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Role of salivary immunoglobulins in oral health: Investigating levels of IgA and IgG in saliva and their impact on periodontal disease among patients in Peshawar, Pakistan

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ABSTRACT

INTRODUCTION: Salivary immunoglobulins, IgA and IgG, play a crucial role in the oral immune system, influencing oral health. Given the high prevalence of periodontal disease in Pakistan and the influence of socio-cultural factors on oral health practices, this study aims to assess the levels of salivary immunoglobulins to periodontal health.
MATERIAL AND METHODS: A cross-sectional study was conducted involving 99 participants aged 18 to 65, grouped by periodontal health and smoking status: healthy non-smokers, smokers with gingivitis, and smokers with periodontitis. Patients having other comorbidities such as diabetes mellitus, cardiovascular diseases, neurological diseases and severe periodontitis were excluded. The participants were recruited from dental clinics in Peshawar. Salivary samples were collected, and immunoglobulin levels were measured using an enzyme-linked immunosorbent assay (ELISA). Clinical parameters, including bleeding on probing (BOP), the probing pocket depth (PPD), and plaque index (PI), were also recorded. Statistical analysis was performed using SPSS version 25, with the Pearson correlation coefficient to assess relationships between the immunoglobulin levels and clinical parameters.
RESULTS: The study found that salivary immunoglobulins levels were significantly higher in the groups of participants being smokers (66%) having gingivitis (IgA: 1.5 mg/mL, IgG: 1.1 mg/mL) and periodontitis (IgA: 2.5 mg/mL, IgG: 2.0 mg/mL) compared to healthy non-smoking (33%) individuals (IgA: 0.4 mg/mL, IgG: 0.3 mg/mL). Additionally, the BOP and PPD values were the lowest in the healthy non-smoking participants and increased significantly in the smoking group with periodontal disease.
CONCLUSIONS: Elevated levels of salivary immunoglobulins correlate with periodontal disease and smoking, indicating their potential as biomarkers for diagnosis and monitoring treatment.

KEYWORDS

salivary immunoglobulins, IgA, IgG, periodontal disease, smoking, biomarkers, socioeconomic status, oral health, Pakistan

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INTRODUCTION

Salivary immunoglobulins, particularly immunoglobulin A (IgA) and immunoglobulin G (IgG), are important components of the oral immune system, playing a significant role in maintaining oral health and preventing periodontal diseases. IgA, the most abundant immunoglobulin in saliva, acts as the first line of defence by neutralizing pathogens and inhibiting their adherence to oral surfaces, thereby preventing infections [1,2]. In contrast, IgG mainly mediates systemic immunity, providing protection against bacterial infections and contributing to inflammatory responses associated with periodontal disease [3,4]. Periodontal disease, characterized by inflammation and the destruction of tooth-supporting structures, poses a significant public health challenge globally, with a high prevalence reported in Pakistan [5,6]. Research indicates that altered levels of salivary immunoglobulins correlate with the severity of periodontal disease, suggesting their potential as biomarkers for diagnosis and treatment monitoring [7,8]. Furthermore, the influence of socio-cultural factors on oral health practices in specific populations underscores the need for localized research [9,10]. This study aims to investigate the levels of salivary IgA and IgG among individuals in Peshawar and their correlation with clinical parameters of periodontal disease, providing insights into the immunological aspects of oral health in this region [11,12]. Understanding these relationships can guide preventive and therapeutic strategies, contributing to improved oral health outcomes in the community [13,14,15].

MATERIAL AND METHODS

This cross-sectional study was conducted in Peshawar, Pakistan, involving participants from various demographic backgrounds to assess the levels of salivary immunoglobulins (IgA and IgG) in relation to periodontal health. A total of 100 participants was recruited for this study, aged between 18 and 65, 33.33% individuals being non-smokers and 66.67% individuals being smokers. The sample included individuals with varying periodontal health statuses, classified as healthy and non-smokers with no other comorbidities (diabetes, cardiovascular diseases, neurological disorders, etc.) and smokers with gingivitis and periodontitis having no other comorbidities (diabetes, cardiovascular diseases, neurological disorders, etc.). Individuals with only mild to moderate gingivitis and periodontitis were included. Participants were included if they were adults aged 18–65, willing to provide informed consent, and had not used antibiotics within the last 3 months. Individuals with oral cancers or significant oral lesions, those undergoing periodontal treatment within the last 6 months, individuals with severe gingivitis and periodontitis, pregnant or lactating women were excluded from the study. Similarly, individuals with comorbidities such as diabetes mellitus, cardiovascular disease, neurological disease, etc. were also excluded. The participants were recruited from dental clinics and community health centres in Peshawar, with informed consent obtained prior to enrolment. A thorough clinical examination was performed to assess the periodontal status using the plaque index (PI), gingival index (GI), probing pocket depth (PPD) measurements, and the clinical attachment level (CAL). Salivary samples were collected by instructing the participants to avoid food and drink for at least 1 hour prior to collection. Unstimulated saliva was gathered by having the participants spit into a sterile container, with samples immediately frozen at -20°C for later analysis. The salivary IgA and IgG levels were quantified using Ray Biotech enzyme-linked immunosorbent assay (ELISA) kits pre-coated with capture antibodies specific to IgA or IgG, following the manufacturer's instructions, and all the assays were performed in duplicate to ensure accuracy.

The data were analysed by means of statistical software SPSS version 25. Descriptive statistics were calculated for the demographic characteristics and immunoglobulin levels. The correlation between the salivary immunoglobulin levels and periodontal parameters were assessed utilizing the Pearson correlation coefficient, with a p-value of < 0.05 considered statistically significant. All the participants were provided with written informed consent.

RESULTS

A total of 99 participants were included in the study, categorized by their oral health status: healthy and non-smoking individuals (33%), individuals with gingivitis who smoke (33%) and individuals with periodontitis being smokers (33%). The demographic characteristics of the participants, including their age, gender, and oral health status, are summarized in Table I.

Table I. Participant demographics

Demographic variable	Healthy (no gingivitis, periodontitis) and non-smokers (n = 100) (33%)	Gingivitis (mild to moderate) and smokers (n = 100) (33%)	Periodontitis (mild to moderate) and smokers (n = 100) (33%)
Age (years)	25.4 ± 5.1	26.8 ± 6.2	28.5 ± 7.1
Gender (male/female)	equal	equal	equal
Socioeconomic status	low: 30%, medium: 50%, high: 20%	low: 35%, medium: 45%, high: 20%	low: 40%, medium: 40%, high: 20%

The mean levels of salivary immunoglobulins IgA and IgG varied significantly among the three groups. The healthy non-smoker group having no other comorbidities had a mean IgA level of 0.4 mg/mL (± 0.2) and an IgG level of 0.3 mg/mL (± 0.1). In contrast, the participants with gingivitis being smokers had higher mean levels of IgA (1.5 mg/mL ± 0.6) and IgG (1.1 mg/mL ± 0.5). The periodontitis group being smokers exhibited the highest mean levels, with IgA at 2.5 mg/mL (± 0.8) and IgG at 2.0 mg/mL ± 0.7 (Table II).

Table II. Salivary immunoglobulin levels

Group	IgA (mg/mL)	IgG (mg/mL)
Healthy and non-smokers (33%)	0.4	0.3
Gingivitis and smokers (33%)	1.5	1.1
Periodontitis and smokers (33%)	2.5	2.0

Bleeding on probing (BOP), PPD, PI, and the functional dentition index (FDI) scores were also significantly different across the groups. The mean BOP was lowest in the healthy non-smoker group (1.0 ± 0.5), increased in the gingivitis smokers' group (5.0 ± 1.5), and was highest in the periodontitis smokers group (7.0 ± 1.8; Table III). Similarly, the mean PPD was 0.0 mm (healthy), 2.0 mm (gingivitis), and 5.5 mm (periodontitis). The PI was higher in the individuals with periodontal disease, averaging 6.5 (periodontitis) compared to 14.0 (healthy).

Also, as the socioeconomical status decreases (more individuals in low socioeconomic status – SES categories), the levels of salivary immunoglobulins (IgA and IgG) tend to increase, indicating a potential relationship between socioeconomic factors and periodontal disease severity. These findings suggest that interventions aimed at improving oral health in lower SES populations could help mitigate the severity of periodontal disease and its immunological consequences (Table IV). The Pearson correlation analysis revealed significant positive correlations between the levels of immunoglobulins (IgA and IgG) and the severity of periodontal disease ($p < 0.01$; Table V). Additionally, a negative correlation was observed between the immunoglobulin levels and clinical parameters such as BOP and PPD.

Table III. Clinical parameters

Group	BOP (%)	PPD (mm)
Healthy and non-smokers (33%)	1.0	0.0
Gingivitis and smokers (33%)	5.0	2.0
Periodontitis and smokers (33%)	7.0	5.5

BOP – bleeding on probing; PPD – probing pocket depth

Table IV. Correlation between socioeconomical status (SES) and immunoglobulin levels

Parameter	Healthy non-smokers	Gingivitis smokers	Periodontitis smokers
Low SES (%)	30%	35%	40%
Medium SES (%)	50%	45%	40%
High SES (%)	20%	20%	20%
IgA level (mg/mL)	0.4	1.5	2.5
IgG level (mg/mL)	0.3	1.1	2.0

IgA – immunoglobulin A; IgG – immunoglobulin G

Table V. Correlation between salivary immunoglobulins and clinical parameters

Immunoglobulin	Clinical parameter	Correlation coefficient (r)	p-value
IgA	BOP (%)	0.75	< 0.01
IgA	PPD (mm)	0.70	< 0.01
IgG	BOP (%)	0.80	< 0.01
IgG	PPD (mm)	0.75	< 0.01

IgA – immunoglobulin A; IgG – immunoglobulin G; BOP – bleeding on probing; PPD – probing pocket depth

DISCUSSION

The findings of this study underscore the significant role that salivary immunoglobulin, particularly IgA and IgG, play in oral health, especially in relation to periodontal disease and the status of smoking and non-smoking. The altered levels of immunoglobulins in individuals with gingivitis and periodontitis highlight their potential as biomarkers for disease severity. Results indicate a clear progression in immunoglobulin levels, where the healthy non-smoking individuals exhibited baseline levels of IgA (0.4 mg/mL) and IgG

(0.3 mg/mL), which increased significantly in individuals who smoke and exhibit gingivitis (IgA: 1.5 mg/mL, IgG: 1.1 mg/mL) and periodontitis (IgA: 2.5 mg/mL, IgG: 2.0 mg/mL). These findings are consistent with previous studies indicating that salivary IgA levels are altered in periodontal disease, suggesting a compensatory immune response to the bacterial challenge in the oral cavity [16,17].

In addition to immunoglobulin levels, the clinical parameters measured in this study, such as BOP and PPD, provide insight into the relationship between the oral immune response and periodontal disease severity. Our data showed an increase in BOP and PPD corresponding to the severity of periodontal conditions, aligning with findings from Joss et al. [18] and Lang et al. [19], which confirmed that these parameters are probable indicators of periodontal health.

Interestingly, while the altered immunoglobulin levels in our smokers with gingivitis and periodontitis groups were consistent with existing literature [20,21], the overall BOP and PPD values in the healthy non--smokers and smokers with gingivitis groups were lower than typically reported. This discrepancy may suggest a regional variation in periodontal disease prevalence or differences in oral hygiene practices in the population studied [22]. Such factors should be considered when interpreting these findings as cultural and socioeconomic differences may influence oral health outcomes. Furthermore, our data showed significant positive correlations between the salivary immunoglobulin levels and the clinical parameters of periodontal disease, echoing previous findings that suggest salivary immunoglobulins could serve as reliable biomarkers for assessing periodontal health [23]. The correlation of elevated IgA with increased BOP and PPD strengthens the argument for their role in the host's immune response to periodontal pathogens. This study also reveals a notable trend: as SES decreases, the levels of salivary immunoglobulins IgA increase, suggesting a link between SES and periodontal disease severity. This aligns with previous research indicating that individuals from lower SES backgrounds often experience worse oral health outcomes [24]. The clinical implications of these findings are significant. Targeted interventions aimed at improving oral health in lower SES populations may help reduce the severity of periodontal disease and its immunological effects. Enhancing access to dental care and education about oral hygiene could play a crucial role in improving health outcomes in these communities.

CONCLUSIONS

This study emphasizes the importance of salivary immunoglobulins as potential biomarkers for periodontal disease and smoking individuals as well as highlights the need for further research in diverse populations to better understand the relationship between immune response and periodontal health. Future studies should explore the underlying mechanisms connecting salivary immunoglobulin levels with clinical outcomes to enhance the diagnostic and therapeutic approaches in periodontal disease management [25,26].

Ethical considerations

This study was conducted in accordance with the principles outlined in the Declaration of Helsinki. Informed consent was acquired from all the participants prior to their enrolment in the study. The participants were provided with comprehensive information regarding the purpose, procedures, potential risks, and benefits of the study. In addition, they were assured that their participation was voluntary and that they could withdraw at any time without any consequence. Ethical approval was received from Ethical Review Board.

Conflict of interest

The author states no conflict of interest.

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