



Presence of *Enterobacteriaceae* and its association with mental health among school going nail-biting students: A comparative study

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Abstract

Background: Onychophagia, commonly known as nail biting, is considered a compulsive behavioral disorder primarily observed in children and adolescents. Nail biting behavior leads to an increased presence of various opportunistic microorganisms in the oral cavity. This study aimed to investigate the association between nail biting and mental health in children aged 10 to 16 years. It further compares the load of *Enterobacteriaceae* in nail-biters and non-nail biters.

Methods: A case control study was conducted on 50 nail biters (cases) and 50 non-nail biters (controls). Data were collected by using convenient sampling technique from school going students aged 10 to 16 years, using pre-designed and self-administered questionnaires, the Massachusetts General Hospital-Nail Biting Questionnaire (MGH-NBQ) and the Strengths and Difficulties Questionnaire (SDQ) as well as saliva samples taken and tested for bacterial growth. All ethical issues were taken into consideration. SPSS v23 was used to analyze the data using descriptive statistics to calculate the mean and standard deviation. The independent *t* test was used to compare mean SDQ scores between nail biters and non-nail biters. *P*-values < 0.05 were considered statistically significant.

Results: Among the 50 cases, 44 (88.0%) of the students had positive *Enterobacteriaceae* growth, while 13 (26.0%) of the controls did not. Nail biters had considerably higher mean scores for emotional symptoms, conduct problems, hyperactivity, and peer problems than non-nail biters (*P* value < 0.001). All of the SDQ domains and nail biting were found to have a statistically significant (*P* = 0.05) association.

Conclusion: The study highlights the persistent and burdensome nature of nail biting, which poses risks in terms of disease transmission. Additionally, nail biting has been associated with various behavioural and emotional disorders. Awareness of the harmful consequences of nail biting, along with appropriate preventive and treatment approaches, can assist young individuals in discontinuing this habit.

Keywords: Nail biting, Children, *Enterobacteriaceae*, Mental health

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Introduction

Nail biting, also known as onychophagia, is thought to be a compulsive behavioural disorder most commonly encountered in children and adolescents.¹ Nail biters bite all of their finger nails evenly and without preference.² This practice is generally seen as innocuous, and it declines with age.³

Numerous factors are thought to play a significant part in the development of onychophagia, with genetic and psychological aspects being the most relevant. Stress, frustration, boredom, transference from other habits such as thumb sucking, and badly manicured nails are also known contributors.⁴ When this habit of nail

biting becomes chronic and has an impact on a person's wellbeing, it is classified as an impulsive disorder, which is defined as a mental disorder characterised by intense need to gratify one's immediate desires and failure to resist the impulse or temptation, according to International Classification of Disease 10th revision (ICD-10).⁵

Chronic nail biting causes a variety of issues, including nail bed distortion, fungal infections, oral infections, poor dental hygiene, notched teeth, swollen and inflamed gingivae and gut infections.^{6,7} Osteomyelitis of the digit as a result of persistent onychophagia has also been documented.⁸ According to the literature review a few studies have been published; the global prevalence of nail



biting ranges 20% to 30% of the general population.^{9,10} Nail biting is more common among youngsters, with a study reporting a 37% prevalence among individuals aged 3 to 21 years.¹¹ A recent study in Pakistan found that 39.2% of the children aged 4 to 10 years bit their nails.¹² This study further found that the mental problems are commonly present among children who bite their nail.¹² The oral cavity is thought to be a breeding ground for a wide range of bacteria.¹³ A study from India reported that *E.coli* was the most common *Enterobacteriaceae* found in chronic nail biting subjects.¹⁴ Biting nails increases the possibility of other hazardous microorganisms entering the oral cavity. One such microorganism is *Enterobacteriaceae*, a group of anaerobic gram negative bacteria that can be pathogenic and cause a variety of disorders and diseases.^{14,15}

Therefore, the present study examines the association between nail biting and mental health in children aged 10 to 16 years. It also compared the *Enterobacteriaceae* load between individuals who bite their nails and those who do not.

Methods

This is a case-control study, which took place at Hamdard College of Medicine and Dentistry, in Karachi on two groups of nail biters and non-nail biters of either sex ranging in age from 10 to 16 years. Data were obtained from Hamdard Public School pupils in grades 4 to 10 after approval from the Institutional Ethics Review Committee (HCM&D/CHS/191/2019). Students who had a propensity for chewing their nails for at least one year were chosen as cases. The controls were chosen among those of the same grade level who did not bite their nails. Students who were unavailable or unwilling to participate during the day of data collection were excluded from providing their responses. Prior to administering the questionnaire, a briefing was provided to explain the study's purpose and various aspects, and parental consent forms were obtained.

Following approval from the school administration and the guardians, data were collected using the Massachusetts General Hospital-Nail Biting Questionnaire (MGH-NBQ) and Strengths and Difficulties Questionnaire (SDQ), two predesigned and self-administered questionnaires based on previous research.^{12,16} Samples of saliva were also taken and examined for bacterial growth.

The MGH-NBQ is a 7-item self-report instrument that measures the frequency, intensity, and control of nail-biting urges, the frequency, resistance, and control of nail-biting behaviours and the distress associated with nail biting. The items are graded on a 5-point Likert scale with scores ranging from 0 to 4, with higher scores indicating more severe symptoms. Total scores are determined by adding the responses of all seven items.

SDQ is a valid and reliable tool that can be utilised in

research. It has 25 attributes divided into five medical scales: hyperactivity, peer relationship problems, conduct problems, emotional symptoms, and prosocial behaviour. Each clinical scale has five items. The response range is between 0 and 2. "Not true" is represented by zero while "partially true" and "certainly true" is represented by 1 and 2, respectively. Except for prosocial behaviour, all positive items are reverse coded. Each clinical scale has a score ranging from 0 and 10. The total difficulty score is calculated by adding the scores from each of the five scales. Hence, the final score could range between 0 and 40. As a result, the prosocial scale was omitted in order to reach a total score. The SDQ was initially published in English and later translated into more than 40 languages, including Urdu, which is the national language of Pakistan. For improved comprehension, the Urdu-translated validated version of SDQ was used.¹⁷ Students' saliva samples were collected under aseptic conditions using sterilised swabs and inoculated onto MacConkey's agar. To prevent any undesired spores from contaminating the agar, the spirit lamp was kept close by, and the room's fans were turned off. The petri dishes were immediately transported to the microbiology lab for culture growth and *E. coli* detection.

SPSS version 23 was used to analyse the data. Descriptive statistics was used to calculate mean and standard deviation of overall MGH-NBQ and SDQ scores and their subscales. The internal consistency coefficient (Cronbach's alpha) was calculated to test the reliability of MGH-NBQ. The growth of *Enterobacteriaceae* was observed in both nail biters and non-nail biters, whether the students were male or female. The independent *t* test was used to compare the differences of mean SDQ scores of nail biters and non-nail biters. *P* values < 0.05 were considered significant.

Results

A total of 100 students completed the MGH-NBQ and SDQ with an equal number of male and female nail biters and non-nail biters. The student's mean age was 13 ± 1.72 years.

The results showed that participants had a moderate overall score of 13.58 ± 7.37 for nail biting behaviour. They experienced urges to bite their nails with a frequency of 1.86 ± 1.44 and intensity of 1.60 ± 1.37 . Their ability to control these urges was rated at 1.86 ± 1.55 . The frequency of nail-biting incidents was 1.68 ± 1.22 . The participants made attempts to resist nail biting at a mean score of 2.08 ± 1.6 , with a perceived control over nail biting behaviour at 2.06 ± 1.21 . They reported a distress level of 2.44 ± 1.61 . The MGH-NBQ demonstrated high internal consistency (alpha coefficient of 0.87) (Table 1). The item-remainder coefficients were calculated to determine the correlation for each item. The frequency of urges exhibited the highest coefficient of 1.000, indicating a strong correlation. On the other hand, distress had a

Table 1. Descriptive statistics and internal consistency

MGH-NBQ	Mean \pm SD	Item-remainder correlation	α without item	Cronbach's alpha (α)
Overall score	13.58 \pm 7.37			
Frequency-urges	1.86 \pm 1.44	1.000	0.838	0.87
Intensity-urges	1.60 \pm 1.37	0.704	0.839	
Control-urges	1.86 \pm 1.55	0.565	0.853	
Frequency-biting	1.68 \pm 1.22	0.774	0.824	
Resistance-biting	2.08 \pm 1.6	0.647	0.850	
Control-biting	2.06 \pm 1.21	0.481	0.855	
Distress	2.44 \pm 1.61	0.219	0.895	

MGH-NBQ, massachusetts general hospital nail biting questionnaire.

coefficient of 0.219, suggesting a weaker correlation. However, removing individual items did not lead to a significant improvement in internal consistency, failing to reach satisfactory levels.

Out of the total nail biters, 44 (88.0%) had positive *Enterobacteriaceae* growth while 13 (26.0%) non-nail biters showed positive growth (see Figure 1). The growth of *Enterobacteriaceae* was also observed in 30 (60.0%) of the male students and 27 (54.0%) of the female students (see Figure 2).

Table 2 shows the mean scores of various SDQ domains for individuals with and without nail biting. Nail biters exhibited significantly higher mean scores in emotional symptoms, conduct problems, hyperactivity, and peer problems compared to non-nail biters. A statistically significant association was observed between nail biting and all domains of the SDQ ($P < 0.01$).

The mean scores of different SDQ domains with nail biting and without nail biting are shown in Table 2. The mean scores for emotional symptoms, conduct problem, hyperactivity and peer problem were significantly higher in nail biters than in non-nail biting. A statistically significant association was observed between all the domains of SDQ and nail biting.

Discussion

The composition of the oral microflora, which naturally develops during childhood, undergoes modifications throughout different life stages due to a range of environmental and behavioural factors. This naturally acquired microflora plays a crucial role in the normal development of the host's physiology and helps protect against invading microorganisms by preventing their colonization. Persistent nail biting can lead to self-infection, where pathogens from the nails can be transferred to other parts of the body especially intestines, causing an infection.

In the present study, a significantly higher presence of *Enterobacteriaceae* was observed among males ($n = 30$, 60.0%) and nail biters ($n = 44$, 88.0%) than in females ($n = 27$, 54.0%) and in the control group (non-nail biters,

Table 2. Mean score of SDQ among nail biting and non-nail biting students

Scale	Nail biting	Mean \pm standard deviation	P value	95% Confidence interval for mean	
				Lower bound	Upper bound
Emotional symptoms	Yes	6.50 \pm 2.21	< 0.001	2.01	3.74
	No	3.62 \pm 2.15			
Conduct problems	Yes	5.06 \pm 2.12	< 0.001	0.65	2.26
	No	3.60 \pm 1.90			
Hyperactivity	Yes	6.80 \pm 2.09	< 0.001	1.54	3.01
	No	4.52 \pm 1.59			
Peer problems	Yes	5.90 \pm 2.09	0.002	0.47	1.92
	No	4.70 \pm 1.52			
Prosocial scale	Yes	7.24 \pm 2.06	0.012	0.210	1.67
	No	8.18 \pm 1.57			
Total score	Yes	24.2 \pm 6.04	< 0.001	5.64	9.99
	No	16.4 \pm 4.84			

$n = 13$, 26.0%). Similar findings have been documented in previous studies.^{1,5,10,14} Nail biting poses a risk of introducing virulent organisms into the oral cavity, especially in children with inadequate toilet hygiene practices, making individuals more susceptible to not only *Enterobacteriaceae*-related infections, but other infections caused by infectious agents, including viruses, and parasites. A study done in Australia reported higher rates of cold and flu among nail biters than the national average rate of Australians who had the cold and flu. The study further reported the existence of parasites/worms among nail biters.¹⁸

The chosen age range for the present study was between 10 to 16 years with mean age of 13.3 \pm 1.7 years with an equal distribution of males and females. A recent Indian study found comparable age range with mean age of 12.8 years.¹ Other studies reported similar age groups along with gender ratio equality.^{10,14,19} However, a lower mean age of 9.4 \pm 3.3 was reported among Iranian nail biters.²⁰ In the our study it was found that the nail biting habit was more among boys than girls which is in accordance with other Indian studies.^{14,21} This is contrary to Ghanizadeh and Shekoochi who found that nail biting habit was more among girls.²⁰

The present study reported the highest mean score in distress (2.44 \pm 1.6), followed by attempt to resist nail biting (2.08 \pm 1.6), and control over nail biting (2.06 \pm 1.2), with an overall mean score of 13.5 \pm 7.3 obtained from a questionnaire (MGH-NBQ) evaluating nail biting habits. Previous studies discovered similar nail-biting behaviours.^{16,22,23} Furthermore, according to the findings of this study, the SDQ domains of emotional problems, conduct problems, hyperactivity, and peer problems were more common among nail biters than non-nail biters. The study also found a lower prosocial behaviour score, indicating a better ability to identify social relationships.

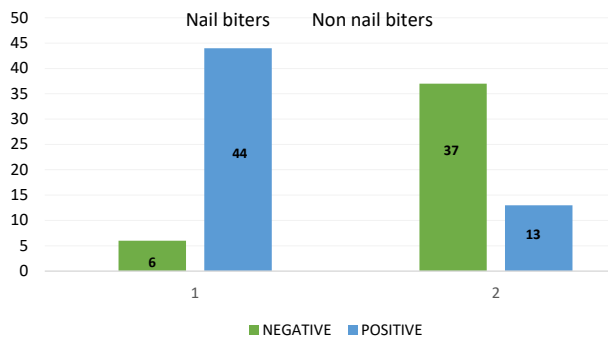


Figure 1. *Enterobacteriaceae* growth in nail biters and non-nail biters

Similar to this study, discovered that prosocial behaviour was significantly weak.²⁰ Other studies have linked aggression to the nail biting.^{3,11,24} These and other studies have found that children who bite their nails are stressed, lonely, and lack affection, and that this behaviour may be indicative of underlying psychopathology.¹⁸ Nonetheless, the link between mental health issues and nail biting has remained controversial.²⁵

Strengths and Limitations

This research focuses on a specific and potentially significant correlation between the presence of *Enterobacteriaceae* and mental health among school-going nail-biting students. The limitations of this study include the small sample size, and that the investigation only included school-aged children. More interventional research, and increased awareness of the negative effects of nail biting are needed among parents and teachers as they are better able to provide support and encouragement.

Conclusion

Nail biting is still an undesirable habit that can contribute to disease transmission. The study highlights the prevalence of *Enterobacteriaceae* is significantly higher among nail biters. Nail biting has also been linked to a number of behavioural and emotional disorders. Knowledge of the detrimental effects of nail biting, as well as appropriate preventive and treatment strategies, can assist young people in giving up.

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Authors' Contribution

Conceptualization: Naveed Mansoori, Shaheer Zafar.

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Methodology: Naveed Mansoori, Shaheer Zafar, Muhammad Abdul Ahad, Sana Javed, Syed Muhammad Mubeen.

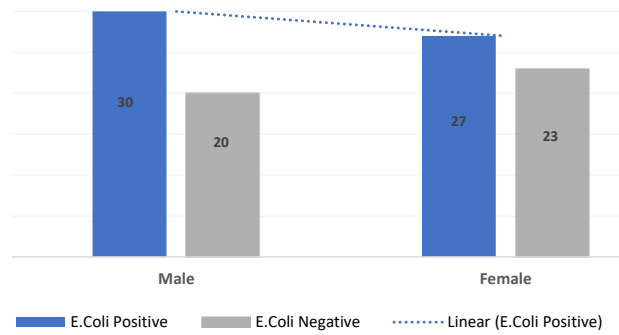


Figure 2. *Enterobacteriaceae* growth among male and female students

Project administration: Naveed Mansoori.

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Writing—original draft: Naveed Mansoori.

Writing—review & editing: Syed Muhammad Mubeen, Shaheer Zafar, Muhammad Abdul Ahad, Sana Javed.

Competing Interests

The authors have declared that no conflict of interest exists.

Data Availability Statement

The datasets for the current study are available from the corresponding author upon reasonable request.

Ethical Approval

The study was approved by the Institutional Ethics Review Committee of Hamdard College of Medicine & Dentistry (HCM&D/CHS/191/2019).

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