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# Periodontal Disease in Adults and Associated Risks for Alzheimer's Disease: Population-Oriented Cross-Sectional Study in Uttar Pradesh

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**KEYWORDS**

Alzheimer's disease; periodontal disease; incidence; dental prophylaxis.

**ABSTRACT:**

The study identifying the relationship between the longitudinal risks of developing periodontal disease within a group of Alzheimer's sufferers of 231,502,578 individuals. The groups' incidence rates of Alzheimer's disease were contrasted. Cox regression was used to examine the relationship between Parkinson's disease (PD) and Alzheimer's disease, taking into account factors such as comorbidities, age, sex, monthly income, and residence urbanicity. When compared to individuals who had dental prophylaxis and rigorous treatment (0.41% year), the incidence rate of Alzheimer's disease was significantly greater among those who did not receive treatment or had teeth pulled (0.63% annually) (P <.001). The group with Parkinson's disease (PD) who did not receive treatment (hazard ratio (HR) = 1.19, 95% confidence interval (CI) = 1.06–1.25) and the group that had teeth extracted (HR = 1.17, 95% CI = 1.05–1.18) had a higher risk of Alzheimer's disease after controlling for confounders, according to the Cox proportional hazards model. The study also found that severe periodontal disease or non-treatment was associated with an advanced threat of developing Alzheimer's disease.

## 1. Introduction

Alzheimer's disease, a global health concern, is expected to quadruple by 2050, with 48% of cases in Asia [1]. Its incidence rates are higher in developing countries and cost $73 billion annually. Risk factors include age, apolipoprotein E e4 allele, family history, and chronic inflammation [2].

Globally, Periodontal Disease affects 20-50% of the population, with gingivitis prevalent in 82% of adolescents and 50% of adults. Dental biofilm forms on teeth, forming dental calculus, leading to soft-tissue inflammation and tooth loss. Factors affecting prevalence include probing index, bleeding index, attachment level, and tooth mobility [3].

Five-year findings from the "Diabetes and Vascular Disease Action The Preterax and Diamicron Modified-Release Controlled Evaluation" experiment demonstrated that periodontitis, particularly in older adults, was the primary cause of tooth loss and that those with fewer teeth had a higher risk of cognitive decline and Alzheimer's disease. Poor dental hygiene has been shown to be a predictor of Alzheimer's disease [4], however the underlying cause has received very little attention.

Pathogens that cause periodontal disease (PD), including as Porphyromonas gingivalis and Aggregatibacter actinomycetemcomitans, raise inflammatory proteins and increase the risk of atherosclerosis. Dental prophylaxis can lessen the risk of stroke, esophageal cancer, and acute myocardial infarction in both PD patients and non-PD patients with severe Parkinson's disease [5].

As far as the authors of the current study were apprehensive, no former study has assessed the effect of PD inflexibility or affiliated treatment on the prevalence of Alzheimer's disease. This study used medical records recaptured from the Uttar Pradesh NHIRD to relating the relationship between the longitudinal pitfalls of developing periodontitis in a cohort of cases with Alzheimer's disease.

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## 2. Materials and Methods

### 2.1 Data Sources

Medical records of the participants were obtained from LHID 2023, the Longitudinal Health Insurance Database. The NHIRD was used in numerous publications that were published in international peer-reviewed journals [6], and the high validity of the study was addressed [7]. The study used the LHID 2023 to retrieve medical records from 1 million beneficiaries in Uttar Pradesh. The NHI program, which covers up to 99% of residents, offers comprehensive medical care. The study was reviewed by an institutional review board, determining no need for written informed consent.

### 2.2 Study Design

Follow-up was conducted from 2013 to 2023 with subjects who were heirs progressed 45 and older, with dental checkups for PD and recorded in the LHID 2023. ICD-9-CM (International Classification of Diseases, Ninth Revision, Clinical Modification) codes were used to classify the subjects as having Parkinson's disease (PD), Alzheimer's disease, and other comorbidities [8]. Participants whose coitus was unknown (n = 46) and those whose Alzheimer's disease onset occurred prior to PD opinion or the indicator period (n = 1,899) were excluded. As a result, information covering over 1,304,775 person-years and 231,502,578 subjects was included.

ICD-9-CM and PD treatment codes were utilized in this study to categorize patients with periodontitis, including those with gingivitis, gingival recession, and acute or chronic periodontitis. Periodontal and dental prophylaxis treatments were graded according to severity using PD treatment codes.

Based on the most advanced periodontal therapy entered, participants with Parkinson's disease (PD) were split into four groups for the 10-year follow-up period. Only dental prophylaxis, or scaling of the teeth, was administered to Group 1 members (n = 145,856,883). Group 2 (n = 139,672) members underwent extensive periodontal procedures, such as subgingival curettage, root planing, and periodontal flap surgery. Group 3 consisted of subjects with PD who needed to have their teeth extracted (n = 1,007,802). Group 4 consisted of subjects who did not receive any of these therapies (n = 84,498,221). The entry date for each member of the cohort was their first-ever visit to an itinerant care provider for Parkinson's disease (PD) between 2013 and 2023. All subjects were tracked until the date of the Alzheimer's complaint opinion, the subject's death, or the study's conclusion (December 31, 2013), whichever happened first.

The study examined the comorbidities of people with Alzheimer's disease (AD), vascular AD, senile AD, and other forms of AD. Age, sex, socioeconomic position, and residential urbanity were among the variables. The subjects were categorized into residential urbanicity, age groups, and socioeconomic status categories, which allowed for the division of the subjects into rural and metropolitan areas.

### 2.3 Statistical Methods

Exposure was given enough time to compute. The incidence of Alzheimer's disease was compared using IRs, which is calculated as the number of cases per 100 person-years (%)/year. Using a Cox commensurable hazards model, the null hypothesis—that PD isn't a threat factor for the beginning of Alzheimer's disease was tested. The group that received dental prophylaxis used as the standard when calculating the hazard rates (HRs) for the other three PD groups. The data was analyzed using SPSS program (interpretation 27.0.1).

## 3. Results

7,987 of the 231,502,578 participants had Alzheimer's disease, yielding an overall incidence rate (IR) of 0.51% per year for Alzheimer's disease (Table 1). From 0.19%/year for participants 45–64 to 1.26%/year for those 65–74 to 2.64%/year for those 75 and above, the IRs for Alzheimer's disease increased considerably with age (P <.001). Compared to people with higher income employment, subjects enrolled in documented monthly incomes were more likely to develop Alzheimer's disease. IRs for Alzheimer's disease were, according to P <.001, 0.30%/year for subjects with incomes under 20,000, 0.29%/year for those with incomes between 20,000 and 39,999, and 0.41%/year for those with incomes over 40,000. For individuals with Alzheimer's disease, the IRs were 0.52%/year for those living in cities and 0.75%/year for those living in rural regions (P <.001). Alzheimer's disease risk was considerably increased (P <.001) in subjects with hypertension (IR = 0.65%/year), diabetes mellitus (IR = 0.67%/year), and

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hyperlipidemia (IR = 0.42%/year). Out of 7,987 PD participants who had just been diagnosed with Alzheimer's disease, 4,159 had dental prophylaxis (IR = 0.41%/year), 107 had extensive therapy (IR = 0.37%/year), 2,987 had tooth extractions (IR = 0.68%/year), and 734 had no treatment (IR = 0.88%/year). Overall, the treatment outcomes were as follows. The group that received no treatment had the highest IR for Alzheimer's disease (P <.001).

**Table 1.** Baseline Characteristics of the Study Subjects

| **Total** | | | | | |
|---|---|---|---|---|---|
| **Variables** | **n** | **Alzheimer's No.** | **Person-Year** | **ID (% Per Year)** | **$X^2$ Test *P*-Value** |
| Total | 231,502,578 | 7,987 | 1,304,775 | 0.51 | |
| Age at baseline (year) | | | | | <.001 |
| 45–64 | 115,751,289 | 1,560 | 993,795 | 0.19 | |
| 65–74 | 77,167,526 | 2,673 | 229,332 | 1.26 | |
| ≥75 | 38,583,763 | 1,900 | 81,647 | 2.64 | |
| Gender | | | | | .444 |
| Male | 200,078,754 | 3,068 | 658,562 | 0.47 | |
| Female | 31,423,824 | 3,065 | 646,212 | 0.47 | |
| Socioeconomic Status | | | | | <.001 |
| <20,000 | 19,291,881 | 771 | 265,801 | 0.30 | |
| 20,000–39,999 | 135,043,171 | 794 | 297,971 | 0.29 | |
| ≥40,000 | 77,167,526 | 947 | 265,286 | 0.41 | |
| Residential urbanicity | | | | | <.001 |
| Urban | 145,900,895 | 3,518 | 808,907 | 0.52 | |
| Rural | 85,601,683 | 732 | 120,943 | 0.75 | |
| Co-morbidity | | | | | |
| Hypertension | 95,901 | 4,489 | 682,146 | 0.65 | <.001 |
| Diabetes | 45,682 | 2,044 | 328,728 | 0.67 | <.001 |
| Hyperlipidemia | 61,980 | 1,967 | 446,359 | 0.42 | <.001 |
| Periodontal Disease | | | | | <.001 |

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| | | | | |
|---|---|---|---|---|
| Dental Prophylaxis | 145,856,883 | 4,159 | 780,786 | 0.41 |
| Intensive Treatment | 139,672 | 107 | 30,134 | 0.37 |
| PD with tooth Extraction | 1,007,802 | 2,987 | 408,246 | 0.68 |
| PD without Treatment | 84,498,221 | 734 | 85,607 | 0.88 |

Following the stratification of the four Parkinson's disease (PD) groups based on variables such as age, sex, income, residential urbanicity, and comorbidity, Table 2 reveals notable patterns in Alzheimer's disease incidence rates. Particularly, the group receiving no treatment exhibited the highest incidence rate, while the cohort undergoing intensive treatment and dental prophylaxis demonstrated a consistently lower risk of Alzheimer's disease across all variable subgroups, except for individuals aged 75 years or older. A chi-square test indicated a significant linear trend ($P \leq .001$) in the association between Alzheimer's disease risk and age, sex, monthly income exceeding $20,000, hypertension, and hyperlipidemia across all four PD groups.

Further analysis using a multiple Cox proportional hazards model, accounting for various factors, revealed that individuals who underwent tooth extraction (HR = 1.17, 95% confidence interval [CI] = 1.05–1.18) and those who received no treatment (HR = 1.19, 95% CI = 1.06–1.25) had a significantly elevated risk of Alzheimer's disease compared to those who underwent dental prophylaxis. Additionally, the multivariate Cox regression model highlighted that individual with hypertension (HR = 1.43, 95% CI = 1.35–1.54), diabetes mellitus (HR = 1.25, 95% CI = 1.17–1.31), and women (HR = 1.22, 95% CI = 1.19–1.28) were more predisposed to developing Alzheimer's disease. These findings underscore the complex interplay of dental interventions and various health factors in influencing the risk of Alzheimer's disease within the context of Parkinson's disease.

**Table 2.** Cox Regression Model for Predictor of Alzheimer's disease Development

| **Variables** | **Univariate** | | **Multivariate[a]** | |
|---|---|---|---|---|
| | **HR** | **95% CI** | **HR** | **95% CI** |
| Age | | | | |
| 45–64 | 1.00 | | 1.00 | |
| 65–74 | 7.41 | 6.96–7.89 | 6.21 | 5.84–6.65 |
| ≥75 | 14.81 | 13.76–15.91 | 12.14 | 11.28–13.10 |
| Gender | | | | |
| Male | 1.00 | | 1.00 | |
| Female | 0.98 | 0.95–1.03 | 1.22 | 1.19–1.28 |
| Socioeconomic Status | | | | |
| <20,000 | 1.00 | | 1.00 | |
| 20,000–39,999 | 0.93 | 0.85–1.04 | 1.02 | 0.92–1.13 |
| ≥40,000 | 1.24 | 1.15–1.36 | 1.03 | 0.94–1.14 |
| Residential urbanicity | | | | |

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| | | | | |
|---|---|---|---|---|
| Urban | 1.00 | | 1.00 | |
| Rural | 1.40 | 1.29–1.52 | 1.02 | 0.94–1.13 |
| Co-morbidity | | | | |
| Hypertension | 2.49 | 2.36–2.64 | 1.43 | 1.35–1.54 |
| Diabetes | 1.48 | 1.41–1.57 | 1.25 | 1.17–1.31 |
| Hyperlipidemia | 0.91 | 0.87–0.98 | 0.88 | 0.83–0.93 |
| Periodontal Disease | | | | |
| Dental Prophylaxis | 1.00 | | 1.00 | |
| Intensive Treatment | 0.92 | 0.79–1.13 | 1.18 | 0.97–1.43 |
| PD with tooth Extraction | 1.48 | 1.41–1.59 | 1.17 | 1.05–1.18 |
| PD without Treatment | 2.01 | 1.87–2.20 | 1.19 | 1.06–1.25 |

[a] Multivariate cox regression analysis.

## 4. Discussion

A crucial threat factor for Alzheimer's disease is periodontal disease, participants with more severe PD or those who did not receive PD treatment had an advanced probability of developing the condition than those who had dental prophylaxis. This was the first population-based cohort study, as far as the authors are aware, to look at the relationship between PD severity and Alzheimer's disease incidence in Uttar Pradesh.

The first symptoms of PD are Gingivitis; periodontitis therapy has been shown to help with the restoration of normal periodontium at this stage. Tooth extraction may be the only treatment option in cases where migration or tooth mobility is observed at an advanced stage of disease. If the inflammation also extends to soft tissues, invasive treatment may be necessary.

The IRs for Alzheimer's disease was 0.19%/year for those 45–64, 1.26%/year for those 65–74, and 2.64%/year for those 75 and beyond. In this study, 79.9% of participants who had dental prophylaxis were aged 45–64, 16.3% were aged 65–74, and only 5.1% were aged 75 and older. These findings may be due to tooth loss in elderly adults or limited access to preventive dental treatment in people with advanced Parkinson's disease [9]. Therefore, it's possible that the benefit of dental prophylaxis in preventing Alzheimer's disease complaints was underestimated in the elderly age groups. Individuals with Parkinson's disease (PD) who receive only emergency periodontal treatment or prescription have a significantly higher risk of Alzheimer's disease compared to those who receive dental prophylaxis.

A meta-analysis revealed that Alzheimer's disease prevalence in developing countries will increase by 200% by 2023, with two- thirds of those aged 60 and aged living with the disease [10]. In the current investigation, the association between the stage of Parkinson's disease and Alzheimer's disease may be influenced by age. In patients younger than 75, the risk of Alzheimer's disease rose with PD inflexibility; however, this effect did not hold true for subjects 75 and older.

No effective prevention or treatment for Alzheimer’s disease has been discovered. Delaying AD onset for 5 years is estimated to lead to a 50% reduction in incidence over the next 50 years. In 2050 a reduction of 9.2 million cases would be achieved if any intervention could delay disease onset or progression by at least one year [11].

Threat factors for Alzheimer's disease include age, coitus, negative early- life events, inheritable association, salutary factors, stroke, and vascular complaint. Metabolic threat factors, including inflammation, may modify the association. High interleukin- 6 and CRP situations in cognitive disabled elders with metabolic pattern may be labels for announcement development. The Framingham Study investigated if conditions involving advanced interleukin-1 could serve as a signal for the development of announcements [12]. Once germs penetrate the bloodstream, an oral infection turns into a

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systemic infection, and Alzheimer's disease may have a higher aetiology due to seditious susceptible responses [13]. The hypothesis that chronic inflammation can raise the risk of cognitive decline and Alzheimer's disease is supported by these reports [13].

Chronic neuro-degeneration is linked to increased interleukin 1b stashing, and periodontal infection can lead to systemic inflammation. Furthermore, prospective research of airmen revealed a correlation between an increased pace of cognitive loss in individuals with Alzheimer's disease and systemic infection as well as elevated serum cytokine conditions [14]. Additionally, it is accepted that a key role for chronic inflammation plays in the central nervous system during the aetiology of stroke and Alzheimer's disease.

Although the exact mechanisms linking Parkinson's complaint (PD) to Alzheimer's complaint are still not completely understood, it's known that PD, a largely current habitual seditious complaint, increases the threat of a number of systemic ails, including cancer, diabetes mellitus, pulmonary complaint, cardiovascular complaint, and unseasonable low- birth weight babies [15]. A systemic seditious state is reflected in periodontal conditions and known intercessors of systemic inflammation similar cytokines, chemokines, and prostaglandins may be unintentionally linked to PD [16]. It has also been claimed that announcement and brain inflammation are nearly related.

This study uses a civil population-grounded database to assess the relationship between Parkinson's disease (PD) and Alzheimer's disease. The Bureau of National Health Insurance collects maps from medical centers to minimize bias. The study uses ICD-9-CM canons and a lower sample size, fastening on definite cases rather than early cognitive decline. In order to reduce excessive coding and non-differential misclassification bias, the addition criteria may include at least one outpatient visit or more than three hospital stays.

Present results showed that the risk of Alzheimer's disease was significantly increase by chronic inflammatory diseases like PD particularly in those without treatment or severe PD, indicating a link between these conditions.

## 5. Conclusion

Subjects with more severe PD and those who had not undergone PD treatment had a higher probability of getting Alzheimer's disease. By maintaining better dental hygiene and seeking treatment to reduce tissue inflammation, people can reduce or delay the onset of Alzheimer's disease, which is preventable and treated like PD.

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