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Pacifiers, thumb sucking, breastfeeding, and bottle use:  
Oral sucking habits of children with and without phonological impairment

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## **Abstract**

**Aims:** The aim of this study was to describe the nutritive and non-nutritive oral sucking habits (breastfeeding, bottle use, pacifier/dummy/soother use, thumb/finger sucking) of preschoolers with and without phonological impairment, and to determine whether oral sucking habits are associated with presence and severity of phonological impairment.

**Methods:** We conducted a cross-sectional study of 199 Australian English-speaking preschoolers with and without phonological impairment. Preschoolers' speech was directly assessed, and parents/caregivers completed a questionnaire. Chi square was used to examine relationships between oral sucking habits, and presence and severity of phonological impairment.

**Results:** Based on caregiver report, 79.9% participants had been breastfed (33.3% for >12 months); 58.3% had used a pacifier (74.2% for  $\geq$ 12 months); 83.9% had used a bottle (73.4% for >12 months), and 15.1% sucked their thumb/fingers. There was no association between a history of oral sucking and the presence and severity of phonological impairment.

**Conclusion:** The majority of preschoolers had been breastfed and bottlefed, and more than half had used a pacifier. The findings support an understanding that phonological impairment is not associated with a history of nutritive and non-nutritive sucking habits. Research is needed to examine association between oral sucking habits and other types of speech sound disorder.

**Keywords:** pacifiers, breastfeeding, thumb sucking, speech sound disorders, children

## Introduction

During the early years of speech development, children may engage in nutritive (breast/bottle feeding) and non-nutritive oral sucking (pacifier/dummy/soother use and digit sucking). Breastfeeding is considered the most ideal form of nutritive sucking because of the nutritional and immunological benefits in breast milk [1]. Breastfeeding for longer than 9-months has also been identified as a protective factor against speech and language problems in children [2]. By contrast, bottle feeding and non-nutritive sucking, particularly pacifier use, are common practices associated with a range of advantages and disadvantages. For instance, pacifier use has been associated with accelerated maturation of oral sucking in preterm infants [3, 4], reduction in infants' pain during medical procedures [5], reduction in a child's risk of developing allergies [6], and a reduction in the risk of sudden infant death syndrome (SIDS) [7]; however, evidence from randomised controlled trials is lacking to unequivocally support or refute the effect of use of pacifiers for risk of SIDS [8]. By contrast, pacifier use during infancy has been associated with increased occurrence of gastrointestinal infections, diarrhoea and oral candida [9, 10], an increased risk of ear infections and malocclusion [11, 12, 13], a case of bowel obstruction [14], poorer emotional competence in boys and young adult males [15], and shorter duration of breastfeeding [16]; however, other research has not supported this latter association [17].

Speech problems in children, broadly referred to as speech sound disorders (SSD), can be divided into five different types [18] including: phonological impairment (i.e., a cognitive-linguistic difficulty associated with pattern-based speech errors), inconsistent speech (phonological) disorder (i.e., difficulty selecting and sequencing speech sounds resulting in the same word being pronounced in different ways), articulation impairment (i.e., difficulty with the physical articulation of specific speech sounds, particularly rhotics and sibilants), childhood apraxia of speech (CAS) (i.e., motor speech disorder associated with difficulty planning and programming speech movement sequences), and childhood dysarthria (i.e., motor speech disorder associated with impaired sensorimotor control processes needed to program and execute muscle movements needed for speech) [19]. Of these five types, phonological impairment (PI) is the most common [20] and is the focus of the current investigation. The pattern-based errors that characterize PI may be delayed for a child's age (i.e., an error pattern evident in young children) or disordered (i.e., atypical error patterns not routinely evident in typically developing children's speech).

Across the relatively small body of research examining the relationship between nutritive/ non-nutritive sucking and PI in children, results have been equivocal. Barbosa and

colleagues [21] conducted a study of 128 Patagonian children between 37- and 70-months old with below normal ( $< 1$  standard deviation) and normal or above normal speech production skills, based on occurrence of phonological processes using a validated single-word picture naming task. It was unclear if errors involving /s/, particularly interdental substitutions, were considered phonological error patterns or articulation errors. It was also not reported whether any of the children had received intervention from a speech-language pathologist. Given that the broad term ‘speech disorder’ was used rather than PI, and that exclusion criteria were not mentioned, it was unclear if any of the participants had articulation or motor speech difficulties rather than or in addition to PI characterised by the presence of age-inappropriate phonological processes. Barbosa and colleagues [21] reported that among the 128 participants 96.5% had been breastfed with 30% breastfed for more than 12 months, 41.7% had used or were still using a pacifier, and 18.3% had engaged in finger sucking. The children who were reported to have sucked their fingers and/or have prolonged pacifier use (i.e., used a pacifier for more than 36 months) were three times more likely to score below the normal range on the speech assessment measuring occurrence of phonological processes. Whether or not this performance equated to a diagnosis of PI only was unclear. By contrast, the children who did not start using a bottle until age 9 months were more likely to score within the normal range on the speech assessment.

In a sample of 65 English-speaking children with SSD and 48 children with typically developing speech, Fox, Dodd, and Howard [22] examined risk factors (including oral sucking history) associated with SSD. Of the 65 children with SSD, 56 had PI [41 = delayed; 15 = disordered], and 9 children had inconsistent speech (phonological) disorder. Children with articulation impairment were excluded. One child with phonological difficulties had mild symptoms of CAS; however, the authors noted that the symptoms did not warrant the diagnosis of CAS. Children with ‘organic motor disorder’ were also excluded, suggesting that children with childhood dysarthria associated with organic causes such as cerebral palsy were excluded. However, it was unclear if any of the children with PI also had symptoms associated with childhood dysarthria or had PI only. Oral sucking habits, including duration of habit, was based on parent report. Of note, Fox et al. grouped pacifier use at night only with no pacifier use. If a bottle or pacifier was used, or thumb sucking present, duration of use was classified as either greater or less than 24 months. Fox et al. reported that their cohort of children with PI were more likely to have used a pacifier, a bottle as a pacifier or sucked their thumb for more than 24 months; however, only the use of a bottle as a pacifier (i.e., non-nutritive sucking on a bottle outside feeding times) was significantly different between the

children with PI compared to their control group. The relationship between duration of bottle use and severity of PI, in addition to nutritive sucking and PI was not considered.

In contrast, Shotts, McDaniel, and Neeley [23] reported no difference in performance on a speech production test for three groups of children (mean age = 45.5 months): Group 1, 30 children with a history of no or limited pacifier use; Group 2, 16 children who had routinely used a pacifier for up to 15 months; and Group 3, 22 children who used a pacifier beyond 18 months of age. Although the mean standard scores for speech production accuracy (based on the Goldman-Fristoe Test of Articulation – Second Edition [24]) were in the normal range for each group (Group 1: 100.47; Group 2, 103.31, Group 3: 105.59), it was unknown how many children in each group may have had SSD, and whether any of these children had PI, given that the minimum standard scores in groups 1, 2 and 3 were 55, 67, and 67 respectively. Standard scores between 85 and 115 are considered within the normal range as they fall within 1 standard deviation of the standardised mean of 100. It was also unknown whether any of the children across the groups had a history of speech-language pathology intervention, as this was not reported. Thus, it was unclear if children with PI would have differed in their history of pacifier use compared to children without PI.

Collectively, the findings of the limited research on oral sucking habits and PI to date are mixed. Although some findings suggest a negative association between prolonged non-nutritive sucking and speech accuracy [21, 22], and protective benefits of prolonged nutritive sucking against PI [21], explanations for these possible associations are uncertain. As Tomblin et al. [25, p. 339] suggests for language impairment, it is possible that the “critical nutrients, immunologic protection, or early maternal language exposures during” breastfeeding may serve as protective factors against PI. Conversely, the presence of a pacifier may increase a child’s risk for PI, given the increased risk of factors that have been associated with both pacifier use and children’s speech acquisition, such as ear infections [2]. These suggestions are of course speculative. Synthesis of the limited research is also constrained due to methodological differences and/or insufficient details. For example, apart from Fox et al. [22], criteria for including/excluding participants with PI have been unclear. Definitions of pacifier use and prolonged use have varied. Moreover, the relationship between severity of PI and duration of oral sucking habits has not been considered.

Pacifier use is a controversial practice. Beyond empirical research, parenting websites, blogs, and social media sites include opinions and ideas about the advantages and disadvantages of non-nutritive sucking [26]. For parents to make an informed decision about

nutritive and non-nutritive sucking, including the potential for prolonged pacifier use to be associated with PI, more research is need.

The purpose of this study was (1) to examine history of nutritive and non-nutritive sucking habits of children with and without PI, and (2) to determine whether prolonged breastfeeding might be advantageous to, and non-nutritive sucking might be detrimental to developing clear, intelligible speech. The specific research questions of interest included:

1. What proportion of Australian preschoolers, with and without PI have engaged in breast feeding, bottle feeding, pacifier sucking, and thumb/finger sucking?
2. What is the duration of breast feeding, bottle feeding, pacifier and thumb/finger sucking in Australian preschoolers, with and without PI?
3. Is there an association between (a) breast-feeding duration and presence/severity of PI, and, (b) pacifier use and presence/severity of PI?

In light of the extant literature, it was predicted that significantly more children without PI would have been breastfed compared to children with PI, and that for the children with PI, longer breastfeeding duration would be associated with less severe PI. By contrast, significantly more children without PI would have not used a pacifier, and of the children with PI, longer pacifier use would be associated with more severe PI.

## **Materials and Method**

Charles Sturt University Ethics Committee evaluated this research and granted ethics approval (Approval number 2013/070) in addition to the NSW Department of Education and Communities State Education Research Applications Process (SERAP) (Approval number 2013267). Informed consent was obtained from all parents/caregivers of children involved in the study. Assent was also obtained from each child who participated in the study.

### **Participants**

#### **Recruitment of Participants**

Participants were recruited as a part of the Sound Start study, a 3-year randomised-controlled trial for children with PI [27]. The data for the current study were collected before intervention started. Parents of 1205 preschool-age children at early childhood centres in Sydney, Australia completed a screening questionnaire that included the Parent Evaluation of Developmental Status [28]. A total of 327 (27.1%) parents/carers expressed concerns about their child's speech. Children were not eligible to participate if their parents/carers were not concerned about their speech, they had a diagnosed developmental delay, hearing loss, cleft lip and/or palate, an articulation impairment only (e.g., lisp), childhood apraxia of speech, or childhood dysarthria previously diagnosed by a speech-language pathologist. All children

were reported by their parents to speak English as good as or better than any other languages spoken at home. A total of 275 children were eligible to receive a speech and language screening assessment as a part of the Sound Start study. At the time of the screening assessment, the parents of these children were asked to complete a comprehensive questionnaire that included items on oral sucking habits; 249 (90.5%) were returned. Children were further excluded from participation from the current study based on their performance on the Diagnostic Evaluation of Articulation and Phonology – Phonology Assessment (DEAP)[29]. Based on children’s performance on the DEAP, four groups of children were identified: (1) *No identified impairment* (NI) obtained DEAP standard score of 7 or more based on percentage of consonants correct (PCC), (2) *Phonological impairment only* (PI-only) obtained DEAP standard score of 6 or less with one or more age-inappropriate common phonological error patterns present including cluster reduction, final consonant deletion, gliding, velar fronting, stopping of fricatives and/or affricates, context sensitive voicing, and deaffrication, but no evidence of motor speech involvement; (3) *Phonological impairment plus lisp* (PI+Lisp) met criteria for a PI but also demonstrated an interdental lisp, and (4) *Speech sound disorder-other* obtained DEAP standard score of 6 or less and demonstrated none of the listed common phonological error patterns. Due to the interest in the relationship between phonological impairment and history of nutritional and non-nutritional sucking behaviours, children who did not meet the criteria for PI only (i.e., children in the PI+Lisp [ $n = 13$ ] and SSD-other [ $n = 37$ ]) were excluded from the current study. Only children with no identified impairment ( $n = 65$ ) and children with phonological impairment only ( $n = 134$ ) are included in the current study. The total samples size for this investigation was therefore 199 children.

### **Participant characteristics**

Participants for this study included more male ( $n = 121$ ) than female ( $n = 78$ ) children, aged between 48 and 66 months ( $M = 54.07$ ,  $SD = 4.11$ ); a typical ratio for children with PI. Participants demonstrated varied performance on the Diagnostic Evaluation of Articulation and Phonology (DEAP)[29] with a mean percentage of consonants correct (PCC) of 72.52 (range = 29.1 – 98.6,  $SD = 15.3$ ). Oromuscular structure and function testing [30] indicated that 160 (80.4%) had structure within the typical range but only 32 (16.1%) had function within the typical range. Structural problems were minor (e.g., missing tooth); no participant had a major structural problem impacting speech (e.g., ankyloglossia, atrophy of the tongue, cleft palate). Function problems were associated with poor speech production accuracy, rather than non-speech function. Hearing was assessed via pure-tone audiometry for 186



(93.5%) of participants: 169 (84.9%) passed the hearing screening at 40dB and 17 (8.5%) did not pass and were referred for follow-up hearing assessment. Thirteen (6.5%) participants did not complete the hearing screening due to being unable to complete the task ( $n = 2$ , 1.0%) or the task being missed in the assessment battery ( $n = 11$ , 5.5%). No child demonstrated overt signs of dysarthria, verbal and/or oral apraxia. Questionnaires were completed by 176 (88.4%) mothers, 19 (9.5%) fathers, and 4 (2.0%) other family members or caregivers.

### **Procedure**

Eligible children were directly assessed by one of two speech-language pathologists (SLPs) using a range of assessments including the DEAP [29], the Robbins and Klee oromuscular structure and function protocol [30], and a hearing screening assessment. Participants' parents completed the comprehensive questionnaire that included items on oral sucking habits.

### **Reliability**

Intra- and inter-judge transcription reliability of the DEAP-Phonology assessments were completed by two speech-language pathologists on 10% of the participant samples, obtaining agreement scores of 89.4% and 88.7% respectively indicating acceptable agreement for broad transcription [31].

### **Analysis**

Descriptive statistics were used to determine the presence and duration of nutritive and non-nutritive sucking behaviours. Children with PI were identified based on performance on the DEAP-Phonology Assessment as measured by PCC score and associated standard score plus presence or absence of the common phonological error patterns that could be targeted with the computer-based program Phoneme Factory [37]. A Chi-square test of independence was used to examine possible association between duration of participants' oral sucking habits and the presence and severity of PI only.

## **Results**

Of the 199 participants who completed the DEAP-Phonology Assessment, 65 (32.7%) scored within normal limits. The remaining participants ( $n = 134$ , 67.3%) were identified to have phonological impairment only (PI-only) based on their performance on the DEAP-Phonology Assessment.

### **Description of oral sucking habits**

As a whole group, 159 (79.9%) were breastfed, 167 (83.9%) were bottlefed, 116 (58.3%) used pacifiers, and 30 (15.1%) engaged in thumb/finger sucking. Table 1 lists duration of nutritive/ non-nutritive sucking for the children in each group and the extent of

missing data: breast feeding ( $n = 1$ , 0.5%), bottle use ( $n = 6$ , 3.0%), pacifier use ( $n = 6$ , 3.0%), and thumb/finger sucking ( $n = 16$ , 8.0%).

The combined sucking history was considered in terms of breastfeeding and pacifier use. Of the children with complete data ( $n = 186$ ), 82 (44.1%) children were breastfed and used a pacifier, 28 (15.1%) only used a pacifier, 66 (35.5%) were breastfed but did not use a pacifier, and only 10 (5.4%) children did not use a pacifier and were not breastfed. Table 2 describes the combined sucking history, considering breast-feeding and pacifier use, for children in each group.

### **Oral sucking habits and the presence and severity of phonological impairment**

Duration of oral sucking habits (breastfeeding, and pacifier use) was categorised into three groups: no use, minimal use (< 12 months), and prolonged use (> 12 months), for participants in each group (see Table 3). An investigation of the association between duration of oral sucking habits and the presence of PI was conducted by comparing participants classified as NI ( $n = 65$ ) and those with PI-only ( $n = 134$ ). An investigation of the association between duration of oral sucking habits (nutritive and non-nutritive) and the severity of PI was conducted by comparing participants' based on a standard score of  $\leq 3$  (severe) or, a standard score of  $\geq 4$ , 5, or 6 (mild/moderate) from the DEAP manual [29]. Figure 1 presents the mean PCC for participants in each of the nutritive (1a) and non-nutritive (1b) duration categories.

*Nutritive sucking.* A non-significant interaction was found between the duration of breast-feeding and the presence of a PI,  $\chi^2(2, N = 195) = 5.79, p = .055$  (see Table 3) and the severity of participants' PI,  $\chi^2(2, N = 131) = 1.85, p = .396$  (see Table 4). Although the relationship was non-significant, there was a trend that participants with PI who breastfed for longer demonstrated, on average, a higher mean PCC than those who were not breastfed for as long (see Figure 1a).

*Non-nutritive sucking.* A non-significant interaction was found between the duration of pacifier use and the presence of PI,  $\chi^2(2, N = 189) = .589, p = .745$  (see Table 3) and the severity of participants' PI,  $\chi^2(2, N = 127) = 4.48, p = .106$  (see Table 4). Although the relationship was non-significant, there was a trend that participants with PI who used a pacifier for longer demonstrated, on average, a lower mean PCC than those who did not use a pacifier for as long (see Figure 1b).

*Combined nutritive and non-nutritive sucking.* Participants' combined sucking exposure was classified according to the presence or absence of two sucking behaviours, breastfeeding and pacifier use: (1) breastfeeding only (total  $n = 66$ , 35.5% [NI  $n = 24$ , 39.3%; PI  $n = 42$ ,

33.6%]), (2) pacifier use only (total  $n = 28$ , 15.1% [NI  $n = 5$ , 8.2%; PI  $n = 23$ , 18.4%]), (3) breastfeeding and pacifier use (total  $n = 82$ , 44.1% [NI  $n = 30$ , 49.2%; PI  $n = 52$ , 41.6%]), and (4) no exposure to breastfeeding or pacifier use (total  $n = 10$ , 5.4% [NI  $n = 2$ , 3.3%; PI  $n = 8$ , 6.4%]) (see Table 2). A non-significant interaction was found between the combination of exposure to different sucking behaviours (as described in Table 2) and the presence of PI,  $\chi^2(3, N = 186) = 4.496, p = .213$  and the severity of participants' PI,  $\chi^2(3, N = 125) = 2.028, p = .567$ .

## Discussion

This study examined the nutritive and non-nutritive sucking habits of Australian preschoolers with and without PI. Breastfeeding, bottle use, and pacifier use were common among both groups. Thumb/finger sucking was uncommon. Contrary to our predictions, nutritive and non-nutritive sucking habits were not associated with the presence or severity of PI.

The finding that the majority of preschoolers in our study were breastfed (79.9%), with one third (33.3%) of those children breastfed for more than 12 months, was commensurate with Barbosa et al. [21], who reported 96.5% of their participants had been breastfed, and 30.5% breastfed for more than 12 months. The similar proportions of preschoolers with (84.3%) and without PI (83.1%) who had used a bottle were somewhat lower than Patagonian preschoolers described by Barbosa and colleagues [21] (94.5%); however, like Barbosa and colleagues, the majority of preschoolers who used a bottle, continued to do so beyond age 12 months. Recall that Fox et al. [22] reported that compared to a control group of children without PI, more children with PI used a bottle as a pacifier. Comparison of their findings with the current study is limited, because a question about the use of a bottle as a pacifier (i.e., sucking on a bottle excluding feeding times), was not included in our questionnaire. This specific issue could be considered in future research.

Compared to previous research, the similar proportions of preschoolers with (59.7%) and without PI (55.4%) who used a pacifier was higher than the rate of Patagonian preschoolers described by Barbosa and colleagues (42%) [21]. The findings from the current study were however lower than previous research of first-time mothers in Australia (79%) [32], but higher than the global average (51%) and similar to cities in Northern Europe (Vienna 55.5%; Dublin 61%) [333]. The usage rate was also considerably higher than some Asian countries (e.g., Japan, 12.5%) and New Zealand (Dunedin, 14%) [333]. In light of the diverse usage rates across countries, further insight into the issue could be gained by

comparing prevalence and severity of PI to children's country of birth and history of oral sucking habits.

Compared with other types of nutritive and non-nutritive sucking, thumb/finger sucking was less common, at an overall rate of 15.1%, similar to Littlefield's [34] report of 17% for English children published 60 years ago, and Moimaz and colleagues [35] report of 15% for 12-month-old children in Brazil. Thumb/finger sucking has been associated with an increased risk of open bite and overjet [35], which has in turn been associated with speech errors, particularly on /s, t/ [36]. It would therefore be valuable for future research to investigate the occlusion of children with PI and their production and error types for /s, t/ compared with children with other types of SSD, particularly articulation impairment characterised by distortion errors on /s/ such as an interdental lisp.

In contrast to previous research, we did not find an association between the duration of children's oral sucking habits and the presence or severity of PI. One explanation for this finding is that we specifically selected children with PI only. PI is presumed to be a cognitive-linguistic difficulty involving a difficulty abstracting rules about the phonological system, and the abstract phonological representation of speech rather than an articulation difficulty. As such, it is reasonable to suggest that non-nutritive sucking habits would be unrelated. By contrast, the finding that breastfeeding, including prolonged breastfeeding beyond 12 months, did not differentiate children with and without PI, nor differentiate children with different severities of PI, differs from previous research [2] and raises questions about the potential influence of breastfeeding on PI in children.

This study is not without limitations. We used a selected sample rather than a representative population sample. The children included in our study were identified based on parents' report of concern for their children's speech. Using direct assessment by SLPs, 134 children had PI and 65 children had no identified impairment. Future research could compare the history of nutritive and non-nutritive sucking habits of children whose parents have no concerns about their child's speech and language development with children who have a diagnosed PI. It could also be helpful to gather more detail about the nature of both nutritive and non-nutritive sucking habits, such as amount of daily use of a pacifier or thumb sucking over time (e.g., pacifier used for sleep only versus used during waking hours for more or less than 12 months).

The impact of nutritive and non-nutritive sucking habits on children's speech development has been contentious, not only among speech-language pathologists but among other health professionals, and parents. This contention can be partially attributed to the fact

that prior literature examining the relationship between oral sucking habits and SSD has not clearly specified the participants' type of SSD. The findings from this study would suggest that pacifier use is not associated with the presence of PI in young children, nor the severity of PI. Future research is needed to determine whether nutritive and non-nutritive sucking habits do play a role in the presence and severity of other types of SSD in children.

**Acknowledgements and Declaration of Conflict of Interest**

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Figure 1. Mean percentage of consonants correct (PCC) demonstrated by participants who were reported to have exposure to breastfeeding (a) and pacifier use (b) with no use, less than 12 months use, and more than 12 months use. (PI-only = phonological impairment only; NI = no identified impairment.)

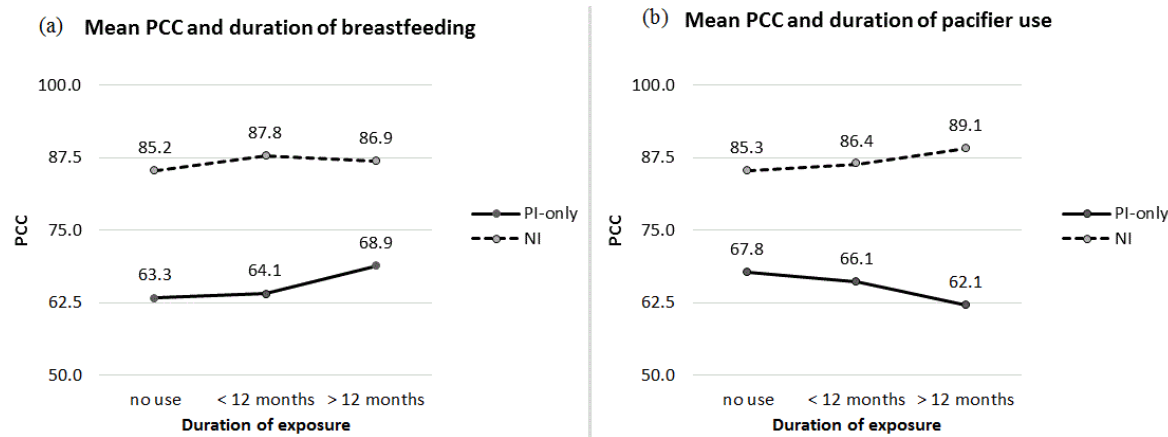


Table 1: Nutritive and non-nutritive sucking history of children with and without phonological impairment (n = 199).

Sucking history	No identified impairment (n = 65)		Phonological impairment only (n = 134)		Total (N = 199)	
	n	%	n	%	n	%
<b>Breast fed</b>						
No	7	10.8%	32	23.9%	39	19.6%
Not reported <sup>a</sup>	0	0.0%	1	0.7%	1	0.5%
Yes	<b>58</b>	<b>89.2%</b>	<b>101</b>	<b>75.4%</b>	<b>159</b>	<b>79.9%</b>
<b>Time breast fed<sup>b</sup></b>						
Not reported <sup>a</sup>	1	1.7%	2	2.0%	3	1.9%
< 6 months	24	41.4%	53	52.5%	77	48.4%
6-12 months	11	19.0%	15	14.9%	26	16.4%
> 12 months	22	37.9%	31	30.7%	53	33.3%
<b>Bottle fed</b>						
No	11	16.9%	15	11.2%	26	13.1%
Not reported <sup>a</sup>	0	0.0%	6	4.5%	6	3.0%
Yes	<b>54</b>	<b>83.1%</b>	<b>113</b>	<b>84.3%</b>	<b>167</b>	<b>83.9%</b>
<b>Time bottle fed<sup>b</sup></b>						
Not reported <sup>a</sup>	1	1.9%	4	3.5%	5	2.5%
< 6 months	5	9.3%	4	3.5%	9	4.5%
6-12 months	3	5.6%	4	3.5%	7	3.5%
> 12 months	45	83.3%	101	89.4%	146	73.4%
<b>Use of pacifier</b>						
No	27	41.5	50	37.3	77	38.7%
Not reported <sup>a</sup>	2	3.1	4	3.1	6	3.0%
Yes	<b>36</b>	<b>55.4</b>	<b>80</b>	<b>59.7</b>	<b>116</b>	<b>58.3%</b>
<b>Time with pacifier<sup>b</sup></b>						
Not reported <sup>a</sup>	1	2.8%	3	3.8%	4	3.4%
1-11 months	7	19.4%	19	23.8%	26	22.4%
12-23 months	13	36.1%	14	17.5%	27	23.3%
24-35 months	7	19.4%	25	31.3%	32	27.6%
36 months or more	8	22.2%	19	23.8%	27	23.3%
<b>Thumb/finger sucking</b>						
No	46	70.8%	107	79.9%	153	76.9%
Not reported <sup>a</sup>	7	10.8%	9	6.7%	16	8.0%
Yes	<b>12</b>	<b>18.5%</b>	<b>18</b>	<b>13.4%</b>	<b>30</b>	<b>15.1%</b>
<b>Time thumb/finger sucking<sup>b</sup></b>						
Not reported <sup>a</sup>	0	0	1	5.6	1	3.3%
< 6 months	2	16.7	2	11.1	4	13.3%
6-12 months	0	0	0	0	0	0.0%
> 12 months	10	83.3	15	83.3	25	83.3%

Note. PI, phonological impairment. The participants represent 90.5% of the total number of children who were assessed during stage 2 of the Sound Start Study ( $n = 199$ ). These data refer to children whose caregiver/s returned the stage 2 questionnaire and children who were identified as having a phonological impairment based on their performance on the DEAP-Phonology assessment (PI only) and those who didn't present with speech sound disorder on this same test (No identified impairment). No data were available for those children whose caregiver/s did not complete the questionnaire. <sup>a</sup> "Not reported" includes children whose caregiver/s indicated that they did not know whether the child was exposed to this sucking behaviour OR, they missed this question on the questionnaire. <sup>b</sup> Time use data and percentages are based on the children whose caregiver/s reported the duration of sucking behaviour.

*Table 2: Combined sucking history (breastfeeding and pacifier use) of children with and without phonological impairment (n = 186). Valid percentages reported*

Sucking history	No identified impairment		Phonological impairment only		Total	
	(n = 61)		(n = 125)		(N = 186)	
	n	%	n	%	n	%
Breast fed only (no pacifier use)	24	39.3	42	33.6	66	35.5
Not breastfed, no pacifier used	2	3.3	8	6.4	10	5.4
Breastfed and pacifier used	30	49.2	52	41.6	82	44.1
Pacifier only (not breastfed)	5	8.2	23	18.4	28	15.1

Table 3. *Nutritive and non-nutritive sucking history of children with no identified impairment and those with a phonological impairment only*

Sucking behaviour and duration	No identified impairment	Phonological impairment only	Total
<b>Breast fed (<i>n</i> = 195)</b>			
No use	7 (3.6%)	32 (16.4%)	39 (20.0%)
< 12 months	35 (17.9%)	68 (34.9%)	103 (52.8%)
> 12 months	22 (11.3%)	31 (15.9%)	53 (27.2%)
Total	64 (32.8%)	131 (67.2%)	195 (100.0%)
<b>Pacifier use (<i>n</i> = 189)</b>			
No use	27 (14.3%)	50 (26.5%)	77 (40.7%)
< 12 months	7 (3.7%)	19 (10.1%)	26 (13.8%)
> 12 months	28 (14.8%)	58 (30.7%)	86 (45.5%)
Total	62 (32.8%)	127 (67.2%)	189 (100.0%)

Table 4. *Nutritive and non-nutritive sucking history of children with phonological impairment of two different severity levels (severe = DEAP SS <3; mild-moderate = DEAP SS 4-6)*

Sucking behaviour and duration	Severity of phonological impairment		Total
	Severe	Mild-Moderate	
<b>Breast fed (<i>n</i> = 131)</b>			
No use	27 (20.6%)	5 (3.8%)	32 (24.4%)
< 12 months	50 (38.2%)	18 (13.7%)	68 (51.9%)
> 12 months	22 (16.8%)	9 (6.9%)	31 (23.7%)
Total	99 (75.6%)	32 (24.4%)	131 (100%)
<b>Pacifier use (<i>n</i> = 127)</b>			
No use	36 (28.3%)	14 (11.01%)	50 (39.4%)
< 12 months	12 (9.4%)	7 (5.5%)	19 (15.0%)
> 12 months	49 (39.6%)	9 (7.1%)	58 (45.7%)
Total	97 (76.4%)	30 (23.6%)	127 (100%)