



Non-nutritive sucking behaviors in preschool children: A longitudinal study

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Abstract

Purpose: Prolonged duration of non-nutritive sucking behaviors may have consequences in regard to the developing orofacial structures and occlusion. Little is known as to why some children have prolonged sucking habits beyond the first 2 to 3 years of life. This paper reports on non-nutritive sucking patterns among a large cohort of healthy children from birth to 36 months of age and older, and identifies factors predictive of prolonged non-nutritive sucking habits.

Methods: Over 600 children were followed from birth to at least 36 months of age using mailed questionnaires sent when children reached the ages of 6 weeks, and 3, 6, 9, 12, 16, and 24 months, and then yearly thereafter. Parents answered questions concerning non-nutritive sucking behaviors including use of pacifier and digit sucking. The study categorized children who maintained habits to 36 months of age or older as having prolonged habits, and using multivariate analyses, compared them to children without prolonged habits on various sociodemographic variables.

Results: The study found that for over 20% of the children, a non-nutritive sucking habit was prolonged to 36 months of age or

older. Factors associated with prolonged sucking habits included older maternal age, higher maternal education level, and having no older siblings.

Conclusions: Identifying factors related to prolonged non-nutritive sucking habits may be important in developing and targeting recommendations regarding such behaviors in an effort to prevent malocclusions that result from prolonged sucking habits. (*Pediatr Dent* 22:187-191, 2000)

Sucking behaviors in infants and young children are derived from the physiological need for nutrients. Current understanding of child development suggests that sucking behaviors also arise and continue due to psychological needs. Thus, normally developed infants have an inherent, biological drive for sucking.¹ This need for sucking can be satisfied through nutritive sucking, including breast- and bottle-feeding, whereby the infant obtains food, or through non-nutritive sucking on objects such as digits, pacifiers, or toys that may serve primarily to satisfy psychological needs. While sucking

Table 1. Cross-sectional Studies of Prolonged Non-nutritive Sucking Habits

Author(s)	Year	Site	Ages	N	Habit Prevalence (%)		Factors Associated with Prolonged Habits
					Digit	Pacifier	
Nanda et al.	1972	India	2-6	2,500	8	—	Not studied
Kohler & Holst	1973	Sweden	4	1,567	30	11	Not studied
Ravn	1974	Denmark	3	248	7	36	Not studied
Infante	1976	US	2	68	24	—	Middle class family non-rural home
			3	200	22	—	
			4	207	22	—	
			5	205	15	—	
Ravn	1976	Denmark	3	310	7	35	Not studied
Svedmyr	1979	Sweden	3-5	462	18	24	Not studied
Modeer et al.	1982	Sweden	4	588	13	31	Not studied
Adair et al.	1995	US	2-4	218	—	55	Not studied
Farsi et al.	1997	Saudi Arabia	3-5	583	11	38	Breastfeeding duration parents' education*

*Parental education was associated with prolonged pacifier habit only

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Table 2. Demographic Characteristics of Respondents at Baseline (N=1,374)

Variable	Categories	%
Mother's age	<20	8
	20-24	21
	25-29	30
	30-34	28
	35+	13
Father's age	<20	1
	20-24	12
	25-29	30
	30-34	32
	35+	25
Mother's education	Up to high school	32
	Some college	33
	College graduate or more	36
Father's education	Up to high school	36
	Some college	28
	College graduate or more	36
Family income	<\$20,000	26
	\$20,000-39,999	36
	\$40,000+	39
Race	White	95
	Other	5

behaviors are normal in infants and young children, prolonged duration of such behaviors may have consequences in regard to the developing orofacial structures and occlusion.²⁻⁶ However, while there is some information available regarding the prevalence of sucking behaviors, including the prevalence of prolonged sucking habits, there is relatively little known about the longitudinal patterns of non-nutritive sucking behaviors and very little information to characterize those with prolonged habits.

Prevalence of non-nutritive sucking behaviors

Several studies have reported on the prevalence of non-nutritive sucking behaviors among infants and young children in different populations. As discussed previously, non-nutritive sucking is regarded as a normal part of development, and early studies of its prevalence generally found that 70-90% of children had some history of a non-nutritive sucking habit.⁷

Like these early studies, most recent studies have used retrospective methods to assess the prevalence of non-nutritive sucking habits. Svedmyr⁸ found that, among a group of mostly 3- to 5-year-old Swedish children, only 14% never had any non-nutritive sucking habit, with 62% having had a pacifier

(or “dummy”) habit. Another study in Sweden found that 88% of 4-year old children had a history of non-nutritive sucking, with 48% having a continuing habit at age 4 years.⁹ This study also found that the predominant habit was the use of a pacifier, which accounted for 78% of those with habits.⁹ A third retrospective study from Sweden found that 78% of 4-year olds had a history of non-nutritive sucking, with about equal proportions with pacifier- and finger-sucking histories. However, this study reported that finger-sucking habits were more likely to continue to age 4 than were pacifier habits.¹⁰

Two retrospective studies from Denmark assessed the prevalence of non-nutritive sucking. Ravn⁷ found that 84% of 3-year olds had a history of non-nutritive sucking, with 76% having a history of a pacifier habit and the remaining 8% a finger-sucking habit. At age 3, 47% still used a pacifier, with girls somewhat more likely to continue this habit. Melsen et. al.¹¹ reported that 86% of 10- to 11-year old children had a history of a non-nutritive sucking habit, with pacifier sucking much more common than finger sucking (78% vs. 8%).

A Finnish study, also of 10- to 11-year old children, found that 87% had a history of a non-nutritive sucking habit, with pacifier-users predominant. However, this study reported that, while finger sucking was less common, 35% of those with a history of this habit continued it beyond age 5, and 8% continued beyond 8 years of age.¹² Only 6% of those with a history of a pacifier habit continued it beyond age 5, with none continuing beyond age 8.¹² By contrast, a study in India found that fewer than 10% of 2- to 6-year olds from a city in India still maintained a non-nutritive sucking habit, with habits being more common in younger children and in females.¹³

Farsi and Salama¹⁴ reported on sucking habits in 3- to 5-year old Saudi children, and found that 48% had a history of a non-nutritive sucking habit, which was associated with higher parental education levels and duration of breast-feeding. Only 6.5% of the children had a prolonged digit habit at age 3 or older, while 2.2% had a prolonged pacifier habit.

There have been relatively few studies of non-nutritive sucking prevalence in US populations. Infante¹⁵ reported that 19% of 2- to 5-year olds had an active finger-sucking habit, with significantly higher proportions of girls and those from upper or middle classes having this habit. Pacifier use was not recorded, although it was noted that few of these children used a pacifier. Adair et al.² recently reported that 55% of 2- to 4-year olds had a history of pacifier use; however, the study excluded children with finger-sucking habits.

As summarized in Table 1, cross-sectional studies of habits have demonstrated that a substantial proportion—about 19-55%—had non-nutritive sucking habits persisting to 3-4 years of age or older. These studies also found that, in general, finger- and thumb-sucking habits were more likely to be prolonged to 3-4 years of age or older than were pacifier habits.

While the studies discussed above provide a body of knowledge concerning non-nutritive sucking behaviors, nearly all studies have used cross-sectional or retrospective study designs. These designs limit the accuracy of the data collected and are not capable of describing the longitudinal patterns of sucking behaviors over time. In addition, although there is evidence that prolonged non-nutritive sucking habits can adversely affect orofacial development, few studies have attempted to identify those children most at risk for having prolonged habits.

Table 3. Non-Nutritive Sucking Habits by Age

	6 wk. (N=1,237)	3 mo. (N=1,193)	6 mo. (N=1,046)	9 mo. (N=934)	12 mo. (N=794)	16 mo. (N=665)	24 mo. (N=606)	36 mo. (N=496)	48 mo. (N=221)
Any sucking habit (%)	87	91	89	78	68	59	53	29	21
Pacifier (%)	78	68	56	42	38	34	25	10	5
Digit (%)	48	80	73	48	31	24	22	14	12
Pacifier and/or digit (%)	85	90	87	71	60	52	44	24	17
Other objects (%)	19	44	66	47	32	20	15	6	6

Methods

As part of an ongoing, longitudinal study of fluoride exposures and ingestion¹⁶⁻²¹ among a birth cohort of over 1,000 Iowa children and their mothers, data concerning patterns of nutritive and non-nutritive sucking have been collected. For this study, 1,374 mothers with newborns were successfully recruited from eight hospital post-partum wards during the time period from March, 1992 to February, 1995, with over 600 participants remaining active in the study to at least 36 months of age. Mailed questionnaires that focused on fluoride exposures were sent to parents periodically during the first 7 years of life. Questions concerning nutritive and non-nutritive sucking were posed to parents when children reached the ages of 6 weeks, to 3, 6, 9, 12, 16, and 24 months, and then yearly thereafter. Non-respondents received a second mailing after three weeks and were contacted by telephone after six weeks.

Questions posed to the parents (usually mothers) asked about non-nutritive sucking habits during the preceding 3-12 months. Specifically, questions about non-nutritive sucking asked whether the child had any sucking habit, and, if so, then asked the parent to identify objects on which the child sucked from a list, which included thumb, other fingers, pacifier, toys, blanket, non-nutritive sucking of mother's breast, and "other." Although these data were not formally validated, questionable responses were clarified by postcard or telephone, when necessary (approximately 8% of total survey responses).

Results from questionnaires were systematically reviewed by at least two study team members, and data were double entered and verified using the SAS, (Cary, NC), software package.²² For the purposes of comparison, non-nutritive sucking habits were categorized as "prolonged" for those reporting a habit at 36 and/or 48 months, while children with no such habits at these ages were categorized as not having a prolonged habit. Multivariate analyses were conducted using logistic regression to identify factors predictive of a non-nutritive sucking habit at 36 months of age or older. Independent variables included childcare attendance, baseline demographic variables, and other factors. The regression analysis included the 627 participants who had remained active in the study and responded at 36 or 48 months (or both). The main dependent variable was a parent report of a non-nutritive sucking habit at 36 and/or 48 months of age. The regression model tested potential risk factors and two-way interactions between them using the Wald χ^2 statistic.

Results

Demographic data for the original 1,374 participating families at the time of the birth of their child are presented in Table 2. Nearly all parents were at least 20 years of age and white, and a majority had attended college. For over 40%, it was their first child.

Table 3 summarizes data concerning non-nutritive sucking behaviors by age. Nearly all children had a non-nutritive sucking habit at some time, with the peak prevalence at age 3 months. As in other studies, prevalence of non-nutritive sucking declined with age, although a majority maintained a habit at 2 years of age in this study, and nearly 30% of respondents had a prolonged habit at 36 months of age, while over 20% had a habit at 48 months. It should be noted that the relative prevalence of pacifier and digit habits changed with age, such that pacifier use was more prevalent at 6 weeks of age, and again at age 12 and 16 months, while digit sucking was more common at 3, 6 and 9 months. Among those with a prolonged habit at 36 and/or 48 months, digit sucking was predominant.

Table 4 presents a comparison of selected characteristics between those with a non-nutritive sucking habit (N=146, 23%) at 36 and/or 48 months, and those who stopped such habits prior to 36 months (N=481, 77%) among 627 children remaining active in the study at 36 months of age or older. There were statistically significant ($P<0.05$) differences between the two groups in terms of whether the child had ever attended a daycare, the mother's education level, and the father's age group. Breastfeeding and mother's age group also approached statistical significance ($P=0.058$ and $P=0.064$, respectively). There were no statistically significant differences between groups regarding child's sex, father's education level, or family income level. In addition, there was no difference between groups in terms of number of children in the family, with both groups having a mean of 1.9 children per family.

In order to consider several factors simultaneously and control for interactions between independent variables, logistic regression was performed to identify factors predictive of non-nutritive sucking habits reported at 36 and/or 48 months. The final model is presented in Table 5. Older maternal age, higher maternal education level, and the study child being the first child were significant predictors of non-nutritive sucking habits at these ages in the multivariate analyses. No statistically significant two-way interactions between independent variables were identified.

Table 4. Proportion of Children with Prolonged Non-Nutritive Sucking Habits (at 36 months or older) by Selected Demographic Characteristics

Factor	N	Proportion with Prolonged Sucking Habit (N)		P value
Child care attendance				0.044
No reported child care experience	266	18%	(48)	
Attended child care	361	27%	(98)	
Child's sex				0.455
Male	309	22%	(68)	
Female	318	25%	(78)	
Breast-fed (any)				0.058
No	177	18%	(32)	
Yes	449	25%	(113)	
Mother's age				0.064
< 20 years	19	16%	(3)	
20-24 years	99	15%	(15)	
25-29 years	198	21%	(41)	
30-34 years	189	28%	(52)	
≥ 35 years	122	29%	(35)	
Mother's education				0.008
High school or less	122	16%	(19)	
Some college	118	18%	(21)	
College graduate	387	27%	(106)	
Mother's first child				0.181
No	348	21%	(74)	
Yes	279	26%	(72)	
Father's age				0.016
< 20 years	39	10%	(4)	
20-24 years	44	23%	(10)	
25-29 years	172	17%	(29)	
30-34 years	201	26%	(53)	
≥ 35 years	171	29%	(50)	
Father's education				0.668
High school or less	199	21%	(42)	
Some college	88	25%	(22)	
College graduate	340	24%	(82)	
Annual family income at baseline				0.338
<\$20,000	115	20%	(23)	
\$20,000-\$39,999	214	22%	(46)	
≥\$40,000	298	26%	(77)	

Discussion

This study found that well over 90% of children engaged in a non-nutritive sucking behavior during the first two years of life, a slightly higher proportion than reported in other studies.^{2,7-14} This higher proportion may be due to the prospective nature of the present study resulting in a more accurate assessment of sucking behavior prevalence, one that is less affected by inaccurate recall than in previous, retrospective studies. The prospective study design may also explain our finding that the relative prevalence of pacifier and digit habits varied by age, which could not be assessed in most previous studies. In addition, the prospective study design allowed us to ask more detailed and specific questions, including whether the child sucked on a number of different objects. Consistent with other studies,^{8,9,12} we also found that over half of the children in our cohort continued to have a non-nutritive sucking habit at the age of 24 months, and that over 20% had a habit at 36 months or older.

Predictors of prolonged sucking habits were identified using multivariate analyses, and older maternal age, higher maternal education levels and being first-born children were significant predictors of a non-nutritive sucking habit at 36 and/or 48 months. It is unclear why older, well-educated, first-time mothers were more likely than others to have children with prolonged non-nutritive sucking habits, and detailed discussions of this issue are beyond the scope of this paper. However, issues such as the amount of time mothers work outside the home and their type of employment may be involved.

Identifying factors associated with prolonged sucking habits may help clinicians to target interventions and counseling regarding non-nutritive sucking habits. That is, clinicians may want to specifically include recommendations regarding discontinuing sucking habits to older, more educated parents of young children than they would normally. Implicit in such possible recommendations is that children visit the dentist during the first 1-2 years of life, so that parents can act on these recommendations before habits become prolonged and adversely affect the children's occlusion.

There were limitations in the study design, so that generalization of our findings to other populations should be done with caution. The cohort of children, although large, is not a random sample of any defined population, and because of continued participation is really a self-selected cohort. Mothers with higher levels of education and

Table 5. Results of Logistic Regression Analysis for Predictors of Prolonged Non-Nutritive Sucking Habits

Variable	Parameter Estimate (S.E.)	P value	Adjusted Odds Ratio
Mother's age (per year)	0.0544 (0.0203)	0.0074	1.056
Mother's education level	0.4640 (0.2226)	0.0371	1.590
First child	0.4727 (0.2093)	0.0239	1.604

income were more likely to remain active in the study (Tables 2 and 4), and may also have been more likely to respond to our questionnaires on a more consistent basis. In addition, although the prospective, ongoing data collection through mailed questionnaires is preferable to retrospective data collection methods, responses are self-reported and not directly validated.

Nevertheless, data such as these have not been reported previously, and since previous studies have implicated continued (beyond age 3 years) non-nutritive sucking habits in development of certain malocclusions such as anterior open bite or posterior crossbite,^{2,6} identifying those at risk for prolonged habits is important. While this paper reports descriptive information regarding non-nutritive sucking behavior patterns in preschool children, the cohort continues to be followed and the children will be examined and study models fabricated in order to relate the sucking behavior data to dental arch measurements and occlusal characteristics.

Conclusions

Based on the results of this ongoing study, it is concluded that: 1) Non-nutritive sucking behaviors are very common during infancy, and continue through the second year of life for a majority of children; 2) Over 20% of respondents had prolonged non-nutritive sucking habits at 36 and/or 48 months of age; 3) In multivariate analyses, these prolonged habits are associated with older maternal age, higher maternal education level and being a first-born child; 4) Identifying those at risk for developing prolonged non-nutritive sucking habits may help clinicians better target interventions so as to prevent the consequences of these habits.

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References

- Johnson ED, Larson BE: Thumb-sucking: literature review. *ASDC J Dent Child* 60:385-91, 1993.
- Adair SM, Milano M, Lorenzo I, Russell C: Effects of current and former pacifier use on the dentition of 24- to 59-month-old children. *Pediatr Dent* 17:437-44, 1995.
- Ogaard B, Larsson E, Lindsten R: The effect of sucking habits, cohort, sex, intercanine arch widths, and breast or bottle feeding on posterior crossbite in Norwegian and Swedish 3-year-old children. *Am J Orthod Dentofac Orthop* 106:161-66, 1994.
- Lindner A, Modeer T: Relation between sucking habits and dental characteristics in preschool children with unilateral cross-bite. *Scand J Dent Res* 97:278-83, 1989.
- Ravn JJ: Sucking habits and occlusion in 3-year-old children. *Scand J Dent Res* 84:204-209, 1976.
- Larsson E: Prevalence of crossbite among children with prolonged dummy- and finger-sucking habit. *Swed Dent J* 7:115-19, 1983.
- Ravn JJ: The prevalence of dummy and finger sucking habits in Copenhagen children until the age of 3 years. *Comm Dent Oral Epidemiol* 2:316-22, 1974.
- Svedmyr B: Dummy sucking. *Swed Dent J* 3:205-10, 1979.
- Modeer T, Odenrick L, Lindner A: Sucking habits and their relation to posterior cross-bite in 4-year-old children. *Scand J Dent Res* 90:323-28, 1982.
- Kohler L, Holst K: Malocclusion and sucking habits of four-year-old children. *Acta Paediat Scand* 62:373-79, 1973.
- Melsen B, Stensgaard K, Pedersen J.: Sucking habits and their influence on swallowing pattern and prevalence of malocclusion. *Eur J Orthodont* 1:271-80, 1979.
- Helle A, Haavikko K: Prevalence of earlier sucking habits revealed by anamnestic data and their consequences for occlusion at age 11. *Proc Finn Dent Soc* 70:191-96, 1974.
- Nanda RS, Khan I, Anand R. Effects of oral habits on the occlusion of preschool children. *J Dent Child* 39: 449-52, 1972.
- Farsi NMA, Salama FS: Sucking habits in Saudi children: prevalence, contributing factors and effects on the primary dentition. *Pediatr Dent* 19:28-33, 1997.
- Infante PF: An epidemiologic study of finger habits in preschool children, as related to malocclusion, socioeconomic status, race, sex, and size of community. *J Dent Child* 43:33-38, 1976.
- Kiritsy MC, Levy SM, Warren JJ, Guha-Chowdhury N, Heilman JR, Marshall T: Fluoride content of juices and juice drinks. *J Am Dent Assoc* 127:895-902, 1996.
- Van Winkle S, Levy SM, Kiritsy MC, Heilman JR, Wefel JS, Marshall T: Water and formula fluoride concentrations: significance for infants fed formula. *Pediatric Dent* 17:305-310, 1995.
- Levy SM, Kiritsy MC, Warren JJ: Sources of fluoride intake in children. *J Pub Health Dent* 55:39-52, 1995.
- Bergus GR, Levy BT, Levy SM, Slager SL, Kiritsy MC: Antibiotic use during the first 200 days of life. *Archives of Family Medicine* 5:523-26, 1996.
- Levy SM, Kiritsy MC, Slager SL, Warren JJ, Kohout FJ: Patterns of fluoride dentifrice use among infants. *Pediatr Dent* 19:50-55, 1997.
- Levy SM, Kiritsy MC, Slager SL, Warren JJ: Patterns of dietary fluoride supplement use during infancy. *J Pub Health Dent* 58:228-33, 1998.
- SAS User's Guide. Statistics, Version 6. Cary, NC: SAS Institute, Inc., 1995.