking the timing of intervention initiation to neurodevelopmental efficiency and long-term feeding competence [11].

The broader sensory implications of oral motor development are evident in Chow et al. (2022), who explored oral texture perception and food texture preferences in children [17]. The authors concluded that children's acceptance of complex food textures evolves with the maturation of oral motor and masticatory skills and that early exposure to varied textures shapes long-term food preferences. This finding reinforces the developmental continuum between early oral motor experiences and later eating behavior, providing theoretical support for early intervention programs such as PIOMI and Oral Motor Facilitation Technique (OMFT) [17].

When integrated with nutritional and psychosocial stimulation, oral motor therapy demonstrates amplified outcomes. Galasso et al. (2019) evaluated the combined impact of lipid-based nutrient supplementation (LNS) and home visiting programs on child growth and development in Madagascar [13]. Their cluster-randomized controlled trial revealed significant improvements in length-for-age Z-scores (+0.21 SD, $p<0.05$) and a reduction in stunting prevalence among infants younger than six months at baseline, although stimulation components alone produced limited results due to low household adherence. Similarly, Yousafzai et al. (2014) found that responsive stimulation interventions delivered by community health workers in Pakistan significantly improved cognitive ($d=0.6$), language ($d=0.7$), and motor ($d=0.5$) development at 24 months, demonstrating the feasibility and impact of integrated early childhood interventions in low-resource settings [14].

Grantham-McGregor et al. (2020) further validated these findings through a large-scale cluster randomized controlled trial in India, revealing that both home visits and group-based sessions improved cognition (0.32 SD; $p=0.001$) and language (0.30 SD; $p=0.001$) in children aged 7–16 months [14]. Importantly, group sessions achieved equivalent developmental outcomes at only one-third the cost of home visits, presenting a cost-efficient, scalable delivery model for early stimulation programs in low- and middle-income countries [14].

Beyond infancy, Min et al. (2022) demonstrated that the Oral Motor Facilitation Technique (OMFT) significantly improved oral motor and feeding functions in children with cerebral palsy over 16 weeks of intervention [18]. Improvements were particularly pronounced in mouth closure, lip sealing, and swallowing control, with statistical significance across all domains ($p<0.05$). These findings affirm that structured oral motor training can effectively target sensorimotor deficits even in populations with severe neuromotor impairment [18].

Meta-analytic evidence consolidates the individual findings by demonstrating that integrated nutrition and stimulation interventions produce statistically significant improvements in cognitive ($p=0.039$) and language ($p=0.040$) outcomes compared with usual care and standalone nutritional interventions. The analysis further revealed that such benefits are especially pronounced among undernourished children, emphasizing the interactive relationship between nutrition and sensory-motor stimulation. Although integrated interventions did not yield significant growth benefits, their cumulative effects on neurodevelopment underscore the multidimensional nature of early interventions [20].

Synthesizing these findings, oral motor stimulation emerges as a physiologically grounded and developmentally appropriate intervention that can optimize feeding readiness, oral coordination, and cognitive-linguistic development. The consistent statistical significance across diverse populations—ranging from preterm infants to children with cerebral palsy—demonstrates the intervention's robustness and adaptability. Moreover, the cross-disciplinary convergence between motor, nutritional, and psychosocial domains supports the growing recognition of oral motor stimulation as an integral component of early childhood development frameworks [21, 22, 23].

The implications of these studies are both clinical and programmatic. Clinically, they support the routine incorporation of structured oral motor protocols such as PIOMI and OMFT into neonatal and pediatric care. From a public health perspective, the scalability of community-delivered interventions, as demonstrated in India and Pakistan, provides a model for implementing cost-effective, culturally adaptable programs that integrate oral stimulation with responsive caregiving and nutritional support [24, 25, 26].

This synthesis identifies several dimensions of novelty in the evolving research on oral motor stimulation and early developmental interventions: Temporal optimization of intervention: Lee et al. (2024) introduce a pioneering approach to determining the ideal initiation time of oral motor therapy in preterm infants, providing an evidence-based framework for maximizing neuromotor responsiveness during critical developmental windows [11]. Multimodal integration of therapy: Min et al. (2022) advance a comprehensive model through the Oral Motor Facilitation Technique, integrating postural alignment, sensory adaptation, and direct feeding practice. This holistic paradigm moves beyond isolated oral stimulation, aligning motor learning principles with functional feeding outcomes. Sensory-behavioral linkage to long-term feeding behavior: Chow et al. (2022) uniquely connect early oral motor experiences with later food texture perception and dietary behavior, establishing a developmental trajectory from sensorimotor competence to nutritional acceptance patterns [17]. Community-based scalability and cost efficiency: Grantham-McGregor et al. (2020) demonstrate that group-based stimulation delivery achieves outcomes comparable to individualized home visits at a fraction of the cost, redefining scalability parameters for early childhood programs in resource-limited settings [14]. Global meta-analytic consolidation provide robust quantitative confirmation that integrated oral-motor–nutritional interventions enhance cognitive and language outcomes, particularly in undernourished populations, strengthening the evidence base for multi-sectoral intervention models. Physiological coherence and cross-populational applicability: The consistent efficacy of oral motor stimulation—across neonatal, neurodevelopmental, and community contexts—highlights its universality as a developmentally grounded approach, linking physiological feeding mechanisms with cognitive and linguistic maturation [27, 28, 29].

Collectively, these innovations advance oral motor research from isolated clinical trials to an integrated, evidence-based framework encompassing timing, technique, and system-level implementation. The emerging paradigm redefines oral motor stimulation not merely as a therapeutic adjunct but as a foundational element of early developmental care and public health strategy

4 Conclusion

Based on evidence synthesis from three studies, oromotor stimulation has been statistically and clinically proven to be an effective intervention for improving feeding in pediatric populations with complex neurological conditions. Probabilistic analyses demonstrated an 85-95% success rate with a large effect size (Cohen's $d \approx 2.8$), supported by strong statistical significance ($p < 0.001$) for all primary outcomes. These studies demonstrated consistent effectiveness across populations, from preterm infants to children with severe cerebral palsy. The PIOMI protocol in preterm infants accelerated the transition to oral feeding by 2.6 days, while the OMFT in cerebral palsy improved oromotor function scores by 73%. The interventions demonstrated a high safety profile, with adverse events below 5%, and good implementation feasibility in routine clinical settings.

These findings support integrating oromotor stimulation as an essential component of feeding difficulty management, with recommendations for a phased implementation supported by strong evidence. Further research is needed to optimize the timing of initiation and analyze cost-effectiveness, but the current evidence is strong enough to encourage widespread adoption in clinical practice with ongoing outcome monitoring.

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