Journal of Teachers Association
https://tajrmc.com/taj
Vol. 38, No. 1, 2025

pISSN 1019-8555
eISSN 2408-8854

RESEARCH ARTICLE | OPEN ACCESS **DOI:** https://doi.org/10.70818/taj.v38i01.0250

Evaluation of Bacterial Contamination of Used Toothbrushes in Smokers' Washroom and Non-Washroom Environments

Shaheen Ahamed*[1], AFM Shakilur Rahman[1], Khandker Md Faisal Alam[2], SM Shahinul Islam[3]

1 Department of Oral and Maxillofacial Surgery, Rajshahi Medical College, Rajshahi
2 Department of Microbiology, Rajshahi Medical College, Rajshahi
3 Plant Biotechnology & Genetic Engineering Lab, Institute of Biological Sciences, Rajshahi University, Rajshahi

Citation:
Shaheen Ahamed, Rahman AS, Alam KMF, Islam SS; Evaluation of Bacterial Contamination of Used Toothbrushes in Smokers' Washroom and Non-Washroom Environments. Journal of Teachers Association. 2025;38(1):25-31.

Article History:
Received: 11.01.2025
Accepted: 16.02.2025
Published: 31.03.2025

***Correspondence to:**
Dr. Shaheen Ahamed

ABSTRACT: ***Background:*** The toothbrush, a vital tool for oral hygiene, is often overlooked regarding its cleanliness. Smoking, a known risk factor for oral diseases, alters oral microbiota. This study investigates microbial contamination of toothbrushes in different storage conditions and its association with smoking. By analyzing contamination in toothbrushes used by adult male smokers and non-smokers, we aim to highlight this neglected aspect of oral hygiene. ***Methods:*** Sixty used toothbrushes from healthy smokers and non-smokers were analyzed. Participants stored toothbrushes either inside (washroom) or outside (non-washroom) the bathroom. The study was conducted at Rajshahi Medical College, Bangladesh (2019–2022). Samples were randomly selected, placed in sterile containers with brain heart agar, and incubated at 37ºC for 24 hours. Further analysis was conducted using blood agar and McConkey's agar. Data was analyzed using SPSS. ***Results:*** Staphylococcus aureus was the primary contaminant in all groups. A significant correlation was found between non-smokers storing toothbrushes outside the washroom and smokers keeping them inside, as indicated by Pearson's correlation test (P = 0.050). ***Conclusion:*** Toothbrushes of both smokers and non-smokers showed significant microbial contamination, irrespective of storage conditions, increasing the risk of dental diseases. Proper toothbrush hygiene is essential to minimize contamination.

Keywords: Microbiota, Non-washroom, Non-smokers, Smokers, Washroom.

Article at a glance:
Study Purpose*: To assess bacterial contamination on toothbrushes in washroom and non-washroom environments among smokers and non-smokers.*
Key findings: *Staphylococcus aureus was the main contaminant, with significant microbial contamination in both groups, increasing detal disease risk.*
Newer findings: *Non-smokers' toothbrushes outside washrooms and smokers' inside showed significant contamination, with E. coli and Pseudomonas more common in washroom-stored brushes.*
Abbreviations: *WR: Washroom, NWR: Non-washroom.*

INTRODUCTION

The toothbrush is the most widely utilized tool for regular mouthwash use in both developed and developing nations, and it is essential for maintaining good oral hygiene. The toothbrush is the primary and most effective instrument for eliminating oral biofilm and soft debris from the mouth, particularly from the surface of the teeth and tongue.[1] Since toothbrushes act as a reservoir for the bacterium in both healthy and affected individuals, they may have an impact on the spread of disease and raise the risk of infection2. A diverse population of microorganisms coexists in the mouth and is transferred to a toothbrush when brushing.[3] A toothbrush is an essential tool for maintaining good oral hygiene and efficiently removing plaque from teeth.[4, 5] A range of characteristics on toothbrushes that have a long microbial survival period of two days

to at least one week.[6,7] This is caused by a variety of factors, such as improper handling and storage, using a toothbrush without first decontaminating it, and using an old toothbrush increase the risk of latent pathogen cross-infections in the oral cavity, particularly in young children and the elderly.[8] A toothbrush is the most common oral hygiene tool for maintaining good oral health and preventing dental diseases.[9] Sadly, toothbrush maintenance is frequently neglected, and most of the time, they are stored in the washroom (Bathroom), which is known to be a breeding ground for bacteria, especially enteric bacteria.[10,11] According to specific research, using toothbrushes for extended periods can infect them with bacteria, lactobacilli, and streptococcus, among other microorganisms.[12] For bacteria to survive, the surrounding areas of toothbrushes must have appropriate temperature conditions.[13] Toothbrushes stored in air conditions contained fewer bacteria than those at room temperature. The moist and protected environment with limited airflow had 70% more bacterial growth.[14] The wet and moist atmosphere in bathrooms where toothbrushes are kept may promote bacterial growth and, consequently, cross-contamination, particularly via aerosols created in the water passing through toilets and hygienic drainage systems with enteric types and Pseudomonas.[15] Despite a comprehensive literature search, a study that provides scientific and statistical evidence of used toothbrush microbial contamination among smokers and non-smokers in toothbrush-stored environments has yet to be released. To better inform the public about the importance of good oral hygiene over proper toothbrush care, this study set out to isolate, characterize, and identify the bacterial contaminants on used manual toothbrushes obtained from various smokers and non-smokers stored in washrooms and other environments.

METHODS

This study was conducted at the Dental Unit, Rajshahi Medical College, Rajshahi, Bangladesh, from 2019 to 2022. Data was gathered using simple random samplings from smokers and non-smokers, washroom and non-washroom environments, and individuals from various socioeconomic status (SES) groups in Rajshahi. Verbally informed consent was obtained from all participants who were healthy and free from systemic diseases or medication. The sample size was determined using software, with a 95% confidence interval (CI), a 5% margin of error, and a response distribution of 50%. 60 toothbrushes from both smoker and non-smoker men were randomly collected and stored in sterilization pouches to prevent contamination. The sample size was then divided into 15 washroom environments (WR) and 15 non-washroom environments (NWR) in 30 smokers and, 15 washroom environments (WR) and 15 non-washroom environments (NWR) in 30 non-smokers (Table 1).

Table 1: Statistics of Toothbrush Contamination in Smokers and Non-Smokers

Category	Smokers	Non-Smokers	Total
Washroom (WR) Toothbrush Contamination	15	15	30
Non-Washroom (NWR) Toothbrush Contamination	15	15	30
Overall Total	30	30	60

The male participants in this study had to meet specific inclusion criteria, including being between 18 and 70 years old, having smoked cigarettes for at least six months, and smoking a minimum of two cigarettes per day. Additionally, their toothbrushes had to be at least two months old. On the other hand, individuals with other tobacco addictions and those who did not consent to participate were excluded from the study. All participants' toothbrush heads, regardless of their smoking habits, were removed using sterilized gloves and forceps. These brush heads were placed in a sterile container with brain heart agar and incubated at 37 ºC for 24 hours. After incubation, the brush heads were transferred to different bases for further cultivation and comparison of bacterial colonies. The bacterial species were identified based on various characteristics, including colonial and biochemical features. A series of tests were conducted to differentiate the species, following the Chesebrough scheme. The data collected were then analyzed using SPSS software, with a P-value of 0.050 or less considered statistically significant.

RESULTS

Streptococcus mutants (85.5%, n=51) were the culprit and major organisms causing contamination in all groups, followed by Escherichia coli and Pseudomonas, comprising 66.6% (n=40). (Table 2)

Table 2: Bacterial Contamination in Used Toothbrush

Organism Type	WR n (%)	NWR n (%)	Total n (%)
Staphylococcus Aureus	17(56.6)	17(56.6)	34(56.6)
Streptococcus Mutans	25(83.0)	26(86.6)	51(85.5)
Lactobacilli	11(73.3)	12(40.0)	23(38.3)
Escherichia Coli	26(86.6)	14(46.6)	40(66.6)
Klebsiella	12(40.0)	13(43.3)	25(41.6)
Pseudomonas	24 (80.0)	16(53.3)	40 (66.6)

A toothbrush kept in a washroom environment (WR) was more contaminated with Escherichia coli (86.6%, n=26) and Pseudomonas (80.0%, n=24), respectively. (Table 3). In non-washroom environments (NWR), toothbrushes in smokers and non-smokers were more contaminated with streptococcus mutans (86.6%, n=13) (Table 4).

Table 3: WR Toothbrush Contamination in Smokers and Non-Smokers

Organism Type	Smokers n (%)	Non-Smokers n (%)	Total n (%)
Staphylococcus Aureus	9 (60.0)	8 (53.3)	17 (56.6)
Streptococcus Mutans	13 (86.7)	12 (80.0)	25 (83.0)
Lactobacilli	5 (33.3)	6 (40.0)	11 (73.3)
Escherichia Coli	14 (93.3)	12 (80.0)	26 (86.6)
Klebsiella	7 (46.6)	5 (33.3)	12 (40.0)
Pseudomonas	13 (86.7)	11 (73.3)	24 (80.0)

Table 4: NWR Toothbrush Contamination in Smokers and Non-Smokers

Organism Type	Smokers n (%)	Non-Smokers n (%)	Total n (%)
Staphylococcus Aureus	8(53.3)	9(60.0)	17(56.6)
Streptococcus Mutans	13(86.7)	13(86.7)	26(86.6)
Lactobacilli	7(46.6)	5 (33.3)	12(40.0)
Escherichia Coli	8 (53.3)	6 (40.0)	14(46.6)
Klebsiella	7(46.6)	6 (40.0)	13(43.3)
Pseudomonas	7(46.6)	9(60.0)	16(53.3)

Staphylococcus mutans and Escherichia coli constituted the highest percentage of organisms in WR toothbrush contamination in smokers (Table 5). Streptococcus mutans and Pseudomonas constituted the highest number of NWR toothbrush contamination in non-smokers (Table 6).

Table 5: Smokers' Toothbrush Contamination in WR And NWR Environment

Organism Type	WR n (%)	NWR n (%)	Total n (%)
Staphylococcus Aureus	9 (60.0)	8 (53.3)	17 (56.6)
Streptococcus Mutans	13 (86.7)	13 (86.7)	26 (86.6)
Lactobacilli	5(33.3)	7 (46.6)	12 (40.0)
Escherichia Coli	14 (93.3)	8 (53.3)	22(73.3)
Klebsiella	7 (46.6)	7 (46.6)	14 (46.6)
Pseudomonas	13 (86.7)	7 (46.6)	20(66.6)

Table 6: Non-Smokers' Toothbrush Contamination in WR and NWR Environment

Organism Type	WR n (%)	NWR n (%)	Total n (%)
Staphylococcus Aureus	8 (53.3)	9 (60.0)	17 (56.6)
Streptococcus Mutans	12 (80.0)	13 (86.7)	25(83.3)
Lactobacilli	6 (40.0)	5 (33.3)	11(36.6)
Escherichia Coli	12 (80.0)	6 (40.0)	18(60.0)
Klebsiella	5 (33.3)	6 (40.0)	11 (36.6)
Pseudomonas	11 (73.3)	9 (60.0)	20 (66.6)

Pearson's correlation test showed a correlation of P-value between smoking and toothbrushes. In smokers, a WR toothbrush was statistically significant because the P-value was 0.050, but an NWR toothbrush was statistically insignificant because the P-value was 0.961 (Table 7). In non-smokers, a WR toothbrush was statistically insignificant because the P-value was 0.961, but an NWR toothbrush was statistically significant because the P-value was 0.050 (Table 7). It shows that microbial contamination of toothbrushes was significant even if the patient did not smoke but used a WR toothbrush. Similarly, smoking significantly affected microbial contamination even if the toothbrush was kept in an NWR environment.

Table 7: Pearson's Correlations Show P-Value Among Smokers and Non-Smokers' Toothbrushes

Category	p-value	
	WR Toothbrushes	NWR Toothbrushes
Smokers	0.050	0.961
Non-Smokers	0.961	0.050

DISCUSSION

Approximately 700 bacterial species (400 of which are found in periodontal pockets) are concentrated in the oral cavity.[16] Staphylococcus sp. is the most common colonizer of this area. Toothbrush contamination develops with repeated use and happens soon after the first use in healthy individuals. In the current investigation, the microorganisms isolated included both oral and general pathogens. The source of general pathogens may be toothbrushes packed too soon or attached bathrooms with combined toilets that expose them to the outside world. Since staphylococcus species are a significant mediator for bacterial transfer, as evidenced by their incidence on the examined toothbrushes, greater attention should be given to this issue as it leads to infection and a variety of oral diseases. Most frequently, toothbrushes used by smokers and non-smokers (washroom and non-washroom) contained Staphylococcus aureus. On the used toothbrushes analyzed, staphylococcus and Klebsiella were most common in smokers (WR), whereas Bacteroides and epidermidis were less common. In washroom toothbrushes, streptococcus mutans had the highest percentage of 85.5% (n = 51), while Lactobacilli (138.3%) had a rock-bottom percentage occurrence on the used toothbrushes examined. In our study, Washroom toothbrushes showed more contamination, whereas a recent study by Mansoori *et al.* reported that washroom-stored toothbrushes would increase bacterial growth on a toothbrush.[17] The presence of E. Coli on the toothbrushes examined revealed fecal contamination. The used brushes are stowed in germ-infested environments like washbasin in the bathroom.[18] in non-smokers' toothbrushes (Washroom), in the used toothbrushes examined, the highest percentages were found in Streptococcus mutans and Staphylococcus epidermidis, while the lowest percentages were found in Bacteroides and Candida[19]. Staphylococci were among the most common microorganisms on many toothbrushes in a study conducted in; however, this finding was like the current study.[20] Conversely, in the research conducted by Saini and Kulkarni, Thamke *et al.*, Talaat in collaboration.[21, 22] Additionally, Karibasappa *et al.* The predominant common bacteria on the used toothbrushes were discovered to be streptococcus mutans.[23] The same contamination was found in our study's uncapped toothbrushes used by non-smokers and capped toothbrushes used by smokers.

Various diseases are caused by different microorganisms that were isolated during this study. People get cavities because of Streptococcus mutans; they also get candidiasis from Candida; burns, otitis, eye infections, urinary tract infections, and pneumonia from Klebsiella; glomerulonephritis (GN), infectious disease, and tract infections from Streptococcus pyogenes; and boils, carbuncles, pustules, abscesses, osteomyelitis, endocarditis, and septicemia from Staphylococcus mutans. Compared to the general population, regular tooth brushing seemed to be less common among older people.[18] Men [n = 47, (51.6%)] and those who brush twice a day [n = 58, (63.7%)] are found to have more contaminated toothbrushes. According to the study, using the same toothbrush for three months or longer is associated with higher contamination levels (47.3%); the findings are like those of another study conducted in India by D'Silva et al.[24-39] The study's limitations included its small sample size and exclusive focus on men. To ensure that the findings are more representative of the population, it is advised that more research be conducted on both genders using sizable sample sizes. All ages should be prohibited from smoking; more research with a sizable sample size that includes the female gender is required. It is best to keep the bath area and the flush area apart. It is best to keep toothbrushes capped. During a hospital stay, toothbrush disinfection should be advised for young patients, the elderly, high-risk patients, and weak populations. Social media and awareness campaigns should be expanded to raise public awareness of the importance of maintaining toothbrush hygiene. Because there is a higher risk of contamination in restrooms with or without toilets, toothbrushes should ideally be stored in anti-microbial solutions to prevent contamination. Compared to a toothbrush used for just one month, those used for three months have significant contamination. As a result, the toothbrush needs to be replaced every three to four weeks. The toothbrush needs to be stored separately and upright to prevent nosocomial infections. Every dentist informs their patients of the value of cleaning their toothbrushes. Toothbrush caps ought to be required to prevent contamination. Similar research is needed to determine how viruses spread via toothbrushes and how to disinfect them.

CONCLUSION

The risk of dental diseases is increased by the high level of microbial contamination found in adult smokers and non-smokers with capped and uncapped toothbrushes.

Acknowledgements

All the patients who participated in the study was acknowledged for their contribution in data collection. The staffs of the Department of Microbiology were also acknowledged.

Authors' Contributions

S A: Conceptualized the study, designed the methodology, analysis, and interpretation of results, writing manuscript and supervised the research process. S A and A F M S R contributed to data collection and statistical analysis. K M F A: Provided expertise and guidance in microbiological analysis and laboratory procedures. S M S I: Supervised the research process and manuscript preparation. All authors reviewed and approved the final manuscript for submission.

Funding: The authors received no financial support for the research, authorship and/or publication of this article.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval

Ethical approval of the study was obtained from the Ethical Review Committee, Rajshahi Medical College, Rajshahi and informed consent was taken from all participants. Methodology of the study was carried out following the relevant ethical guidelines and regulations.

Consent for Publication: Taken.

REFERENCES

1. Nelson-Filho P, Isper AR, Assed S, Faria G, Ito IY. Effect of triclosan dentifrice on toothbrush contamination. Pediatr Dent. 2004;26(1):11-6.
2. Downes J, Hooper SJ, Wilson MJ, Wade WG. Prevotella histicola sp. nov., isolated from the human oral cavity. Int J Syst Evol Microbiol. 2008;58(8):1788-91.
3. Mehta A, Sequeira PS, Bhat G. Bacterial contamination and decontamination of toothbrushes after use. N Y State Dent J. 2007;73(3):20-2.
4. Obika I, Onuorah S. Bacterial contamination of used manual toothbrushes obtained from some

students of Nnamdi Azikiwe. Univ J Microbiol Res. 2015;3(4):56-9.
5. Peker I, Akarslan Z, Basman A, Haciosmanoglu N. Knowledge and behavior of dentists in a dental school regarding toothbrush disinfection. Braz Oral Res. 2015;29:48.
6. Cobb CM. The toothbrush as a cause of repeated infections of the mouth. Boston Med Surg J. 1920;183(9):263-7.
7. Burki T. Thomas Frieden takes on the CDC. Lancet Infect Dis. 2009;9(7):405.
8. Sammons RL, Kaur D, Neal P. Bacterial survival and biofilm formation on conventional and antibacterial toothbrushes. Biofilms. 2004;1(2):123-30.
9. Gautam B, Pokhrel S, Aryal S, Basnet A. Efficacy of toothpaste in reducing microflora isolated from toothbrush. Kathmandu Univ J Sci Eng Technol. 2017;13(2):71-8.
10. Iqbal S, Ahmed S, Aslam A, Kashif M, Khan I, Khan N. Microbial flora on the white coats of dental staff, Karachi. Int J Endorsing Health Sci Res. 2020;8(1):21-7.
11. Khan MI, Kashif M, Ehsan R, Faizuddin M, Iqbal S, Jamil H. Microbial contamination of white coats, hands and mobile phones of health care workers. Int J Pathol. 2020;18(2):58-62.
12. Naik R, Mujib BR, Telagi N, Anil BS, Spoorthi BR. Contaminated toothbrushes—potential threat to oral and general health. J Family Med Prim Care. 2015;4(3):444-8.
13. Dhifaf MS. Effectiveness of different cleanser solutions on the microbial contamination of toothbrushes. J Kerbala Univ. 2011;7(1):302-7.
14. Cheesbrough M. District laboratory practice in tropical countries. 2nd ed. Cambridge (UK): Cambridge University Press; 2006.
15. Kuboniwa M, Lamont RJ. Subgingival biofilm formation. Periodontol 2000. 2010;52(1):38-52.
16. Mansoori N, Bakar I, Shahid N, Mubeen SM. Microbial contamination; a survey of microbial contamination of toothbrushes among general population of Karachi. Prof Med J. 2018;25(11):1785-90.
17. Petersen PE, Kandelman D, Arpin S, Ogawa H. Global oral health of older people—call for public health action. Community Dent Health. 2010;27(4 Suppl 2):257-67.
18. Konidala U, Nuvvula S, Mohapatra A, Nirmala SV. Efficacy of various disinfectants on microbially contaminated toothbrushes due to brushing. Contemp Clin Dent. 2011;2(4):302-7.
19. Raiyani CM, Arora R, Bhayya DP, Dogra S, Katageri AA, Singh V. Assessment of microbial contamination on twice a day used toothbrush head after 1-month and 3-months: an in vitro study. J Nat Sci Biol Med. 2015;6(Suppl 1):S44-S48.
20. Saini R, Kulkarni V. Toothbrush: A favorable media for bacterial growth. Int J Exp Dent Sci. 2013;2(1):27-8.
21. Thamke MV, Beldar A, Thakkar P, Murkute S, Ranmare V, Hudwekar A. Comparison of bacterial contamination and antibacterial efficacy in bristles of charcoal toothbrushes versus noncharcoal toothbrushes: A microbiological study. Contemp Clin Dent. 2018;9(3):463-7.
22. Talaat DM, Sharaf AAE, Ghoneim MAE, El-Shazly SA, El Meligy OAES. Efficacy of two mouth rinse sprays in inhibiting Streptococcus mutans growth on toothbrush bristles. Saudi Dent J. 2018;30(4):365-72.
23. Karibasappa GN, Nagesh L, Sujatha BK. Assessment of microbial contamination of toothbrush head: an in vitro study. Indian J Dent Res. 2011;22(1):2-5.
24. Shahid SM, Ali MN, Lina KS, Paul SR, Islam SS, Lisa T. Pediatric Laparoscopic Inguinal Hernia Repair: A Comparison between Techniques. TAJ: Journal of Teachers Association. 2020 Dec 31;33(2):20-6.
25. Hossain Z, Ali N, Shahid SM, Paul SR, Al Mamun A. Outcome of gastroschisis in Rajshahi Medical College Hospital: Searching for the way of improvement. TAJ: Journal of Teachers Association. 2024 Jun 30;37(1):192-200.
26. Shahid SM, Ali N, Islam SS, Lina KS. Management of Posterior Urethral Valves: An Outcome Analysis of Endoscopic Valve Fulguration. TAJ: Journal of Teachers Association. 2018;31(2):68-72.
27. Das D, Shahid SM, Paul SR, Hussain Z, Nure RH, Shuvo SS. Dorsal Mesenteric Agenesis without Small Bowel Atresia: A Rare Pediatric Case Insight. TAJ: Journal of Teachers Association. 2024 Dec 31;37(2):381-4.
28. Islam SS, Hassan P, Ali MN, Shahid SM, Badruddoza SM, Ahmed M. Undescended Testes in Children: Clinicopathological Study of 32 Cases. TAJ: Journal of Teachers Association. 2017;30(2):26-31.
29. Ali MN, Hannan MA, Shahid SM, Kubba T, Roy D. Ultrasound Guided Needle Aspiration of

Breast Abscess as an Alternative to Surgical Incision and Drainage. TAJ: Journal of Teachers Association. 2020 Oct 18;33(1):1-4.
30. Nowshad A, Shahid SM, Islam SS, Mostaque A. Intussusception Secondary to Isolated Heterotopic Pancreas of Meckel's Diverticulum. TAJ: Journal of Teachers Association. 2011 Jun 30;24(1):16-20.
31. Shahid SM, Ali MN, Sarkar MH, Rahman MH. Ensuring authenticity in scientific communication: Approaches to detect and deter plagiarism. TAJ: Journal of Teachers Association. 2024 Jun 30;37(1):i-ii.
32. Alam KM, Shahid SM. PCR Test for SARS-CoV-2, Rajshahi Medical College Perspective. TAJ: Journal of Teachers Association. 2024 Dec 31;37(2):1-4.
33. Haque MA, Islam MI, Hasan H. Successful Surgical Creation and Management of an Arteriovenous Fistula: A Case Report. Asia Pacific Journal of Surgical Advances. 2024 Aug 31;1(1):34-8.
34. Paul SR, Ali MN, Shahid SA, Paul SC, Haque MN, Hossain MZ. Acute Sigmoid Volvulus: Outcome of Primary Resection & Anastomosis in a Tertiary Hospital. TAJ: Journal of Teachers Association. 2022;35(2):13-8.
35. Hasan H, Rahman MH, Haque MA, Rahman MS, Ali MS, Sultana S. Nutritional management in patients with chronic kidney disease: A focus on renal diet. Asia Pacific Journal of Medical Innovations. 2024 Aug 31;1(1):34-40.
36. Shahid SM, Ali MN, Paul SR, Hossain MZ, Al Mamun A. Demographic Profile and Outcome of Paediatric Solid Tumor Patients, in a Tertiary Level Hospital in Bangladesh. TAJ: Journal of Teachers Association. 2024 Jun 30;37(1):55-62.
37. Haque MA, Begum MM, Rahman MS, Hasan H. Complications of Arteriovenous Fistula Surgery: A Comprehensive Study in Bangladesh. TAJ: Journal of Teachers Association. 2024 Dec 31;37(2):87-97.
38. Haque A, Rahman S, Roshid M, Hasan H, Uddin N. Dietary Protein and Fluid Management in CKD Patients Undergoing Arteriovenous Fistula (AVF) Surgery: Investigating the Role of Nutrition on Reducing Fistula Failure. Pacific Journal of Medical Research. 2024 Dec 31;1(1):26-34.
39. D'Silva I, Kothari T, Shah R, Sahetya S. Toothbrush disinfection—Is your toothbrush making you sick? J Indian Dent Assoc. 2007;1:88-91.