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Periodontitis and Incident Diabetes Mellitus: A Nationwide Cohort Study From Korea

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1 | Introduction

Periodontitis (PD) is a chronic inflammatory disease characterized by destruction of tooth-supporting tissues and has been increasingly linked to diabetes mellitus (DM). Periodontal inflammation may contribute to systemic metabolic dysregulation through inflammatory mediators, oxidative stress, and endothelial dysfunction, thereby worsening insulin resistance [1–3]. However, previous studies often relied on cross-sectional designs or heterogeneous exposure definitions, limiting causal interpretation and comparability [1, 4]. In particular, claims-based studies using ICD codes alone may misclassify gingivitis or mild disease as PD. Therefore, a more specific exposure definition incorporating treatment procedures is needed.

Using a nationwide Korean cohort and a washout design to strengthen temporality, the present study aimed to investigate the association between clinically treated PD and incident DM.

2 | Methods

We conducted a retrospective cohort study using the Korean National Health Insurance Service–National Sample Cohort (NHIS–NSC) from 2002 to 2019. Adults aged ≥19 years who underwent national health screening in 2009 were eligible. Individuals with any diagnosis of PD (ICD-10 K05), periodontal treatment procedure codes, or DM (ICD-10 E10–E14) during the washout period (2002–2008) were excluded to minimize reverse causality and ensure incident case identification. Baseline was defined as January 1, 2009.

Treated PD was defined as ICD-10 code K05 combined with at least one periodontal treatment procedure code (U2211, U2232, or U2240) during 2009. Incident DM was defined as the first occurrence of ICD-10 codes E10–E14 during follow-up (2009–2019). Participants were followed until DM diagnosis, death, or December 31, 2019.

Cox proportional hazards regression models estimated hazard ratios (HRs) and 95% confidence intervals (CIs). The multivariable model adjusted for age (continuous), sex, income level, region, smoking, alcohol consumption, physical activity, body mass index, total cholesterol (continuous), and disability status. Effect modification by sex was tested using an interaction term (PD × sex). Sensitivity analyses applied alternative washout periods (3-year and 5-year) and stricter exposure definitions based on periodontal treatment frequency (≥2 and ≥3 procedures).

3 | Results

A total of 73 907 participants aged ≥19 years were included, of whom 19 866 (26.9%) had treated PD at baseline and 54 041 (73.1%) did not (Table S1). Participants with treated PD tended to be older and showed a less favorable metabolic profile (including body mass index and total cholesterol) at baseline (all $p < 0.001$).

Shi Jun Park and Su-Min Park contributed equally to this work and shared first authorship.

During follow-up (2009–2019), 22 311 incident DM cases were identified (13 061 in the non-PD group; 7250 in the PD group).

In the multivariable Cox model, treated PD was significantly associated with incident DM (HR 1.329, 95% CI 1.290–1.369; $p < 0.0001$) (Table 1). Kaplan–Meier curves showed consistently higher cumulative incidence of DM among participants with PD (Figure 1).

TABLE 1 | Association between periodontitis and incident diabetes mellitus (multivariable Cox proportional hazards model).

Variables	HR	95% CI	*p*
Periodontitis (overall)			
No	1.00		
Yes	1.329	(1.290–1.369)	< 0.0001
Periodontitis (Men)			
No	1.00		
Yes	1.450	(1.400–1.510)	< 0.0001
Periodontitis (Women)			
No	1.00		
Yes	1.340	(1.270–1.380)	< 0.0001
Interaction			
(PD × Sex)			0.0196
Age			
Per 10 years	1.669	(1.647–1.692)	< 0.0001
Total Cholesterol			
Per 10 mg/dL	1.008	(1.006–1.010)	< 0.0001

Note: Adjusted for income, region, smoking, alcohol, physical activity, disability, and BMI.

Sensitivity analyses using alternative washout periods (3-year and 5-year) and stricter exposure definitions (≥ 2 and ≥ 3 periodontal treatment procedures) produced similar estimates, supporting the robustness of the findings (Tables S2–S4).

4 | Discussion

In this nationwide cohort study, baseline treated PD was independently associated with an increased risk of incident DM. This finding is consistent with cohort evidence supporting a longitudinal relationship between periodontal inflammation and metabolic outcomes [1, 5, 6]. Our study strengthens prior claims-based research by applying a washout design and a treatment-based definition, improving exposure specificity and temporality.

The association is biologically plausible, as PD may contribute to systemic inflammation through mediators such as interleukin-6 and tumor necrosis factor-α, which can impair glucose metabolism and worsen insulin resistance [2, 3]. In addition, prior cohort studies have suggested that improved oral hygiene or recovery from periodontal disease may reduce diabetes risk, supporting potential clinical relevance [5, 6]. Sensitivity analyses using alternative washout periods (3-year and 5-year) yielded consistent estimates, and stronger exposure definitions based on higher periodontal treatment frequency (≥ 3 procedures) showed a tendency toward greater risk, supporting the robustness of the findings.

Several limitations should be considered. First, PD and DM were defined using administrative claims, and clinical indicators such as periodontal probing depth or HbA1c were unavailable. Second, PD status was assessed only at baseline, preventing time-varying assessment of disease progression or treatment. Third, surveillance bias may exist because individuals receiving periodontal treatment could have more frequent healthcare contact. Finally, residual confounding cannot be fully excluded.

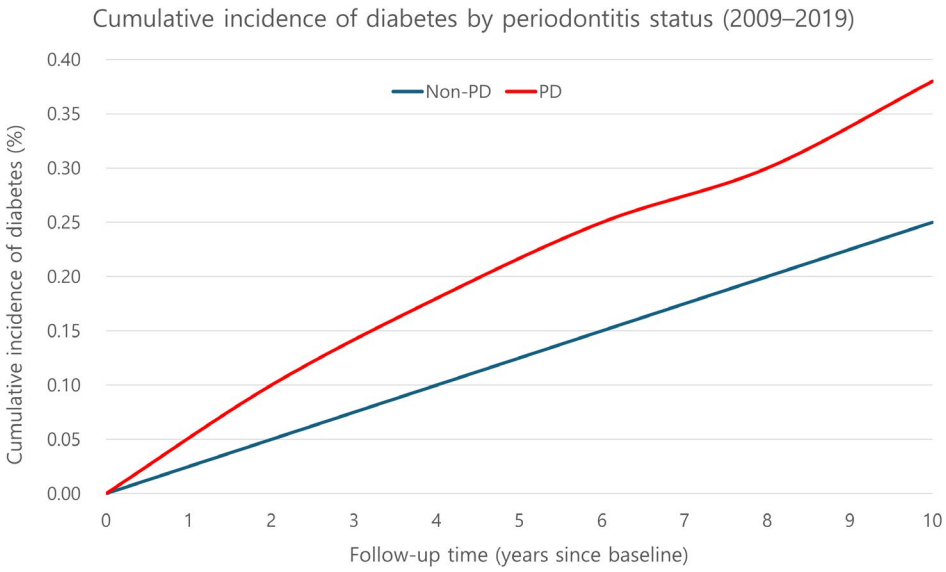

FIGURE 1 | Cumulative incidence of diabetes mellitus according to periodontitis status (2009–2019). The incidence rate was 24.85 per 1000 person-years in the nonperiodontitis group and 43.27 per 1000 person-years in the periodontitis group. Median follow-up was 11.00 years (IQR 10.92–11.00) and 10.23 years (IQR 6.79–10.63), respectively.

5 | Conclusion

Baseline treated PD was associated with significantly increased risk of incident DM during an average follow-up of more than 10 years in a nationwide Korean cohort. These findings support the importance of integrating periodontal management into diabetes prevention strategies and strengthening collaboration between dental and medical care systems.

Disclosure

AI statement: The authors declare that no generative artificial intelligence (AI) tools were used to generate the scientific content of this manuscript. AI-based tools were used solely for language editing and clarity improvement, and all final content, interpretation, and conclusions were reviewed and approved by the authors.

Data Availability Statement

The data that support the findings of this study are available from Korean National Health Insurance Service (NHIS). Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the author(s) with the permission of Korean National Health Insurance Service (NHIS).

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** Baseline characteristics of the study population according to periodontitis status (2009). **Table S2:** Sensitivity analysis using alternative washout periods (cohort eligibility unchanged). **Table S3:** Sensitivity analyses using alternative exposure definitions based on periodontal procedure patterns. **Table S4:** Sex-stratified Cox regression models and interaction test for effect modification.