

# Establishing the association between nonnutritive sucking behavior and malocclusions

## A systematic review and meta-analysis

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Infants and young children may engage in nonnutritive sucking behavior (NNSB), that is, habitual sucking of digits, pacifiers, or other objects without deriving any nourishment from them. NNSB is a type of “comfort habit,”<sup>1</sup> affording the child a sense of security and calmness. Researchers have suggested the use of NNSB as a non-pharmacological intervention in the management of acutely painful procedures in preterm infants, neonates, and older infants,<sup>2</sup> and pacifier sucking is related to the reduced incidence of sudden infant death syndrome.<sup>3</sup> However, pacifier use also has been associated with shorter duration of breast-feeding<sup>3,4</sup> and otitis media.<sup>5</sup> Malocclusion, defined as “a deviation in intramaxillary and/or intermaxillary relations of teeth from normal occlusion [contact between teeth],”<sup>6</sup> is

### ABSTRACT

**Background.** The authors studied the effects of nonnutritive sucking behavior (NNSB) on malocclusions through a systematic review of association (etiology).

**Types of Studies Reviewed.** The authors performed a 3-step search strategy, including electronic searches. Studies of healthy participants with a history of active or previous NNSB, for whom specific malocclusion outcomes had been assessed, were eligible for inclusion. The authors considered before-and-after studies, prospective and retrospective (longitudinal) studies, case-control studies, and analytical cross-sectional studies. They excluded reviews, text- and opinion-based articles, conference abstracts, case reports, case-series, and descriptive cross-sectional studies. The authors, using standardized instruments, independently assessed methodological quality and extracted data from the included studies. In situations for which there were sufficient studies, the authors conducted meta-analyses using the random-effects model, supplemented with the fixed-effects model in situations for which statistical heterogeneity was less than 50%, which the authors assessed using the  $I^2$  statistic.

**Results.** The authors included 15 identified studies. They found that NNSB was associated with varying risks of developing malocclusions. Pacifier suckers are less likely to develop an increased overjet compared with digit suckers, although the results of a meta-analysis of 7 studies whose investigators had assessed posterior crossbite in the primary dentition demonstrated a significant association with pacifier sucking over digit sucking ( $n = 5,560$ ; risk ratio, 1.42; 95% confidence interval, 1.18-1.70;  $P = .0001$ ). Longer duration of NNSB was associated with an increased risk of developing malocclusions. Across-study heterogeneity likely resulted from methodological and sample size differences.

**Conclusions.** The authors of this study have confirmed the association between NNSB and the development of malocclusions. This study provides the highest level of evidence on this topic. Pacifiers were associated with a higher risk of developing most malocclusion features when compared with digit sucking.

**Practical Implications.** Though malocclusions are of multifactorial etiology, clinicians should inform parents and caregivers about the dental risks of NNSB, an environmental factor that is modifiable. NNSB should be discouraged in order to avoid the development of malocclusions. Future studies should adopt standardized, universally agreed and accepted definitions and classifications when measuring and reporting orthodontic outcome measures. This will help achieve across-study homogeneity.

**Key Words.** Evidence-based dentistry; finger sucking; malocclusion; meta-analysis; orthodontics; pacifiers; pediatric dentistry; sucking behavior; sucking habits; systematic review.

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another recognized outcome related to NNSB.<sup>7</sup> NNSBs are said to contribute specifically to the development of increased overjet (“horizontal projection of maxillary teeth beyond the mandibular anterior teeth”<sup>6</sup>), posterior crossbite (“an abnormal relationship of a tooth or teeth to the opposing teeth, in which normal buccolingual or labiolingual relationships are reversed”<sup>6</sup>), anterior open bite (“lack of [anterior] tooth contact in an occluding position”<sup>6</sup>), and incorrect sagittal relationship of teeth.<sup>7</sup>

Clinicians should not interpret the presence of a malocclusion as always needing treatment, as the spectrum of malocclusions ranges from those that are associated with minimal or no functional, dental health-related, or esthetic impairment, to those that are severe and can predispose a patient to traumatic dental injury<sup>8,9</sup> or impaction resorption,<sup>10</sup> both of which can cause tooth loss, as well as those that can elicit unfavorable social responses.<sup>11</sup> Clinicians may use reliable and validated indexes, such as the Index of Orthodontic Treatment Need,<sup>12</sup> to stratify patients’ need for orthodontic treatment according to the severity of their malocclusions.

Malocclusions also have multifactorial etiology; they are determined by a complex interaction of both genetics and environment. Whether malocclusions can be corrected by “therapeutic environmental intervention” may be determined by correctly diagnosing the extent to which genetics and the environment play a part in the expression of the phenotype.<sup>13</sup> If the features of a patient’s malocclusion have limited genetic origin, a clinician may suggest that the patient’s parents attempt to modify environmental factors that can induce malocclusion during the patient’s growth and development.<sup>14</sup> The clinician may suggest withdrawing pacifiers from the infant, or the clinician may advise interceptive orthodontic devices for digit suckers.<sup>15</sup> In patients who have ceased NNSB but for whom features of malocclusion have persisted and are severe, the clinician may encourage orthodontic intervention.

Orthodontic treatment carries significant implications for patients and their caregivers or families with respect to absenteeism from school or work and travel to attend appointments, pressure on health service providers to rationalize the use of limited resources, and society as a whole. “Prevention or interception of harmful behaviors may prevent the development of malocclusions, minimize their psychosocial impact, and reduce the demand for orthodontic treatment and the associated economic burden.”<sup>16</sup> Although a large body of literature exists, largely composed of retrospective cohort studies, case reports, case series, and opinion or review articles whose authors have reported on the relationship between NNSB and malocclusions, to our knowledge,

no investigators previously have undertaken a study to reveal high-level evidence, in the form of a systematic review of association (etiology). We conducted this review with the objective of assessing the association between NNSB and malocclusions.

## METHODS

We registered the title of this review and prospectively archived the protocol with the Joanna Briggs Institute (JBI) before commencing the review; we followed the JBI methodology for systematic reviews of association (etiology).<sup>17</sup>

**Review questions.** The objective of this review was to identify the relationship of NNSB on the development of malocclusions. We addressed the following specific review questions:

- What is the risk of developing malocclusions in participants with NNSB compared to those without NNSB?
- What is the risk of developing malocclusions between participants with different types of NNSB?
- What is the risk of developing malocclusions in participants with longer duration of NNSB compared with those having a shorter duration of NNSB?

**Inclusion criteria.** The usual population, intervention, comparator, and outcome approach to generate review questions for systematic reviews does not align with reviews related to etiology. Therefore, we used the population, exposure, and outcome approach to generate the review questions.<sup>17</sup>

**Population.** We conducted a search for studies of healthy participants with a history of active or previous NNSB and no previous orthodontic or surgical treatment. We set no restrictions on the basis of participants’ ages or sex. We excluded studies of participants who had a cleft lip, palate, or both; other craniofacial deformities; any syndrome; or a history of maxillofacial trauma.

**Exposures of interest.** We considered for inclusion studies whose investigators had evaluated the orthodontic impact of pacifier and digit sucking.

**Types of outcomes.** We assessed the following outcomes: increased overjet, sagittal relationship, posterior crossbite, and anterior open bite.

**Types of studies.** In this review, we considered for inclusion before-and-after studies, prospective and retrospective cohort (longitudinal) studies, case-control studies, and analytical cross-sectional studies. We excluded reviews, text- and opinion-based articles, conference abstracts, case reports, case-series, and descriptive cross-sectional studies.

**ABBREVIATION KEY.** AOB: Anterior open bite. CINAHL: Cumulative Index to Nursing and Allied Health Literature. CR: Canine relationship. JBI: Joanna Briggs Institute. MR: Molar relationship. NNSB: Nonnutritive sucking behavior. OJ: Overjet. X-bite: Posterior crossbite.



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