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Dental Pocket and Type 2 Diabetes among Elderly People Aged 88 in Japan

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Abstract

Background: This study aimed to clarify the relationship between periodontal pocket depth and type 2 diabetes in individuals aged 88. We examined the relationship between periodontal pockets and type 2 diabetes in 590 older adults aged 88 years in Japan.

Method: The subjects of this study were 664 individuals who underwent a dental check-ups in Matsudo city for individuals aged 88 years. The periodontal pocket recorded by trained dentists was categorized as healthy and mildly equated pocket <5 mm. We performed univariate and multivariate binomial logistic regression analyses to examine the association of the type of dental pocket and type 2 diabetes. Unadjusted and covariate-adjusted odds ratios (ORs) and 95％confidence intervals (CIs) were calculated for the type 2 diabetes.

Results: Valid responses without missing data from 590 respondents were used in the analyses. The multivariate analysis indicated a significant association between deep periodontal pockets and type 2 diabetes (OR: 2.02, 95%CI: 1.13-3.59).

Conclusion: This survey indicated the possibility that the prevalence of type 2 diabetes was high among older adults aged 88 years with deep periodontal pockets. A synergistic improvement effect can be expected from the health management for older adults in later stages, which includes glycemic control and oral health management. The study recommends that proper dental health check-up and maintenance of good oral health are important for preventing type 2 diabetes even in individuals aged 88.

Keywords: Diabetes, Periodontal pockets, Dental check-up, Geriatric preventive health

1. Introduction

Type 2 diabetes is a worldwide significant and growing health problem and requires long-term care (International Diabetes Federation, 2021). The progression of type 2 diabetes deteriorates patients' quality of life and a significant adverse effect on the nationwide expenditure for healthcare (Ripsin, 2009). A dozen of risk factors of type 2 diabetes have been demonstrated, including low physical activity (Dotevall, 2004), smoking habit (Willi, 2007), and drinking habit (Waki, 2005). Dental diseases including periodontitis has been identified as a risk factor of type 2 diabetes and (Miyawaki, 2016; Preshaw, 2012).

Among older adults the prevalence of dental disease including dental caries and periodontal is high Dental caries and periodontal disease account for approximately 90% of tooth loss cases, deteriorating quality of life (Ministry of Health, Labour and Welfare 2016). Periodontal disease results from bacteria making endotoxins, which affect insulin activity and make it hard to regulate blood sugar levels (Pihlstrom, 2005). Treating periodontal disease

reduces the amount of C-reactive protein (Iwamoto, 2003). Having periodontal disease increases the chance of developing macrovascular problems in patients who have type 2 diabetes and moderate obesity (Nishimura, 2006). As periodontal disease lowers masticatory ability, people eat more of the easy-to-chew sweets; they avoid vegetables that have a lot of dietary fiber, and they increase their intake of sugars such as carbohydrates (Morita, 2011). Changes in what people eat because their chewing ability gets worse increase the chance of having type 2 diabetes, even in the group with periodontal pockets that are 6 mm or more (Tani, 2011).

Epidemiological studies of workers and community residents in Japan have demonstrated a relationship between periodontal pocket depth and type 2 diabetes. Miyawaki et al. (2016) found that tooth loosening is an independent predictor of incident type 2 diabetes in male workers aged 36–55 years. A cohort study of workers aged 30–69 years revealed a higher likelihood of contracting the disease (Morita, 2011). Saito et al. (2004) found a link between periodontal disease and the onset of glucose intolerance in their analysis of–the older adults aged 50 to 79. The older adults in the later stages have not been the subject of any previous studies, which have all limited their populations to those under 80 years old. This study aimed to clarify the relationship between periodontal pocket depth and type 2 diabetes in individuals aged 88. We highlight the importance of dental checkups in the modern age of a super-aging society.

2. Methods

2.1 Study Subjects

The current study design is a population-based cross-sectional study with the administrative services participants. The study municipality, Matsudo city in Chiba prefecture, started dental check-ups in dentistry clinics, and those by house call dentistry for insured individuals aged 88 years for cerebrating their age in accordance with Japanese culture. The subjects of this study were 664 individuals who underwent a dental check-up in Matsudo city among 2,220 individuals aged 88 years during 2019-2021.

The dental health check-ups were conducted as part of health maintenance; therefore, consent was not obtained from participants. We obtained permission from Matsudo city to use the data anonymously to achieve health promotion of insured older adult individuals, and this study was approved by the Ethics Committee of Wayo Women's University (authorization no. 2261). This study was conducted in accordance with the World Medical Association Declaration of Helsinki, the Ethical Guidelines for Epidemiological Research of the Ministry of Education, Culture, Sports, Science and Technology, and the guidelines of the Ministry of Health, Labour and Welfare, Japan.

2.2 Measurement

Periodontal examination: Trained dentists counted the number of teeth and recorded the probing pocket depth at six points (buccal-mesial, mid buccal, buccal-distal, lingual-mesial, mid-lingual, and lingual-distal) on a right upper molar, an upper incisor, a left upper molar, a right lower molar, a lower incisor, and a left lower molar. Measurements were made to the nearest millimeter, and where any doubt existed, a lower value was assigned. The periodontal pocket was categorized as follows: healthy and mildly equated pocket <5 mm. Information about the participant's oral health included the number of proper teeth (zero or over), condition of oral information about participants' oral health including remaining teeth (zero or over), condition of oral health (good or bad), and overall access to dental check-ups (yes or no).

Information on participants' characteristics, health conditions, and lifestyle habits was obtained using a dentist interview sheet for dental health check-ups: including sex, living status (in-home or in facilities), smoking status (current or never/past), abdominal/visceral obesity (yes or no), cerebral/myocardial infarction (yes or no), rheumatism (yes or no), and type 2 diabetes.

2.3 Statistical Analyses

We excluded 74 individuals (11.1% of participants) from analyses because of a lack of data, and the data of 590 individuals were analyzed.

We performed chi-square test, univariate and multivariate binomial logistic regression analyses to examine the effects of the type of dental pocket on type 2 diabetes. Unadjusted and covariate-adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for the type 2 diabetes. The multivariate analyses included sex, dwelling status, smoking habits, obesity, infarction, rheumatism, remaining teeth, oral health, and overall access to dental check-ups as variables. Statistical significance was set at $P < 0.05$. Statistical tests were performed using Stata 16.1 (2004).

3. Results

Valid responses without missing data were obtained from 590 respondents (population coverage rate: 9.5%) and used in the analyses. The prevalence rate of type 2 diabetes was 11.0% (65 subjects). The number of males was 256 (43.4%). Most subjects were dwelling at home (563, 95.4%). Regarding the distribution of subjects' lifestyles and health conditions, 162 current-smokers or ex-smokers, 9 obese (1.5%), 105 infarction cases (17.8%), and 13 rheumatism cases (2.2%) were analyzed. Of them, 56 had no teeth (9.5%), 442 sustained good oral health condition (74.9%), 359 received dental checkups (60.8%), and 209 had deep periodontal pockets (35.4%).

Table 1 presents the characteristics of the participants according to their type 2 diabetes status. A deep periodontal pocket was found to be significantly associated with type 2 diabetes status (OR: 2.04, 95%CI: 1.22-3.44). Table 2 shows the results of the multivariate analysis, which indicated a significant association between deep periodontal pockets and type 2 diabetes status (OR: 2.02, 95%CI: 1.13-3.59).

Table 1. Subjects Characteristics and Distribution of Cases of Type2 Diabetes

Items		**No Diabetes**		**Diabetes**		**Total**	**P-value**
Sex	Male	226	88.3%	30	11.7%	256	0.634
	Female	299	89.5%	35	10.5%	334	
Living	In-home	504	89.5%	59	10.5%	563	0.057
	In-Facility	21	77.8%	6	22.2%	27	
Smoking	Never/Past	378	88.3%	50	11.7%	428	0.402
	Current	147	90.7%	15	9.3%	162	
Obesity	No	518	89.2%	63	10.8%	581	0.279
	Yes	7	77.8%	2	22.2%	9	
Infarction	No	438	90.3%	47	9.7%	485	0.027
	Yes	87	82.9%	18	17.1%	105	
Rheumatism	No	513	88.9%	64	11.1%	577	0.699
	Yes	12	92.3%	1	7.7%	13	
Remaining teeth	Zero	49	87.5%	7	13%	56	0.709
	Over	476	89.1%	58	11%	534	
Oral health	Bad	126	85.1%	22	14.9%	148	0.084
	Good	399	90.3%	43	9.7%	442	
Dental check-up	No	200	86.6%	31	13.4%	231	0.135
	Yes	325	90.5%	34	9.5%	359	
Dental pocket	No	349	91.6%	32	8.4%	381	0.006
	Yes	176	84.2%	33	15.8%	209	

Chi-square test.

Table 2. Association of Type2 Diabetes and dental pocket among older adults aged 88 in Japan

Items	Crude OR	95% CI	Adjusted OR	95% CI
Female	0.88	0.53 – 1.48	0.88	0.47 – 1.65
Living-in-home	0.41	0.16 – 1.06	0.50	0.18 – 1.36
Smoking	0.77	0.42 – 1.42	0.64	0.31 – 1.30
Obesity	2.35	0.48 – 11.56	2.85	0.55 – 14.68
Infarction	1.93	1.07 – 3.48	1.85	1.00 – 3.41
Rheumatism	0.67	0.09 – 5.22	0.74	0.09 – 6.13
No teeth	1.17	0.51 – 2.71	1.55	0.62 – 3.85
Oral health	0.62	0.36 – 1.07	0.78	0.42 – 1.44
Dental check-up	0.67	0.40 – 1.13	0.71	0.41 – 1.21
Dental pocket	2.04	1.22 – 3.44	2.02	1.13 – 3.59

Logistic regression model, N=590, OR: Odds Ratio, CI: Confidence Interval.

4. Discussions

We examined the relationship between periodontal pockets and type 2 diabetes in 590 older adults aged 88 years in Japan. Inflammation-related substances are released into the body from the periodontal pockets through blood vessels, thus increasing insulin resistance. Plaque control by brushing and scaling by dentists improves glycemic control. A synergistic improvement effect can be expected from the health management by older adults in later stages, which includes glycemic control and oral health management.

Longitudinal studies (Miyawaki, 2016; Preshaw, 2012) in community populations have suggested that the depth of periodontal pockets and tooth loosening are risk factors of type 2 diabetes development. In a previous study, the association was significant in working men, suggesting that proper dental health guidance and maintenance of good oral health are important from the perspective of preventing type 2 diabetes in the future (Tani, 2023). The present study suggests a similar association. This suggests the effectiveness of dental health check-ups in older adults. In Japan, public-sector dental health check-ups targeting older adults are expanding. The Basic Policy on Economic and Fiscal Management and Reform 2022, approved by the Cabinet in June 2022, stipulates that dental check-ups will be compulsory (universal dental check-ups). Our finding that maintenance of oral health is associated with preventive health even in people aged 88 years and above supports this policy trend.

To maintain and improve the oral health of older adults aged 88 years and older, the older adults living in facilities must receive check-ups; however, the management of the older adults living at home is greatly affected by their living conditions (living alone or together). However, the management of older adult people living at home is affected by their living conditions (living alone or together). Many of the subjects receiving home visits for nutritional and dietary guidance are those who need dietary therapy for lifestyle-related diseases and those who need nutritional improvement due to malnutrition. Factors contributing to the deterioration of the nutritional status of patients include older adults living at homes who have not visited the dentist for many years and those who do not receive basic nutritional and dietary guidance or perform basic oral health management, such as gargling and brushing teeth, missing teeth, and having missing dentures. There was a decrease in healthy eating habits due to the disease, taste due to the inability to perform oral care, appetite due to toothache, and the amount of food and water due to eating and swallowing disorders. To solve these problems, dental check-ups for older adults at home are necessitated (Nakamura, 2015).

4.1 Strengths and Limitations of This Study

Information on periodontal pockets and other oral health conditions was based on dental health check-ups, the reliability of which was higher than that of self-reports. The study subjects were older adults aged 88 years.

First, as this was a cross-sectional study, there were limitations to risk assessment. Second, as the participants were not randomly selected from one municipality, the results may not be generalizable to the general population. Third, type 2 diabetes may also have a reverse cause-and-effect, such as the deterioration of periodontal pockets. In people with type 2 diabetes, the amount of secreted saliva decreases, and the concentration of sugar in saliva increases, which causes plaque to adhere and progress to periodontal disease. On the other hand, there are some

evidences of improvement in metabolic control in people with type 2 diabetes, after treating periodontal disease (Vergnes, 2010). Serum IL-6 and C-reactive protein levels are high in people with periodontitis (Paraskevas, 2008) and are also related to insulin resistance (Nesto, 2004). Inflammatory markers have been suggested to increase the risk of incident type 2 diabetes (Schmidt, 1999). In addition, recent studies have indicated that adipokines may impact both periodontitis and type 2 diabetes susceptibility (Preshaw, 2012). The biological mechanism of the association between periodontitis and type 2 diabetes has not been sufficiently clarified, though it is thought that systemic inflammation caused by periodontitis may lead to type 2 diabetes.

5. Conclusions

This survey, involving dentist interviews, indicated the possibility that the prevalence of type 2 diabetes was high among older adults aged 88 years with deep periodontal pockets.

Authors' Contributions

MK and ST contributed to the concept and design of the study and conducted the statistical analyses. MK and ST had full access to all study data and were responsible for data integrity, and MK and ST were responsible for the accuracy of the data analyses. KT, SM, SO, YH, YH, TF, and YY were responsible for the interpretation of the results and drafting the manuscript, critically reviewing, agreeing to publish it and controlling the decision to publish. The authors read and approved the final manuscript.

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Availability of Data and Materials

The data used to derive our conclusions are unsuitable for public deposition due to ethical restrictions imposed by the municipality.

Ethics Approval and Consent to Participate

Ethics approval for this study was obtained from the Ethics Committee of Wayo Women's University (authorization no. 2261). Under the research agreement between the research municipality and our group, we obtained the data in an anonymous format.

Patient Consent Statement

Not Applicable.

Clinical Trial Registration

Not Applicable.

Competing Interests Statement

The authors declare that they have no competing interests.

References

Dotevall, A., Johansson, S., Wilhelmsen, L., & Rosengren, A. (2004). Increased levels of triglycerides, BMI and blood pressure and low physical activity increase the risk of diabetes in Swedish women. A prospective 18-year follow-up of the BEDA study. *Diabet Med, 21*, 615-622. https://doi.org/10.1111/j.1464-5491.2004.01189.x

International Diabetes Federation. (2021). *IDF Diabetes Atlas 2021: Tenth edition*. Retrieved Sep 15, 2023, from https://diabetesatlas.org/atlas/tenth-edition/

Iwamoto, Y., Nishimura, F., Soga, Y., Takeuchi, K., Kurihara, M., Takashiba, S., & Murayama, Y. (2003). Antimicrobial periodontal treatment decreases serum C-reactive protein, tumor necrosis factor-alpha, but not adiponectin levels in patients with chronic periodontitis. *J Periodontol, 74*, 1231-1236. https://doi.org/10.1902/jop.2003.74.8.1231

Ministry of Health, Labour and Welfare. (2016). *Fact-finding survey for dental disease 2016*. https://www.mhlw.go.jp/toukei/list/dl/62-28-02.pdf. [Japanese].

Miyawaki, A., Toyokawa, S., Inoue, K., Miyoshi, Y., & Kobayashi, Y. (2016). Self-Reported Periodontitis and Incident Type 2 Diabetes among Male Workers from a 5-Year Follow-Up to MY Health Up Study. *PLoS One,*

11, e0153464. https://doi.org/10.1371/journal.pone.0153464

Morita, I., Inagaki, K., Nakamura, F., Noguchi, T., Matsubara, T., Yoshii, S., ..., & Sabbah, W. (2011). Relationship between periodontal status and levels of glycated hemoglobin. *J Dent Res, 90*, 41-46.

Nakamura, I. (2015). Nutritional improvement in collaboration by home care dietitian and dentist. *Ann Jpn Prosthodont Soc, 7*, 109-111. [Japanese] https://doi.org/10.2186/ajps.7.109

Nesto, R. (2004). C-reactive protein, its role in inflammation, Type 2 diabetes and cardiovascular disease, and the effects of insulin-sensitizing treatment with thiazolidinediones. *Diabet Med, 21*, 810-817. https://doi.org/10.1111/j.1464-5491.2004.01296.x

Nishimura, F. (2006). Clinical and Basic Research on Bi-directional Relationships between Periodontal Disease and Diabetes/Diabetic Complications. *Jpn J Periodont, 48*, 101-105. [Japanese]

Paraskevas, S., Huizinga, J. D., & Loos, B.G. (2008). A systematic review and meta-analyses on C-reactive protein in relation to periodontitis. *J Clin Periodontol, 35*, 277-290. https://doi.org/10.1111/j.1600-051X.2007.01173.x

Pihlstrom, B. L., Michalowicz, B. S., & Johnson, N. W. (2005). Periodontal diseases. *Lancet, 366*, 1809-1820. http://dx.doi.org/10.1016/S0140-6736(05)67728-8

Preshaw, P. M., Alba, A. L., Herrera, D., Jepsen, S., Konstantinidis, A., ..., & Makrilakis, K. (2012). Periodontitis and diabetes: a two-way relationship. *Diabetologia, 55*, 21-31. https://doi.org/10.1007/s00125-011-2342-y

Ripsin, C. M., Kang, H., & Urban, R. J. (2009). Management of blood glucose in type 2 diabetes mellitus. *Am Fam Physician, 79*, 29-36.

Saito, T., Shimazaki, Y., Kiyohara, Y., Kato, I., Kubo, M., Iida, M., & Koga, T. (2004). The severity of periodontal disease is associated with the development of glucose intolerance in non-diabetics: the Hisayama study. *J Dent Res, 83*, 485-490. https://doi.org/10.1177/154405910408300610

Schmidt, M. I., Duncan, B. B., Sharrett, A. R., Lindberg, G., Savage, P. J., ..., Offenbacher, S. (1999). Markers of inflammation and prediction of diabetes mellitus in adults (Atherosclerosis Risk in Communities study): a cohort study. *Lancet, 353*,1649-1652. https://doi.org/10.1016/S0140-6736(99)01046-6

Stata Corp. (2020). *Stata Statistical Software: Release 16.1*. College Station, TX: StataCorp LP.

Tani, N., Takeuchi, K., & Fukuda, H. (2023). Association between periodontal pocket depth determined during dental check-ups and new onset of diabetes in community residents: the LIFE study. *Jpn J Public Health, 70*, 39-47. [Japanese]

Vergnes, J. (2010). Treating periodontal disease may improve metabolic control in diabetics. *Evid Based Dent, 11*, 73-74. https://doi.org/10.1038/sj.ebd.6400734

Waki, K., Noda, M., Sasaki, S., Matsumura, Y., Takahashi, Y., ..., & Isogawa, A. (2005). Alcohol consumption and other risk factors for self-reported diabetes among middle-aged Japanese: A population-based prospective study in the JPHC study cohort I. *Diabet Med, 22*, 323-31. https://doi.org/10.1111/j.1464-5491.2004.01403.x

Willi, C., Bodenmann, P., Ghali, W. A., Faris, P. D., & Cornuz, J. (2007). Active smoking and the risk of type 2 diabetes: a systematic review and meta-analysis. *JAMA, 298*, 2654-2664. https://doi.org/10.1001/jama.298.22.2654