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# Assessment of Periodontal Health in Patients with Alzheimer's disease in Karachi, Pakistan

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## ABSTRACT

Alzheimer's disease (AD), causes permanent loss of neurons and neural connections. **Objective:** To assess the periodontal health status of Alzheimer's disease (AD) patients by assessing plaque index, gingival condition, probing pocket depth, attachment levels, and bleeding on probing, and to correlate these findings with cognitive impairment levels as determined by Mini-Mental State Examination (MMSE) scores. **Methods:** A cross-sectional study, was conducted at Medicare Hospital between July and October 2024. Total 60 patients were recruited in the study. Hence plaque index, gingival condition, probing depth, attachment levels, and bleeding on probing were used to assess periodontal health, whereas MMSE scores were used to classify cognitive impairment. For statistical analysis, ANOVA and unpaired t-test analyses are carried out using SPSS version 24.0. All of the findings were deemed statistically significant if P was less than 0.05. **Results:** The study results revealed that the demographic and neurological parameters such as age, the distribution of genders, and the number of teeth of those patients suffering from Alzheimer's disease. Hence, MMSE scores were significantly lower, indicating substantial cognitive impairment ($P < 0.001$). As the severity of AD increases, there is a trend for all recorded variables to get worse ($p < 0.01$). PPD and CAL reveal more periodontal tissue loss in patients with severe AD, while PI and GI show more plaque accumulation and gingival inflammation. **Conclusions:** This study highlighted a strong link between worsening periodontal health and Alzheimer's severity, emphasizing the need for proactive dental care to improve patient well-being.

## INTRODUCTION

The progressive neurodegenerative disease known as Alzheimer's disease in which there are irreversible neural connections. It causes loss of memory, decline in cognition, and ultimately significant functional reliance and mortality [1]. It is the most commonly occurring form of dementia which is usually found among elderly individuals approximately 60-80% globally [2]. Individuals in the advanced phases become reliant on caretakers, underscoring the significant financial and emotional strain on families and healthcare systems [3, 4]. Chronic inflammatory conditions, known as periodontal disease, affect the periodontium [5, 6]. This has arisen due to microbial dysbiosis in numerous researches [7]. Through alterations in the oral microbiota, which contains a wide variety of microorganisms in the oral cavity, Alzheimer's disease is connected to poor oral health [8, 9]. Recent studies have demonstrated that patients suffering from dementia have more chances of getting Alzheimer's disease. In contrast, those who experienced dementia earlier in life had more severe forms of Alzheimer's disease [10, 11]. Oral pathogens such as Treponema, spirochetes, Porphyromonas gingivalis, and Prevotella intermedia are more prevalent in these patients [12]. According to one theory, these periodontal bacteria could enter the brain through various pathways such as blood-brain barrier, and cause direct damage [13, 14]. Hence, there is little information on how this association shows up in Asian communities, especially in places like Pakistan where oral and neurological health outcomes may be influenced by cultural, nutritional, and medical practices [15].

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Furthermore, the frequency and severity of periodontal disease among Alzheimer's disease patients may be significantly influenced by socioeconomic characteristics, dental care accessibility, and knowledge of oral hygiene habits in Pakistani communities. By assessing periodontal health in Alzheimer's patients while taking into account regional sociocultural and healthcare aspects, this study fills a gap in the body of existing data. The results of this study may influence interdisciplinary techniques to better manage Alzheimer's disease, enhance oral healthcare procedures for neurodegenerative patients, and influence public health policy.

Although growing global evidence suggests a relationship between Alzheimer's disease and periodontal deterioration, limited regional research exists in Pakistan examining how cognitive decline specifically influences periodontal health status. Most prior studies have not adequately explored this association within Pakistani populations, where oral hygiene practices, healthcare access, and sociocultural factors may significantly alter outcomes. Therefore, this study aimed to assess periodontal health parameters in Alzheimer's patients, correlate these findings with cognitive impairment severity, and address the regional evidence gap to support integrated neurological and dental healthcare strategies.

## METHODS

The cross-sectional research was conducted at Medicare Hospital from July to October of 2024. ERB/JMDC/Approval# 00021124 was the reference number. Purposive sample was used to determine the periodontal health of Alzheimer's disease patients. Hence, clinical attachment loss (CAL) was used as the primary parameter as it is the most reliable predictor for the advancement of periodontal disease. Based on a 95% confidence interval and the anticipated prevalence of periodontal disease among AD patients, a total sample size of 60 participants was produced using Open Epi software. Participants who were 50 years of age or older and had a confirmed diagnosis of AD were eligible. Participants had to have at least 12 natural teeth to be recruited those with mental, behavioral, or systemic conditions that affect oral health assessment, those taking drugs that affect cognition, and those who had had periodontal therapy within the previous six months were not part of the study. The goal of the study was explained to each selected participant, informed consent was taken from them. Further, the participants were allowed to leave the study at any time. Various tests were of the participants was taken to evaluate their mental and health status. The diagnosis was further confirmed by MRI and CT scans. Mini-Mental State Examination (MMSE) was used to measure the cognitive impairment. Four groups were made of participants on the basis of severity of condition such as it was considered mild (score ≥25), moderate (scoring ≥11), severe (score ≤10), and normal (score ≥26). The periodontal health status of patients was assessed such as Index of plaque and gingivae, level of Clinical Attachment. Hence the severity of Periodontal Disease was determined by Probing Pocket Depth (PPD), and bleeding on probing (%BOP). The level of Oral hygiene was classified as good, fair, or poor on the basis of index of periodontal and gingiva. The thickness of dental plaque which is present on tooth surfaces is measured through plaque index, with scores ranging from 0 which means no plaque to 3 means excessive plaque.The redness, swelling, and bleeding upon probing, with scores from 0 (representing healthy gingiva) to 3 (indicating severe inflammation) helps to examine the gingival inflammation through gingival index. Periodontal probe is used to measure the depth of periodontal pockets and patients with deeper pockets shows that they have advanced periodontitis. Clinical Attachment Level (CAL) measures periodontal tissue loss by determining the distance from the cementoenamel junction to the base of the pocket. The percentage of sites exhibiting Bleeding on Probing (%BOP) reflects the severity of gingival inflammation, more chances of periodontal disease progression. To analyze the data, SPSS version 24.0 was used. The mean ± SD was used to report descriptive statistics. The differences among the groups in the severity of AD were assessed using a one-way ANOVA, and the clinical and demographic characteristics of the two groups were compared using unpaired t-tests. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

The results of the study revealed demographic factors of participants suffering from Alzheimer's disease. Hence, MMSE scores were significantly lower, indicating substantial cognitive impairment ($P < 0.001$) as shown in table 1.

**Table 1:** Demographic Factors of Participants with Alzheimer's disease

| Variables | Participants with Alzheimer's Disease AD | Participants who are Non-Cognitively Impaired | p-Value |
|---|---|---|---|
| Age (Mean ± SD) | 66.3 ± 8.1 | 63.8 ± 7.9 | <0.001* |
| **Gender** | | | |
| Male | 27/60 = 45.0% | 27/62 = 43.5% | |
| Female | 33/60 = 55.0% | 35/62 = 56.5% | |
| Total teeth present | 15.5 ± 3.9 | 16.7 ± 4.1 | |
| **Status of Oral Hygiene** | | | |
| Good | 3/60 = 5.0% | 10/62 = 16.1% | |
| Fair | 18/60 = 30.0% | 19/62 = 30.6% | |
| Poor | 39/60 = 65.0% | 33/62 = 53.2% | |
| Mini-Mental State Examination Scores | 13.8 ± 7.9 | 28.9 ± 1.1 | |

*P < 0.05 is considered statistically significant

As shown in Table 2 the severity of AD increases, there is a trend for all recorded variables Plaque index, gingival index, Probing Pocket Depth, Clinical Attachment Level, and %

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Bleeding on Probing to get worse ($p < 0.01$). PPD and CAL reveal more periodontal tissue loss in patients with severe AD, while PI and GI show more plaque accumulation and gingival inflammation.

**Table 2:** Groupwise Assessments Periodontal Parameters

| Assessment of Parameters | Participants with Alzheimer's Disease AD Normal (Mean ± SD) | Participants with Alzheimer's Disease AD Mild (Mean ± SD) | Participants with Alzheimer's Disease AD Moderate (Mean ± SD) | Participants with Alzheimer's Disease AD Severe (Mean ± SD) | p-Value |
|---|---|---|---|---|---|
| Plaque Index (PI) | 1.42 ± 0.30 | 1.95 ± 0.22 | 2.60 ± 0.18 | 3.52 ± 0.35 | < 0.01* |
| Gingival Index (GI) | 0.60 ± 0.20 | 1.12 ± 0.25 | 1.68 ± 0.22 | 2.30 ± 0.30 | < 0.01* |
| Probing Pocket Depth (PPD) | 2.32 ± 0.48 | 3.12 ± 0.42 | 4.05 ± 0.38 | 5.10 ± 0.55 | < 0.01* |
| Clinical Attachment Level (CAL) | 2.72 ± 0.52 | 3.52 ± 0.38 | 4.50 ± 0.45 | 5.63 ± 0.57 | < 0.01* |
| % Sites with Bleeding on Probing (%BOP) | 31.00 ± 5.70 | 39.10 ± 5.30 | 57.20 ± 7.00 | 69.50 ± 12.70 | < 0.01* |

## DISCUSSION

In recent times medical research has been greatly emphasizing the connection between periodontal health and Alzheimer's disease. According to the findings, Alzheimer's disease patients' periodontal health considerably declined as the illness worsened. These results demonstrate the complex connection between oral health and cognitive decline, which is in line with another research done worldwide [16]. One of the studies conducted in 2023 observed similar results [17]. Hence, due to their poor oral hygiene, the inflammatory markers were directly impacted as some of the variables help in the spread of severe periodontal parameters such as inflammation of gums and increased buildup of plaque [18]. The study conducted revealed a high correlation between the deterioration of periodontal diseases and the degree of cognitive impairment. Periodontal indicators showed clear distinctions across the cognitive phases (normal, mild, moderate, and severe Alzheimer's disease. Hence, similar results were observed in earlier research, in which results revealed that the severe Alzheimer's disease group's mean index of plaque and gingival were more than those of the normal group [19]. Patients with severe Alzheimer's disease frequently struggle to carry out everyday tasks, such as keeping their teeth clean. As these patients are unable to take sufficient nutritional intake, they cannot clean their mouths properly, and irregular brushing all contribute to the fast advancement of periodontal disease [20]. The results showed Probing Pocket Depth and Clinical Attachment Level were higher. This finding implies that periodontal tissue damage exacerbates with worsening cognitive deterioration. Similar results were revealed in which dementia patients had considerably greater PPD and CAL than non-demented controls. These alterations reflect the development of periodontal disease, in which microbial biofilm buildup and persistent inflammation progressively weaken the alveolar bone and connective tissues [21, 22]. Further, the results showed that the bleeding on probing also increased significantly in the severe stages. This represents the gingival inflammatory response which is a typical clinical sign of active periodontal disease. Gingival bleeding is a symptom of gingivitis, which is frequently the initial stage of periodontal disease, according to earlier research [23]. Gingival inflammation was more common which can progress to more serious periodontal diseases and if left untreated, then bleeding on probing will be increased [24]. The main limitations of the study were the study design due to which the capacity to establish a causal relationship between the disease and periodontium was limited. Furthermore, the influence of additional variables that can shed more light on the variation in periodontal health among Alzheimer's patients, such as socioeconomic level, medication usage, and nutritional status, was not investigated. This study provides useful information for Pakistan, a country with less research on this topic. Further, the necessity of focused dental care interventions for those with Alzheimer's disease, was planned. Hence, counseling of caretakers regarding oral hygiene was essential to reduce the negative consequences of these patients related to poor periodontal health [25]. The results highlight how crucial it is to include dental care in Alzheimer's patients' treatment plans to improve oral health and maybe delay the rate of cognitive deterioration. Furthermore, studies are required to investigate therapeutic and preventative measures meant to enhance these people's dental and cognitive health outcomes.

A major limitation of this study is its cross-sectional single-center design, which restricts causal interpretation between periodontal disease progression and Alzheimer's severity. The relatively small sample size and lack of evaluation of confounding factors such as socioeconomic status, medication use, and nutritional condition further limit generalizability. Future multicenter longitudinal studies with larger cohorts are recommended to clarify causal pathways, investigate modifiable risk factors, and develop preventive oral healthcare interventions that may improve both periodontal and cognitive outcomes in Alzheimer's patients.

## CONCLUSIONS

The research underscores a strong link between deteriorating health of periodontium and the advancement of Alzheimer's disease. As cognitive function declines, the severity of periodontitis intensifies, driven by plaque

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accumulation, inflammation of the gums, and loss of tissue. It is crucial to emphasize the importance of oral healthcare, as inadequate periodontal health may hasten cognitive decline. Incorporating proactive dental care into treatment strategies and providing education to caregivers regarding oral hygiene can help in improving oral health care.

## Authors' Contribution

Conceptualization: UM, SR
Methodology: MIK
Formal analysis: UM, RT, HBZ
Writing and Drafting: HBZ, AA
Review and Editing: HBZ, AA, MUK, SR, AA

All authors approved the final manuscript and take responsibility for the integrity of the work

## Conflicts of Interest

All the authors declare no conflict of interest.

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