

Influence of nail biting and finger sucking habits on the oral carriage of *Enterobacteriaceae*

FIROZ G. KAMAL, REGINALD AJAY BERNARD

Abstract

Background: Oral habits like thumb sucking and nail biting are pernicious habits that act as an adaptive function in obtaining pleasure and subduing anxiety. These habits may also act as carriers of numerous microorganisms into the oral cavity, of which, *Enterobacteriaceae* members are transient pathogens, which might result in debilitating systemic conditions. **Aim:** To study the oral carriage of *Enterobacteriaceae* in children having habit of nail biting and thumb sucking. And to study the association of the organism with the individual's respective plaque indices. **Subjects and Methods:** Totally, 40 chronic nail biters, 40 chronic thumb suckers, and 20 controls (no habit) (8-15 years old) were enrolled in the study. Appropriate history and their plaque indices recorded. Sterile containers were used to collect the salivary samples and later cultured on Agar plates. Biochemical tests categorized the organisms into subspecies. **Statistical Analysis Used:** ANNOVA, Student's *t*-test. **Results:** Presence of a nail biting habit indicated a higher plaque index, which in turn showed a higher carriage of *Enterobacteria* spps, predominantly *Escherichia coli*. **Conclusions:** Oral surgical intervention in individuals with pernicious oral habits need to be counseled and educated on the possible complications, which might otherwise provide an environment that disseminates these microorganisms resulting in a broad range of local and systemic infections.

Keywords: Bacteremia, cellulitis, *Enterobacteriaceae*, extraction complications, nail biting, thumb sucking

Introduction

The mouth harbors a diverse, abundant, and complex microbial community, which tends to inhabit both the soft and hard tissues in the form of biofilms.^[1] However, a highly efficient innate host defense system constantly monitors the bacterial colonization and prevents bacterial invasion of the local tissues.^[2,3] Accumulating evidence suggests the impact of the dental diseases on the general health of the individual, warranting a harmonious relation of the microorganisms with that of the oral tissues, albeit any shift in this balanced ecology would unfold a series of events that might result in a disease status.

Habits such as thumb sucking and nail biting, are seen usually in children as an adaptive function of obtaining pleasure.^[4,5]

Department of Oral and Maxillofacial Pathology, Narayana Dental College and Hospital, Chinthareddypalem, Nellore, Andhra Pradesh, India

Correspondence: Dr. Firoz G. Kamal, Narayana Dental College and Hospital, Chinthareddypalem, Nellore Andhra Pradesh, India. E-mail: kamal641@gmail.com

These habits act as carriers of numerous microorganisms into the oral cavity, of which, *Enterobacteriaceae* members are transient pathogens, which might result in debilitating systemic conditions.^[6,7] We undertook the present study to find the prevalence of *Enterobacteriaceae* in children with both thumb sucking and nail biting habits and to correlate it with their respective plaque indices.

Subjects and Methods

The study population comprised of 100 subjects between the ages of 8-15 years and were grouped into three categories, nail biters group (NBG), thumb suckers group (TSG), and the controls group (CGs). Individuals consulting the Departments of Oral Medicine, Pedodontics and Orthodontics of the institute were selected for the study after an informed consent was obtained.

Details in relation to age, sex, oral hygiene practice, medical history, and data pertinent to their nail biting and thumb sucking habits and plaque index score recorded. The subjects were instructed to rinse their mouth with 10 ml of phosphate-buffered saline solution for 60 s^[8] and were asked to expectorate the rinse into a universal container. Individual samples were centrifugation at 17000 g (12500 rpm) for 10 min, following which the supernatant was discarded, and the deposit re-suspended in 1 ml of phosphate-buffered saline to obtain a concentrated rinse. The procedures followed were in accordance with the ethical standards on human experimentation.

One loop full of concentrated rinse was inoculated on to Mc Conkey's agar and blood agar culture media using standard

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streak plate method. Batches of culture plates were incubated at 37°C for 24 h, and the growth of *Enterobacteriaceae* observed as pink and white colored colonies.

The suspected colonies were subjected to Gram stain for the identification of Gram-negative bacteria. Once identified, the colonies were further subjected to biochemical reactions such as oxidase test, indole test, methyl red test, Voges-Proskauer test, and citrate utilization test for the subspecies identification.

Results

The mean plaque index was highest in NBG at 1.834 while in TSG 1.763 and in the CG 1.7. With a statistical difference between NBG and CGs [$P = 0.008$, Table 1].

Carriage rate of *Enterobacteria* in all the groups was analyzed using Pearson Chi-square test, and it was found that an increased carriage was seen among NBG when compared to the CG [$P = 0.009$, Table 2].

Four species of *Enterobacteria* were isolated, which included *Escherichia coli*, *Klebsiella*, *Proteus*, and *Enterobacter*. While the most commonly isolated organism in nail biting children was *E. coli*, the less commonly isolated organism was *Proteus*. In thumb-sucking children, *Klebsiella* was isolated the most while the less commonly isolated organism was *enterobacter*. On the other hand, only *Klebsiella* was isolated from the CG [Table 3].

Discussion

Members of *Enterobacteriaceae* are Gram-negative straight rods, aerobic and facultative anaerobic, oxidase negative and catalase-positive organisms, mainly distributed in soil, water, plants, animals, and intestinal canal of humans.^[9] These *Enterobacteria*, which are considered as pathogenic, are transient organisms of oral cavity and can gain entry through oral pernicious habits or due to poor hygiene maintenance, but do not cause any disease or any alteration of the oral microbial flora as such. The most notable species of *Enterobacteria* considered as pathogenic are *Enterobacter cloacae*, *Enterobacter aerogenes*, and *Enterobacter agglomerans*.^[10] These are the most common pathogens associated with hospital infections, representing 6% of all the nosocomial isolates and 10% of all pneumonia isolates.^[11,12]

Reports suggest that enteric organisms in the oral cavity are responsible for the post extraction cellulitis of the floor of the mouth and neck caused by *Salmonella choleraesuis*.^[13] In some cases, *Enterobacteria* like *E. aerogenes* and *E. coli* along with other Gram-negative organisms are the causative agents in osteomyelitis of the mandible.^[14]

Earlier studies have reported that these organisms can cause bacteremia in up to 5-10% among all the Gram-negative

Table 1: Mean plaque scores between two groups using t-test

Group	Mean	SD	P
Nail biting	1.83	0.20	0.008*
Control	1.70	0.29	

* $P=0.008$ significant. SD: Standard deviation

Table 2: Comparison of *Enterobacteriaceae* carriage rate between two groups using Pearson Chi-square test

Group	Organism		P
	Present	absent	
Nail biting	17	23	0.009*
Control	2	18	

* $P=0.009$ significant

Table 3: Species of *Enterobacteriaceae* isolated

Groups	Species	Number of patients	Percentage
Nail biting	<i>E. coli</i>	10	42%
	<i>Klebsiella</i>	4	
	<i>Enterobacter</i>	2	
	<i>Proteus</i>	1	
Thumb sucking	<i>Klebsiella</i>	5	30%
	<i>Proteus</i>	4	
	<i>E. coli</i>	2	
	<i>Enterobacter</i>	1	
Control	<i>Klebsiella</i>	2	10%

E. coli: *Escherichia coli*

infections in adults and up to 0.6% of all the Gram-negative infections in children.^[15]

Literature revealed that environmental organisms can be inoculated into the oral cavity through paranormal habits like nail biting resulting in transmission of infections to other parts of the body, by contaminated hands or environmental objects, which may be responsible for the cause of morbidity and mortality worldwide.^[16]

The study analyzed the prevalence of the *Enterobacteria* organism in the stated population group, and correlated it to the study and CGs and to the oral hygiene status and isolated the predominant type of species in the *Enterobacteria* group.

The plaque index of all the groups was recorded and the mean levels of plaque among the individual groups were studied using the Student's *t*-test which showed a higher mean index value in the TSG (1.763), than the CG (1.7). Further comparison of mean plaque indices between NBG and CG showed an index value of 1.834, which was not consistent with the study of Baydas *et al.* (2.083) but giving us a statistically significant result using *t*-test,

$P = 0.008$ [Table 1]. An ANOVA test was used to compare the Mean of all the three groups, which showed no statistically significant difference ($P = 0.113$). Saliva of the individuals was analyzed for isolation of the organism and it was found that an isolation of 42% was seen among NBG as against a 30% in TSG, with a 10% isolation in the CG. This was consistent with the studies done by Baydas *et al.* who stated that there was a higher carriage of *Enterobacteria* among NBG. A Pearson Chi-square test revealed a statistical significance ($P = 0.009$) in the prevalence of *Enterobacteria* between these two groups, NBG and CG [Table 2], indicating that this might be due to poor oral/general hygiene maintenance.

A similar study done by Reddy *et al.* showed an increased carriage rate of *Enterobacteria* among nails biters (65.6%), than the CG (8.2%).^[17]

In a study^[18] done on Caucasians for the prevalence of coliforms in the dental plaque, the isolation rate was 5% while Hägg *et al.*^[19] reported an 11.1% prevalence of coliform carriage in the individuals on fixed orthodontic therapy. In another study of 120 healthy individuals by Mobbs *et al.*,^[20] a 6.6% prevalence of *Enterobacteria* was seen, of which, students showed the highest prevalence. This was found to be consistent with our study wherein the CG showed a 10% isolation.

The carriage of *Enterobacteria*, when compared between TSG and CG showed a higher prevalence in TSG (12%) than the CG (10%), though not statistically significant.

A lower isolation rate was seen in our study when compared to Baydas *et al.*'s study despite using the same technique. This could be attributed to the environmental conditions and geographic distribution of the organism, age, ethnic variations, socio-economic status, and oral hygiene status of the individuals and resistance to a particular organism as stated by Sedgley and Samaranayake *et al.*^[9]

The data indicate that though there was no significance in between the overall mean plaque index, a significant difference between the NBG and the CG, in accordance with previous studies of Baydas *et al.*, suggesting that there could indeed be a correlation between the nail-biting habit, plaque index, and the oral carriage of the organism.

The *Enterobacteria* species isolated in our study were *E. coli*, *Klebsiella*, *Proteus*, and *Enterobacter*. Of these, the most commonly isolated *Enterobacteria* among all three groups was *E. coli* (in 12 subjects), whereas the least isolated *Enterobacteria* was enterobacter (3 subjects) as shown in Table 3. Our results are consistent with the results of Baydas *et al.* and Sushma *et al.*¹⁶ who showed a greater isolation of *E. coli*. Other organisms such as streptococci, staphylococci, pseudomonas, and candida were also seen along with *Enterobacteria*.

This indicates the greater prevalence of *E. coli* in humans among different population groups. Studies by earlier authors reported that *E. coli* was the most frequently isolated organism among *Enterobacteriaceae* family in different systemic illnesses. With these data, it can be suggested that *E. coli* gets a channel of entry into the oral cavity through the chronic nail biting and thumb sucking habits and can be a perpetrator of local and systemic infections.

Earlier studies have shown that surgical manipulation of the oral cavity in these individuals could lead to localized disease like gingivitis and systemic infections like bacteremia and infective endocarditis.^[7]

Conclusions

This study would like to emphasize the need of caution while surgically managing children, with nail biting and thumb sucking habits, to prevent the dissemination of environmental microorganisms into the oral cavity thereby preventing local and systemic complications.

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