Original Article | Iran J Med Microbiol. 2023; 17(4): 406-413

10.30699/ijmm.17.4.406

Iranian Journal of Medical Microbiology | ISSN:2345-4342

Molecular Detection of Oral *Helicobacter pylori* and Its Association with Dental Conditions Among Patients with *Helicobacter* Infection in Baghdad City

Marwa Dhari Alewi*, Ahlam Taha Mohammed

Department of Preventive Dentistry, College of Dentistry, University of Baghdad, Baghdad, Iraq

ABSTRACT

Background and Aim: *Helicobacter pylori* is found in the stomach and the oral cavity, which plays a significant role in oral diseases and recurrent gastric infections. This study aimed to detect the presence of oral *H. pylori* and investigate its potential association with dental caries and erosion.

Materials and Methods: Saliva and plaque samples were collected from two groups: a study group of 40 *H. pylori*-infected patients, confirmed by immunological tests, and a control group included 40 subjects who were given negative results after laboratory examination. Molecular detection of *H. pylori* was performed using the polymerase chain reaction (PCR). Additionally, clinical assessments of dental caries and erosions were conducted.

Results: The study group showed a higher prevalence of *H. pylori* in saliva (62.5%) compared to dental plaque (45.0%). Among the study group, 70% tested positive for *H. pylori* by PCR, while 30% tested negative. Dental caries experience (DMFS) was slightly higher in the study group compared to the control group, and significant differences in (DS) and (DMFT) ($p<0.05$). The prevalence of dental erosion was also higher in the study group compared to the control group.

Conclusion: The presence of *H. pylori* in the oral cavity represents an important risk factor for dental caries and erosion.

Keywords: *Helicobacter pylori*, PCR, Dental erosion, Saliva

Received: 2023/06/08; **Accepted**: 2023/08/25; **Published Online:** 2023/09/27

Corresponding Information: **Marwa Dhari Alewi**, *Department of Preventive Dentistry, College of Dentistry, University of Baghdad, Baghdad, Iraq* Email: marwadhari1989@gmail.com

Use a device to scan and read the article online

Dhari Alewi M, Taha Mohammed A. Molecular Detection of Oral *Helicobacter pylori* and Its Association with Dental Conditions Among Patients with *Helicobacter* Infection in Baghdad City. Iran J Med Microbiol. 2023;17(4):406-13.

Download citation: BibTeX | RIS | EndNote | Medlars | ProCite | Reference Manager | RefWorks

Send citation to: Mendeley Zotero RefWorks

1. Introduction

Oral health is fundamental to human well-being as it serves as the foundation for overall body health **(1)**. The oral cavity acts as a critical gateway, facilitating the passage of substances from the external environment to the stomach **(2, 3)**. Furthermore, it serves as a reservoir for various microorganisms, including *Helicobacter pylori, Neisseria spp*, and different *streptococcal species*, which can contribute to diseases within the oral cavity and beyond the gastrointestinal tract. Recent studies have highlighted the potential risk of *H. pylori* in the oral cavity for recurrent gastric infections **(4, 5)**.

The impact of oral health extends far beyond the confines of the oral cavity, with repercussions on broader aspects of human health. In the studies conducted by Moghadam *et al.* **(6, 7)**, they confirmed that there is a significant association between changes in oral microbiome bacteria, increased inflammatory cytokines, and Alzheimer's disease (AD). Furthermore, the microbiome is considered one of the health biomarkers by many researchers. This has led to the association of microbiome changes with many neurological diseases **(8)**.

Dental caries involves localized destruction of dental hard tissues due to acids produced by bacterial fermentation of dietary carbohydrates **(9)**. Its global prevalence affects both developed and developing nations **(10)**.

However, dental caries, a prevalent oral disease affecting individuals worldwide, significantly affects children and substantially impacts their overall quality of life **(11)**. Despite efforts to combat dental caries, it remains a persistent public health challenge in many countries and can lead to tooth loss if left untreated **(12)**.

Dental erosion is another oral health condition characterized by the chemical loss of mineralized tooth substance caused by exposure to acids unrelated to oral bacteria **(13)**. It affects individuals across societies, age groups, and cultures, particularly the older population with natural teeth **(14)**.

Both dental caries and erosion are chronic processes that evolve and share common risk factors, including reduced saliva flow and its protective components **(15)**. Saliva, being a non-invasive sample, presents an attractive option for epidemiological studies due to its convenient and painless collection, along with minimal risk to the participants **(16)**.

H. pylori, one of the most prevalent bacterial pathogens globally, is estimated to have infected approximately 4.4 billion individuals in 2015 **(14)**. Detecting *H. pylori* is crucial for diagnosis and management. Several invasive and non-invasive methods are available for its detection, each with its unique advantages, disadvantages, and limitations. The polymerase chain reaction (PCR) technique, in particular, holds promise for detecting *H. pylori* in saliva samples, providing a viable alternative for diagnosis **(17)**. Numerous studies have successfully isolated *H. pylori* from various oral specimens, such as dental plaque, saliva, and dental pulp **(18, 19)**. Moreover, the presence of *H. pylori* in the oral cavity alone has been linked to various oral diseases **(20)**. Dental plaque, formed through biofilm accumulation, has been identified as a carrier for *H. pylori*, further emphasizing the importance of understanding its role in oral health **(21, 22)**.

This study aims to detect *H. pylori* using the polymerase chain reaction (PCR) technique in saliva and plaque samples from patients with *H. pylori* infection. Furthermore, it seeks to explore the relationship between *H. pylori* detection and the presence of dental caries and erosion.

2. Materials and Methods

Study Design and Participants

This case-control study included 40 patients infected with *H. pylori* after laboratory examination (Stool Antigen Test or Antibodies Rapid Test) as a study group and 40 subjects who were given negative results for *H. pylori* after laboratory examination as a control group. The subjects of the present study from patients who attend different hospitals in Baghdad city with an age range of **(30-40)** years. Before data collection, ethical approval was obtained from the ethical approval committee, College of Dentistry / the University of Baghdad, to perform this study (Ref. number:479); Before starting the examination, collect demographic information about name, gender, age, symptoms, medical history, and oral health status from each study and control group.

Dental Examinations

Dental caries examinations were conducted using mouth dental mirrors and CPI probes, according to the World Health Organization (WHO) criteria in 2013 **(23)**. To assess dental erosion, the Basic Erosive Wear Examination (BEWE) criteria from 2011, established by Lussi and Thomas, were employed **(24)**.

Saliva and Subgingival Plaque Collection

Unstimulated saliva samples were collected from both groups using the spitting method described by Khurshid et al. **(25)**. Participants were instructed to remain calm, minimize movement, and accumulate saliva on the floor of their mouths before spitting it into a sterile disposable cap. This process was repeated every 30 seconds for a total of 5 minutes. The collected saliva samples were immediately placed in a cooling box, centrifuged at 3000 rpm for 10 minutes, and the supernatant was separated using a micropipette and stored at -20°C until analysis **(26)**.

Subgingival plaque samples were collected by inserting two sterile paper points into the gingival sulcus for 20 seconds, following the area's isolation using sterile cotton rolls to prevent contamination from saliva. Samples were collected from all posterior teeth and placed in sterile tubes containing 1.5 ml phosphate-buffered saline (PBS) with a pH of 7. The samples were stored in dry ice coolers during transportation to the laboratory and kept at -20°C until DNA extraction **(27)**.

DNA Extraction and Polymerase Chain Reaction (PCR)

Following the manufacturer's instruction, *H. pylori* DNA was extracted using the AddPrep Bacterial Genomic Extraction kit (Add Bio, Korea). Briefly. The DNA pellet was rehydrated by adding 100 µL of rehydration solution and kept at -20°C until further

assay. After extracting DNA from saliva and plaque specimens from patients and control subjects and using specific primers (Table 1), the PCR amplification was carried out according to a published protocol **(28)**. Each PCR reaction mixture (20 µL) was prepared using HS Prime Taq Premix (2X) (GeNetBio, Korea). The PCR cocktail mixtures were prepared in 20 µL containing a final concentration of 1X Taq Master Mix, 1 µM of each primer, and 2 µL of DNA template (2 ng/µL). The PCR was done using a T100 BioRad thermal cycler (BioRad., USA).

The activation of polymerase was carried out at 95°C for 10 minutes. For 30 cycles, the step of DNA denaturation was carried out at 95°C for 45 seconds and then followed by primers annealing at 57°C for a similar period. The temperature was raised to 72°C for one minute to allow the extension of primer-mediated amplification of the targeted genes. Finally, a five-minute final extension at 72°C was performed.

Examination of PCR products was done via agarose gel electrophoresis according to manufacturer instructions (GeNetBio, Korea). The gel was examined under UV light using a gel documentation system (Gel Doc EZ Image, Bio-Rad, USA) to document and determine expected bands.

Table 1. Primers used for amplification of specific genes of *H. pylori*.

Primer name	Sequence 5 – 3´	Product size (bp)	Ref.
HP16S	F- GGCTATGACGGGTATCCGGC R- GCCGTGCAGCACCTGTTTTC	764	(27)
Vac A-F	F-ATGGAAATACAACAAACACAC R- CTGCTTGAATGCGCCAAAC	259	(27)
Cag A	F- CGTTAGCTGCATTACTGGAGA R-GAGCGCGTAGGCGGGATAGTC	295	(29)

Statistical Analysis

Using Statistical Package for Social Science version 22 (SPSS Inc., Chicago, Illinois, USA) for data description, Analysis, and presentation were performed. It was classified into two categories:

1- Descriptive Analysis:

Frequency is the percentage for qualitative variables, while mean, Standard Deviation (SD), and Standard Error (SE) are for the quantitative variable.

2- Inferential Analysis:

Independent Sample T-test: the parametric test of the difference between two groups.

3. Results

The finding in Table 2 showed that the higher cases of negative *H. pylori* PCR were in plaque while the higher cases of positive *H. pylori* PCR were in saliva, and there was a moderate positive significant correlation between the saliva and plaque.

Table 2. *H. pylori* PCR of saliva and plaque in the study group.

		N	%	r	P-value
Saliva	-Ve	15	37.5	0.501	0.000
	+Ve	25	62.5		
Plaque	-Ve	22	55.0		
	+Ve	18	45.0		

+Ve: positive cases N: number.
-Ve: negative cases r: person correlation.

The findings in Table 3 showed no positive *H. pylori* PCR cases in the control group; in contrast, 28 subjects (70%) of the study group had positive PCR.

Caries experience among the study and control groups is shown in Table 4. Results showed that caries experience for the study group was higher than that for the control group, with a statistically significant difference (P<0.05) in DS and DMFT but no significant difference in other components (P>0.05).

Findings in Table 5 revealed that caries experience only DS and FS were higher in negative cases than those in positive cases but with statistically no significant difference. At the same time, other variables were higher in positive cases than negative cases but with no significant differences except MS; statistically, its result was significant (P<0.05). Furthermore, the results of this study revealed that dental erosion was higher among the study group than

those among the control group, with a statistically significant difference (P<0.05), as shown in Table 6.

Table 3. Detection of *H. pylori* PCR among study and control groups.

PCR	Groups				X^2	P-value	Total	
	Study		Control					
	N	%	N	%			N	%
+ve	28	70.00	0	0.00	43.077	0.000	28	35.00
-ve	12	30.00	40	100.00			52	65.00
Total	40	100.00	40	100.00			80	100.00

Table 4. Carie's experience among study and control groups.

Variables	Groups					
	Study		Control			
	Mean	±SE	Mean	±SE	T-test	P- value
DS	6.800	0.336	3.500	0.601	4.790*	0.000
MS	2.000	0.641	2.750	0.839	0.711	0.480
FS	2.050	0.334	2.575	0.237	1.282	0.204
DMFS	10.850	0.884	8.825	1.263	1.313	0.193
DMFT	4.950	0.347	2.900	0.279	4.602*	0.000

DMFS: Decay, missed, filled surface. SE: Standard Error. DMFT: Decay, missed, filled teeth.
DS: Decayed Surface. MS: Missed Surface. FS: Filled Surface.

Table 5. Caries experience among the study group in relation to the presence of *H. pylori*.

Variables	*H.pylori* PCR							
	+ve PCR			-ve PCR				
	N	Mean	±SE	N	Mean	±SE	T-test	P-value
DS	28	6.500	0.407	12	7.500	0.571	1.427	0.167
MS	28	2.679	0.871	12	0.417	0.417	2.342	0.025
FS	28	1.750	0.380	12	2.750	0.653	1.324	0.201
DMFS	28	10.929	1.185	12	10.667	1.089	0.163	0.872
DMFT	28	5.250	0.617	12	4.821	0.424	0.572	0.573

N: number. DMFS: Decay, missed, filled surface. SE: Standard Error.
DMFT: Decay, missed, filled teeth. DS: Decayed Surface. MS: Missed Surface.
FS: Filled Surface.

Table 6. Dental erosion among study and control groups.

Dental erosion	Groups		z-test	P- value
	Study	Control		
Median	5	0	7.781	0.000
Mean rank	60.43	20.58		

Finally, findings in Table (6) showed that dental erosion was higher in positive cases than in negative cases but with statistically no significant difference (P>0.05).

Table 6. Dental erosion among the study group in relation to the presence of *H. pylori*.

Dental erosion	*H.pylori* PCR		z-test	P- value
	+ve	-ve		
Median	6	5	0.780	0.457
Mean rank	22.67	19.57		

+ve: positive cases. -ve: negative cases.

4. Discussion

Poor oral cavity health has been linked to a heightened risk of oral and gastric diseases **(30)**. The presence of *H. pylori* in the oral cavity can lead to reinfection even after its eradication **(31)**. The urease test must be more specific for detecting *H. pylori* in dental biofilm. Consequently, oral *H. pylori* detection primarily relies on polymerase chain reaction (PCR) analysis **(32)**. Thus, bacterial DNA detection in saliva using PCR has become one of the well-established diagnostic methods for *H. pylori* infection **(33)**. The present study found that PCR–ve H. *pylori* was mainly detected in plaque. In contrast, the PCR +ve *H. pylori* were found mainly in saliva, with a moderate positive significant correlation between the two sites. This can be attributed to the high shedding of the bacteria into the saliva from the plaques or may be explained due to the presence of different strains of urease-producing bacteria found in the oral cavity, such as *Streptococcus Vestibularis* and *Actinomyces Viscosus,* which may be falsely detected and cause false-positive results **(34)**.

Also, the current study found that the PCR test for *H. pylori* detection was positive in most (70%) subjects recruited. This percentage was higher than that of Sekhar Goud, Kannan **(35)**, in which *H. pylori* was identified using PCR in (56.6%) of the total patients. The difference in the results could be attributed to several methodological variations, like sample population characteristics and study design, in addition to lifestyle and regional differences.

Dental caries may affect the presence of systemic *H. pylori* infection by acting as a reservoir for *H. pylori*. The current study showed that the caries experience for the study group was higher than that for the control group, with a significant difference in DS and DMFT. A previous study by Chen, and Dou **(36)** reported the same findings; these results could be explained by the fact that the caries cavity is a retentive area for plaque and is difficult to reach with a brush during oral cleaning, making it difficult to remove accumulated oral bacteria. Therefore, the caries cavity could serve as a reservoir for *H*. *pylori* because self-cleaning is difficult to work, contributing to inducing systemic *H*. *pylori* infection. This finding aligns with that reported in a previous study by Hamada, and Nomura **(37)**, in which patients with severe dental caries showed a higher detection rate of *H*. *pylori* in their saliva than those patients who do not have caries.

Also, the results of the present study revealed that dental erosion was significantly higher among the study group than the control group, with significant differences. This could be explained by the fact that most patients with *H. pylori* infection have gastric reflux, and the pH of stomach acid is much lower than the critical pH of enamel dissolution; therefore, reflux of stomach contents into the oral cavity over an extended period can cause severe loss of tooth structure, or it may be due to that when reduced salivary flow rate, acid clearance is reduced. Less dilution of acid will be present upon attack of the tooth surface, contributing to erosion progress, especially where there is direct contact with the acid. This happens because the acid clearance is the most rapid in that location, and the salivary film velocity is the highest in the mouth **(38)**. This finding aligns with a more recent study by Iwai *et al.* in 2019, which emphasized that dental caries and erosion may influence systemic *H. pylori* infection by acting as continuous sources of *H. pylori* reinfection **(19)**.

Dental caries and erosion may be continuous sources of *H. pylori* reinfection, potentially influencing systemic *H. pylori* infection. However, it is essential to note that dental caries and erosion can occur independently, and the association between the two conditions may not always be apparent. The presence of *H. pylori* in the oral cavity and its potential for reinfection even after gastric eradication highlights the importance of maintaining good oral health for overall well-being. Further research is needed to elucidate the complex relationship between oral and gastric *H. pylori* infections and their impact on human health.

5. Conclusion

An important association between *H. pylori* colonization in dental plaque and saliva and oral diseases, including dental caries and erosion.

Ethical Consideration

This study was approved by the Medical Ethical Committee, Faculty of Dentistry, University of Baghdad, (Ref. number:479).

Acknowledgment

None.

Funding

None.

Conflict of Interest

The authors declared no conflict of interest.

Reference

1. Munther S. An Oral Health Status and Treatment Needed in Relation to Dental Knowledge, Among a Group of Children Attending Preventive Department, College of Dentistry, University of Baghdad. J Baghdad Coll Dent. 2015;27(4):138-42. [DOI:10.12816/0024077]
2. Farquhar DR, Divaris K, Mazul AL, Weissler MC, Zevallos JP, Olshan AF. Poor oral health affects survival in head and neck cancer. Oral Oncol. 2017;73:111-7. [PMID] [PMCID] [DOI:10.1016/j.oraloncology.2017.08.009]
3. Darvishi M, Noori M, Nazer MR, Soleiman-Meigooni S, Forootan M. The Relationship between Helicobacter Pylori and Extra-Gastrointestinal Infections. Iran J Med Microbiol. 2020;14(6):543-65. [DOI:10.30699/ijmm.14.6.543]
4. Miyabayashi H, Furihata K, Shimizu T, Ueno I, Akamatsu T. Influence of Oral Helicobacter pylori on the Success of Eradication Therapy Against Gastric Helicobacter pylori. Helicobacter. 2000; 5(1):30-7. [PMID] [DOI:10.1046/j.1523-5378.2000.00004.x]
5. Moghadam MT, Chegini Z, Norouzi A, Dousari AS, Shariati A. Three-Decade Failure to the Eradication of Refractory Helicobacter pylori Infection and Recent Efforts to Eradicate the Infection. Curr Pharm Biotechnol. 2021;22(7): 945-59. [PMID] [DOI:10.2174/1389201021666200807110849]
6. Taati Moghadam M, Amirmozafari N, Mojtahedi A, Bakhshayesh B, Shariati A, Masjedian Jazi F. Association of perturbation of oral bacterial with an incident of Alzheimer's disease: A pilot study. J Clin Lab Anal. 2022;36(7):e24483. [DOI:10.1002/jcla.24483] [PMID] [PMCID]
7. Moghadam MT, Bakhshayesh B, Babakhani S, Ajorloo P, Shariati A, Mirzaei M, et al. The effect of bacterial composition shifts in the oral microbiota on Alzheimer's disease. Curr Mol Med. 2023. [PMID] [DOI:10.2174/1566524023666220819140748]
8. Moghadam MT, Ramírez-Coronel AA, Darijani S, Akbarizadeh MR, Naderifar M, Soltaninejad S, et al. Perturbations in Microbiota Composition as a Novel Mediator in Neuropsychiatric, Neurological and Mental Disorders: Preventive and Therapeutic Complementary Therapies to Balance the Change. Curr Alzheimer Res. 2023; 20(4):213-23. [PMID] [DOI:10.2174/1567205020666230718160914]
9. Abonayla MF, Alwaheb AM. The Effect of Socioeconomic Level on Dental Caries among Preschool Children in Baghdad City. Indian J Public Health. 2020;11(02):2338-42. [DOI:10.37506/v11/i2/2020/ijphrd/195185]
10. Al-Abbasi SW, Radhi NJMH. Dental Caries and Treatment Needs among Kindergarten Children in Al-Basrah Governorate/Iraq. J Baghdad Coll Dent. 2016;28(4):149-52. [DOI:10.12816/0033227]
11. Alshmaa ZM, Alwaheb AM. Impact of Dental Caries on Quality of Life of Primary School Children aged 8-10 Years in Al-Najaf City, Iraq. Indian J Public Health. 2019;10(10):2691-5. [DOI:10.5958/0976-5506.2019.03274.1]
12. Khaudyer AT, Mohammed AT, Al-Ghurabi BH. Oral health condition among Kindergarten children in Relation to Salivary soluble Cluster of Differentiation 14 and Tool Like Receptor 2 (comparative study). Indian J Public Health. 2019; 10(9):1407. [DOI:10.5958/0976-5506.2019.02643.3]
13. Schlueter N, Amaechi BT, Bartlett D, Buzalaf MAR, Carvalho TS, Ganss C, et al. Terminology of erosive tooth wear: consensus report of a workshop organized by the ORCA and the Cariology Research Group of the IADR. Caries Res. 2020; 54(1):2-6. [DOI:10.1159/000503308] [PMID]
14. Hoobi NM. Caries severity in relation to oral health knowledge and behavior of third and fifth year dental students/University of Baghdad (A comparative study). J Baghdad Coll Dent. 2014; 26(3):164-8. [DOI:10.12816/0015244]
15. Heidari K, Kaboosi H, Jamali A, Ghaemi EA, Peyravii Ghadikolaii F. Prevalence of pathogenic genes CagA and VacA of helicobacter pylori isolated in patients with digestive disorders. Iran J Med Microbiol. 2019;13(1):80-8. [DOI:10.30699/ijmm.13.1.80]
16. Mirzaei S, Keshavarzi F, Karami P. The Prevalence of H. Pylori cagA Gene in Patients with Gastric Ulcer. Iran J Med Microbiol. 2021;15(3):345-51. [DOI:10.30699/ijmm.15.3.345]
17. Thamer SR, Al-Ani S. Establishment of the possible association between the presence of Helicobacter pylori in the saliva and gastric biopsy by using polymerase chain reaction technique in association with oral manifestation of peptic ulcer

disease. J Baghdad Coll Dent. 2015;27(3):85-8. [DOI:10.12816/0015040]

18. Azami M, Darvishi Z, Borji M, Sayehmiri K. Helicobacter pylori infection is associated with anemia in pregnant women-a meta-analysis study. Iran J Med Microbiol. 2016;10(1):1-7.
19. Iwai K, Watanabe I, Yamamoto T, Kuriyama N, Matsui D, Nomura R, et al. Association between Helicobacter pylori infection and dental pulp reservoirs in Japanese adults. BMC Oral Health. 2019;19(1):267. [PMID] [PMCID] [DOI:10.1186/s12903-019-0967-2]
20. Leimola-Virtanen R, Happonen RP, Syrjänen S. Cytomegalovirus (CMV) and Helicobacter pylori(HP) found in oral mucosal ulcers. J Oral Pathol Med. 1995;24(1):14-7. [PMID] [DOI:10.1111/j.1600-0714.1995.tb01123.x]
21. Rasmussen LT, Labio RWd, Gatti LL, Silva LCd, Queiroz VFd, Smith MdAC, et al. Helicobacter pylori detection in gastric biopsies, saliva and dental plaque of Brazilian dyspeptic patients. Mem Inst Oswaldo Cruz. 2010;105(3):326-30. [DOI:10.1590/S0074-02762010000300015] [PMID]
22. Al-Sarray AJA, Al-Kayat T, Mohammed BM, Al-assadi MJB, Abu-Zaid Y. Dielectric and Electrical Properties of Intercalated 1-(4-nitrophenyl)-N-(p-tolyl) methanimine into the Interlayers of Bentonite Clay. J Med Chem Sci. 2022;5(7(Special Issue)):1321-30.
23. (WHO) WHO. Basic methods of oral health survey. 5 ed. Geneva: World Health Organization; 2013.
24. Lussi A, Jaeggi T. Dental erosion: diagnosis, risk assessment, prevention, treatment: Quintessence; 2011.
25. Khurshid Z, Zohaib S, Najeeb S, Zafar MS, Slowey PD, Almas K. Human saliva collection devices for proteomics: an update. Int J Mol Sci. 2016;17(6): 846. [DOI:10.3390/ijms17060846] [PMID] [PMCID]
26. Carvalho SPM, Sales-Peres A, Ribeiro-Bicudo LA, Silva RHAd. Quality evaluation of DNA obtained from stored human saliva and its applicability to identification in Forensic Dentistry. Rev Odonto Cienc. 2010;25:48-53. [DOI:10.1590/S1980-65232010000100010]
27. Valadan Tahbaz S, Yadegar A, Amirmozafari N, Yaghoobee S, Ehsani Ardakani MJ, Zojaji H. Occurrence of Helicobacter pylori and its major virulence genotypes in dental plaque samples of patients with chronic periodontitis in Iran. Gastroenterol Hepatol Bed Bench. 2017;10 (Suppl1):S70-S8.
28. Abbaszadegan, M. R., Taghehchian, N., Aarabi, A., Nozari, S., Saburi, E., Moghbeli, M. Kindlin1 As a Sex and Location Specific Diagnostic Marker in Gastric Cancer Patients. Iran J Pathol, 2022; 17(1): 23-28. [PMID] [PMCID] [DOI: 10.30699/ijp.2021.526950.2603]
29. RIGGIO MP, LENNON A. Identification by PCR of Helicobacter pylori in subgingival plaque of adult periodontitis patients. J Med Microbiol. 1999; 48(3):317-22. [DOI:10.1099/00222615-48-3-317] [PMID]
30. Jordão HWT, McKenna G, McMenamin ÚC, Kunzmann AT, Murray LJ, Coleman HG. The association between self-reported poor oral health and gastrointestinal cancer risk in the UK Biobank: A large prospective cohort study. United European Gastroenterol J. 2019;7(9):1241-9. [DOI:10.1177/2050640619858043] [PMID] [PMCID]
31. Bürgers R, Schneider-Brachert W, Reischl U, Behr A, Hiller K-A, Lehn N, et al. Helicobacter pylori in human oral cavity and stomach. Eur J Oral Sci. 2008;116(4):297-304. [PMID] [DOI:10.1111/j.1600-0722.2008.00543.x]
32. Yee JKC. Are the view of Helicobacter pylori colonized in the oral cavity an illusion? Exp Mol Med. 2017;49(11):e397. [DOI:10.1038/emm.2017.225] [PMID] [PMCID]
33. Rahman LQ, Rahman AQ, Bakir AA, Muhamadamin RA, Khudhur PK. DNA detection of Helicobacter pylori in saliva of patients with low salivary pH. Zanco j Pure Appl Sci. 2020;24(2):283-90. [DOI:10.15218/zjms.2020.032]
34. Kadota T, Hamada M, Nomura R, Ogaya Y, Okawa R, Uzawa N, et al. Distribution of Helicobacter pylori and periodontopathic bacterial species in the oral cavity. Biomedicines. 2020;8(6):161. [DOI:10.3390/biomedicines8060161] [PMID] [PMCID]
35. Sekhar Goud EVS, Kannan R, Rao UK, Joshua E, Tavaraja R, Jain Y. Identification of Helicobacter pylori in Saliva of Patients with and without Gastritis by Polymerase Chain Reaction. J Pharm Bioallied Sci. 2019;11(Suppl 3):S523-S9. [DOI:10.4103/jpbs.JPBS_260_18] [PMID] [PMCID]
36. Chen Y, Dou G, Wang D, Yang J, Zhang Y, Garnett JA, et al. Comparative Microbial Profiles of Caries and Black Extrinsic Tooth Stain in Primary Dentition. Caries Res. 2021;55(4):310-21. [DOI:10.1159/000517006] [PMID]

37. Hamada M, Nomura R, Ogaya Y, Matayoshi S, Kadota T, Morita Y, et al. Potential involvement of Helicobacter pylori from oral specimens in overweight body-mass index. Sci Rep. 2019;9(1): 4845. [DOI:10.1038/s41598-019-41166-5] [PMID] [PMCID]

38. Proctor DM, Relman DA. The landscape ecology and microbiota of the human nose, mouth, and throat. Cell Host Microbe. 2017;21(4):421-32. [DOI:10.1016/j.chom.2017.03.011] [PMID] [PMCID]