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The effect of the national scaling program on tooth loss: a claim-based matched large cohort study in Korea

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Objective: Tooth loss affects quality of life. Scaling is a measure to prevent periodontal disease and tooth loss. This study aimed to determine the effect of scaling on tooth loss. ***Basic research design***: Secondary analysis of the Korean National Health Insurance Services database, comprising 514,866 Koreans as an initial cohort, followed for 14 years up to 2015. The study population comprised people who had received an oral check-up in 2002-2003. Using propensity score matching, we matched the intervention group (receipt of scaling) and controls (no scaling) 1:1. The outcome, tooth loss was defined as including all teeth except for third molars until 2015. The final sample included 94,738 people. Analysis used a Cox proportional hazard regression model. ***Results***: Scaling showed conflicting results in univariate and multivariable analyses. In univariate analysis, people who received scaling were more likely to lose teeth (HR, 1.04; 95% CI, 1.02-1.05). After adjusting for confounders in the multivariable analysis, those who didn't receive scaling were more likely to lose teeth (HR, 0.97; 95% CI, 0.95, 0.99). The effects of scaling were identified in people without diabetes (HR, 0.97; 95% CI, 0.95, 0.99) but not in people with diabetes (HR, 0.97; 95% CI, 0.89-1.06). ***Conclusions***: Scaling was associated with less tooth loss. Regular scaling might be encouraged for vulnerable groups, such as males, older adults, lower income, handicapped, chronic diseases, and smokers.

Keywords*: Tooth loss, Scaling, Supportive periodontal therapy, Propensity score matching, Matched cohort*

Introduction

The importance of dental health in the quality of life has been recognized. The oral diseases, mainly dental caries and periodontal diseases, may lead to chronic diseases or tooth loss (Lee *et al.*, 2015; Tonetti *et al.*, 2000). In previous studies, tooth loss was known to negatively affect depression, malnutrition, and quality of life (Griep *et al.*, 2000; Kaye *et al.*, 2010; Okoro *et al.*, 2012). More tooth loss is associated with worse health status (Okoro *et al.*, 2012). Tooth loss could cause also social problems that put pressure on individuals, communities, and society (Vergnes and Mazevet, 2020). Various methods should be taken to prevent tooth loss.

Periodontal maintenance may prevent tooth loss (Axelsson *et al.*, 2004; Chambrone and Chambrone, 2006; Dannewitz *et al.*, 2006; Eickholz *et al.*, 2008; Lamont *et al.*, 2018; Pretzl *et al.*, 2009; Ramsay *et al.*, 2018). Risk factors for tooth loss include poor oral hygiene and irregular supportive periodontal therapy (Eickholz *et al.*, 2008). A German study that supported the effects of anti-infective periodontal therapy, found the cost of dental maintenance through the anti-infective therapy is relatively low compared with control groups (Pretzl *et al.*, 2009).

Risk factors of tooth loss are various. Socioeconomic status, such as gender, age, social position, and lifestyle, such as smoking, are related to tooth loss (Eickholz *et al.*, 2008; Fardal *et al.*, 2004; Vettore *et al.*, 2016). Dental conditions, such as plaque and calculus, are also related to tooth loss (Axelsson *et al.*, 2004; Dannewitz *et al.*, 2006). Scaling is one process of periodontal maintenance (Pich, 2019).

The use of scaling has soared in Korea since July 2013, when it was covered by the National Health Insurance Services (hereafter the NHIS) to prevent tooth loss (Lee *et al.*, 2016). Tooth loss has been steadily increasing, despite dental health-care policies to expand social health-insurance coverage (Lee *et al.*, 2017). It is necessary to identify how systemic changes have affected oral-health improvement and disease prevention. There have been many studies on the effects of scaling. However, since most studies are individual unit or clinical-based, they are not free from the individual fallacy and cannot tell about the effect of introducing a scaling program to improve population dental health. Therefore, it is necessary to check whether scaling has an effect at the population level.

The purpose of this study was to determine the effect of regular scaling on tooth loss using propensity score matching (hereafter PSM). We also identify the effect of regular scaling on tooth loss by income level.

Method

We used the NHIS Medical check-up cohort database. The cohort consisted of 514,866 Koreans as an initial group, followed up for 14 years, up to 2015. The cohort data represent a random sample of about 10% of medical

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examinations in 2002-2003 (5.15 million). Citizens are recommended to have a medical check-up at least once biennially. Participants were qualified individuals aged 40-79 years in 2002-2003 who received a general medical check-up. The database records social and economic qualification data (including death and disability), medical resource use (consultation and medical check-up), and status of clinic and hospital. Key components of the check-up are a medical interview, postural examination, chest X-ray examination, blood test, urine test, and dental screening. Dental screening consists of questionnaires related to dental lifestyle (eating habits, brushing teeth etc.) and structured checklist to check the condition of the teeth with visual examination.

We analysed data for people who received an oral check-up in 2002-2003, excluding those who did not receive an oral check-up. (N = 259,354) or who had missing data (N = 51,833). The intervention group comprised patients whose teeth were scaled in 2002-2003. Statistical matching using propensity-score estimating was used to reduce confounding between the intervention and control groups. The propensity scores estimating the probability of scaling were calculated for the entire study population. In the multiple logistic regression model for the propensity score, the covariates used were gender, age, income level, type of social security, disability, and the Charlson Comorbidity Index (hereafter the CCI). The scaling was matched 1:1 using propensity scores to the control group who did not have scaling. The final sample included 94,738 (Figure 1).

Receipt of scaling was defined by an item in the questionnaire that asked "Have you had a scaling in the last year?" Tooth loss was defined in any participants who had teeth extracted (except for the third molars) in

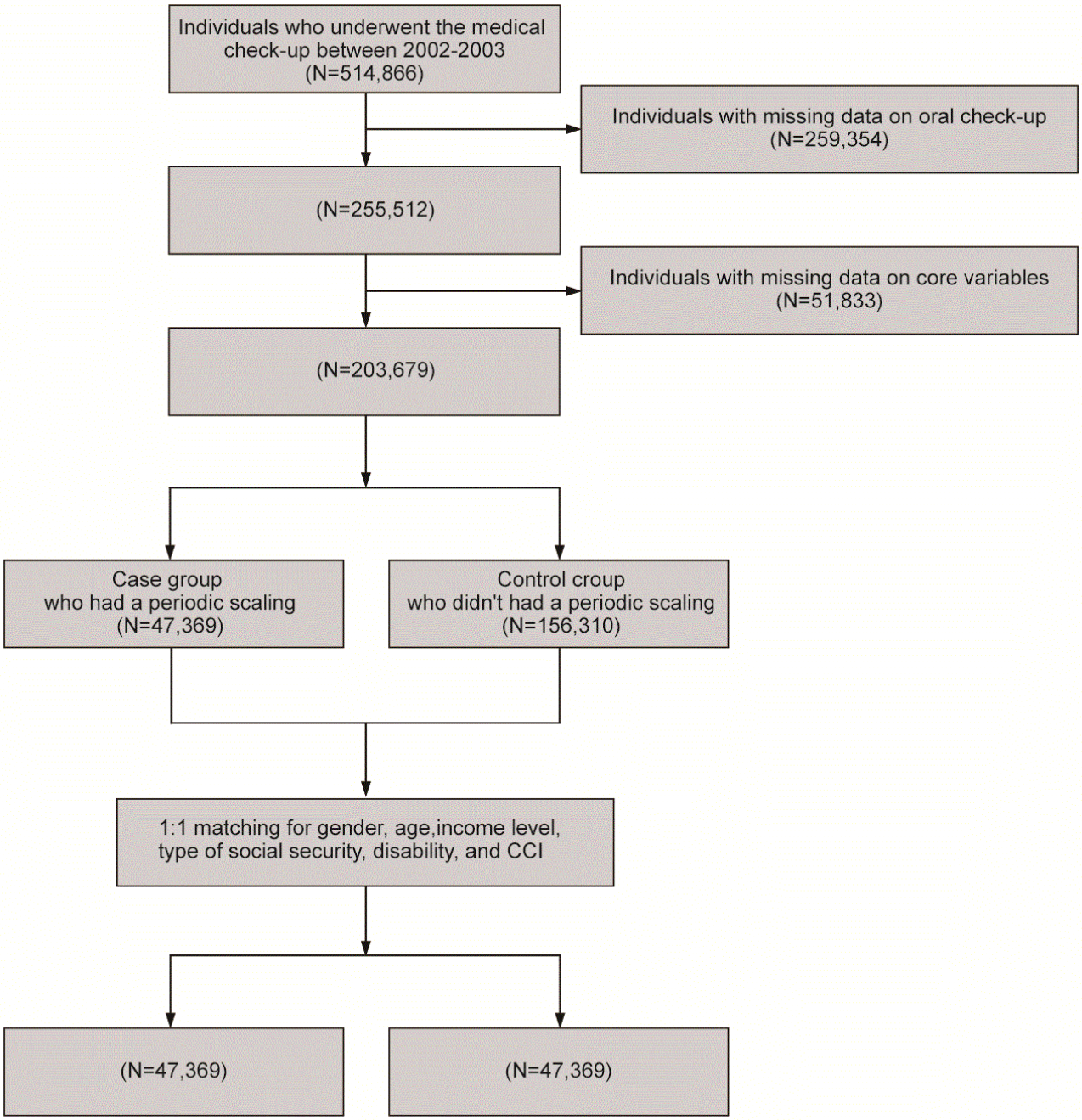

Figure 1. *Cohort profile of 94,738 people included in analysis.*

the database until 2015 (procedure codes U4412, U4413 and U4414 (incisor, molar or complicated extraction respectively). After the oral check-up, the extraction code was checked in the dental-care details of all the subjects.

Confounding variables included gender, age, type of social security (industrial worker, self-employed, and medical aid), income level (recorded as low, medium or high according to the insurance premiums of all people in the household), residential area, CCI, diabetes mellitus (hereafter DM), Body Mass Index (hereafter BMI) and lifestyle (smoking, alcohol use, physical activity). Age was divided into four groups by 10-year periods (40–49, 50–59, 60-69, and ≥ 70 years). The CCI was calculated as the sum of the scores of comorbid conditions (out of 22 total conditions). Each condition was assigned a score of 1, 2, 3, or 6 depending on the severity of the disease. Scores are summed for each patient to indicate the patient's general condition. The CCI data were analysed in three categories (0, 1, ≥2) (Deyo *et al*., 1992; Sundararajan *et al*., 2004). The patients with DM were participants who had been diagnosed with E10-E14 (Type 1, type2 and other specified DM) more than three times a year in 2002 and 2003. According to the 10th version of international Classification Diseases (ICD-10). BMI was calculated as the weight in kilograms divided by the square of their height in meters. BMI was categorized as underweight (under 18.5 kg/m^2), normal weight (18.5–23 kg/m^2), overweight (23–27.5 kg/m^2), and obese (> 27.5 kg/m^2) (Who, 2004). Smoking was divided into "Non-smoker" or "Ex- or Current smoker". Alcohol was divided into "None", "< once per week", "once or twice per week", and "3 times or more per week". Physical activity was divided into "None", "once or twice a week", "three or four times per week", and "five to seven times per week". Visiting a dental clinic, one of the independent variables, was defined by the question about "Have you visited a dental clinic or hospital in the last year?" in the check-up questionnaire. Blood tests such as fasting blood sugar, total cholesterol, hemoglobin, AST, ALT, and GAMMA GTP were also added.

Chi-squared tests were used to investigate differences in socio-economic, comorbidity, and lifestyle factors between participants who had and had not received scaling. Cox proportional hazard regression models were used to identify the effect of scaling on tooth loss while adjusting for confounders. We calculated hazard ratios (HRs) and 95% confidence intervals (CIs) to identify the risk factors associated with tooth loss. A $p < 0.05$ was considered statistically significant. All data were analyzed using the SAS 9.4 (SAS Institute, Cary, North Carolina).

Results

Table 1 describes intervention and control groups, which were similar in gender, age, income level, type of social security and CCI, because these variables were used for matching. There were proportionately more patients with DM in the intervention group. More patients were underweight (BMI: < 18.5 kg/m^2) or had normal BMI (BMI: 18.5~22.9 kg/m^2) in the control group whereas more were overweight (BMI: 23–24.9 kg/m^2) or obese (BMI: ≥ 25 kg/m^2) in the intervention group. Proportionately more of the intervention group were ex- or current smokers but more of the control group drank alcohol more three times per week. More people exercised periodically per week and had had dental care in the last year in the control group. In bivariate analysis more of the scaling group had lost teeth than in the control group.

Participants who had lost teeth differed in haematological values from those who had not lost teeth (Table 2).

Table 3 shows the risk factors for tooth loss in multivariable Cox proportional regression. Whilst in univariate analysis, those who received scaling were more likely to lose teeth, after adjusting for confounders however, those who didn't receive scaling were more likely to lose teeth in multivariable analysis. Being female, older, earning less, being an industrial worker, having diabetes, having a higher BMI, smoking drinking alcohol more than three times a week and having dental care in the last year also predicted tooth loss.

Scaling did not predict tooth loss in patients with diabetes, but but had a protective effect in patients without diabetes (Figure 2).

Discussion

This study determined whether scaling predicted tooth loss in Koreans over a 12-year follow-up period. The risk of tooth loss was lower for those who received scaling when taking into account confounding factors. These findings of are consistent with previous studies.

Although many studies have identified factors associated with tooth loss, few have investigated the effect of scaling. Risk factors for tooth loss are various. Not only demographic factors such as age and economic status, but also oral conditions and habits such as severe periodontitis, higher caries index and previous dental visits predicted tooth loss (Ribeiro *et al.*, 2015; Saito *et al.*, 2019; 2020). According to the results, risk factors that significantly affect tooth loss are gender, age, income level, type of social security, CCI, DM, BMI, smoking status, drinking status, dental visits, periodic scaling, fasting blood sugar, total cholesterol, hemoglobin, ALT, and GAMMA GTP in multi-variate analysis.

DM is a significant factor in dental health and tooth loss (Faggion Jr *et al.*, 2007; Kim *et al.*, 2019; Lee *et al.*, 2015). We identified the effects of scaling according to DM. Scaling was effective in non-diabetic patients, not in diabetic patients. The association between DM and dental health can be explained by the expression of systemic inflammation and the appropriate mechanism of insulin sensitivity and glucose mechanics. The increased severity or chronicity of PD increases the insulin resistance and deteriorates glycemic control (Lee *et al.*, 2015).

Scaling showed conflicting relationships with tooth loss in univariate and multivariable analyses. Receiving scaling and visiting a dental clinic are interrelated. A visit to a dental clinic in the past year means that there is a high probability of a dental problem; hence such visits are closely associated with tooth loss. After adjusting for confounders in multivariable analysis that the group who received scaling was less likely to lose teeth. Overall supportive periodontal therapy offers a good prognosis for teeth (Graetz *et al.*, 2017; Petsos *et al.*, 2021; Rahim-Wöstefeld *et al.*, 2022). The cost of maintaining teeth through complementary dental care is relatively low compared to replacing them with implants or bridges (Pretzl *et al.*, 2009).

Table 1. Characteristics of cohorts who did or did not receive scaling.

		Periodic scaling		
		Yes *N = 47,369* *%*	*No* *N = 47,369* *%*	*P* *Chi sq.*
Gender	Male	65.5	65.5	0.9782
	Female	34.5	34.5	
Age	40's	56.3	56.3	1.0000
	50's	29.5	29.5	
	60's	11.7	11.7	
	70's	2.5	2.5	
Income level	Low	15.8	15.8	0.9997
	Medium	25.7	25.7	
	High	58.5	58.5	
Social security	Industrial worker	75.6	75.6	0.9938
	Self-employee	24.3	24.3	
	Medical aid	0.1	0.1	
Disability	No	99.6	99.7	0.8684
	Yes	0.4	0.3	
CCI	0 point	55.1	55.1	0.9999
	1 point	28.7	28.7	
	≥ 2 points	16.2	16.2	
DM	No	95.4	95.9	<.0001
	Yes	4.6	4.1	
BMI	< 18.5	1.9	2.1	<.0001
	18.5~22.9	34.2	35.6	
	23~24.9	28.7	27.9	
	≥ 25	35.1	34.5	
Smoke	Non-smoker	59.4	60.5	0.0005
	Ex- or Current smoker	40.6	39.5	
Alcohol	None	49.1	49.0	<.0001
	< 3 time / week	40.2	39.4	
	≥ 3 times / week	10.6	11.6	
Physical activity	None	45.4	52.8	<.0001
	1~2 times / week	32.1	27.8	
	3~4 times / week	13.2	10.8	
	5~7 times / week	9.4	8.6	
Dental care in last year	None	14.3	70.5	<.0001
	Yes	85.7	29.5	
Extraction	None	32.4	36.5	<.0001
	Yes	67.6	63.5	

Table 2. Haematological values in participants who had and did not have extractions.

	Extraction		
	Yes *Mean (SD)*	*No* *Mean (SD)*	*P*
Fasting Blood sugar (mg/dL)	97.70 (31.60)	95.02 (29.56)	<.0001
Total cholesterol (mg/dL)	200.30 (37.32)	198.10 (37.28)	<.0001
Hemoglobin (g/dL)	14.29 (1.46)	14.03 (1.54)	<.0001
AST (U/L)	26.84 (17.84)	26.98 (16.00)	<.0001
ALT (U/L)	27.42 (21.97)	25.78 (20.90)	<.0001
GAMMA GTP (U/L)	41.41 (53.34)	36.32 (52.24)	<.0001

Propensity score matching (PSM) was used to minimize confounding between the scaling and control groups. Confounding arises from differences between the two groups in controlled cohort studies that are unrelated to the intervention. As randomised allocation to receive the intervention was not possible, PSM was used to minimize confounding by attempting to create comparable intervention group and groups for all observed covariates.

There are some limitations of this study. First, tooth loss could only be recorded when a tooth was removed in a clinic or hospital. Teeth removed outside clinics or hospitals were not considered in the analysis. Second, although we adjusted for several confounders in analyses, we were unable to examine other factors associated with tooth loss, such as oral condition and thus there is a risk of residual confounding. Thus, these data do not provide the most robust evidence of a benefit from scaling in preventing tooth loss.

Table 3. Multivariable Cox proportional hazard regression of risk factors for tooth loss.

			Hazard Ratio (95% CI)
Gender	(Ref: Male)	Female	1.131 (1.101, 1.161)
Age	(Ref: 40's)	50's	1.286 (1.263,1.309)
		60's	1.933 (1.884, 1.984)
		70's	2.537 (2.404, 2.678)
Income level	(Ref: low)	Medium	1.017 (0.992, 1.043)
		high	0.804 (0.785, 0.823)
Social security	(Ref: industrial worker)	self-employer	1.484 (1.455, 1.514)
		Medical aid	1.289 (0.973, 1.707)
Presence of disability	(Ref: Normal)	Present	1.016 (0.886,1.166)
CCI	(Ref: 0)	1	0.979 (0.961, 0.997)
		≥ 2	0.991 (0.968, 1.014)
DM	(Ref: None)	Yes	1.069 (1.027, 1.113)
BMI	(Ref: 18.5~22.9)	< 18.5	0.965 (0.909, 1.025)
		23~24.9	1.051 (1.029, 1.072)
		≥ 25	1.128 (1.106, 1.150)
Smoke	(Ref: Non-smoker)	Ex- or Current smoker	1.147 (1.124, 1.170)
Alcohol	(Ref: None)	< 3 time / week	0.977 (0.958, 0.996)
		≥ 3 times / week	1.063 (1.033, 1.094)
Physical activity	(Ref: None)	1~2 times / week	0.983 (0.965, 1.002)
		3~4 times / week	1.014 (0.988, 1.041)
		5~7 times / week	1.008 (0.979, 1.037)
Experience of dental care in last year	(Ref: No)	Yes	1.108 (1.086, 1.130)
Receipt of scaling	(Ref: No)	Yes	0.973 (0.954, 0.992)
Fasting Blood sugar	(continuous)		1.001 (1.001, 1.001)
Total cholesterol	(continuous)		1.000 (0.999, 1.000)
Hemoglobin	(continuous)		1.019 (1.012, 1.027)
SGOT_AST	(continuous)		1.001 (1.000, 1.001)
SGPT_ALT	(continuous)		0.999 (0.998, 0.999)
GAMMA_GTP	(continuous)		1.001 (1.001, 1.001)

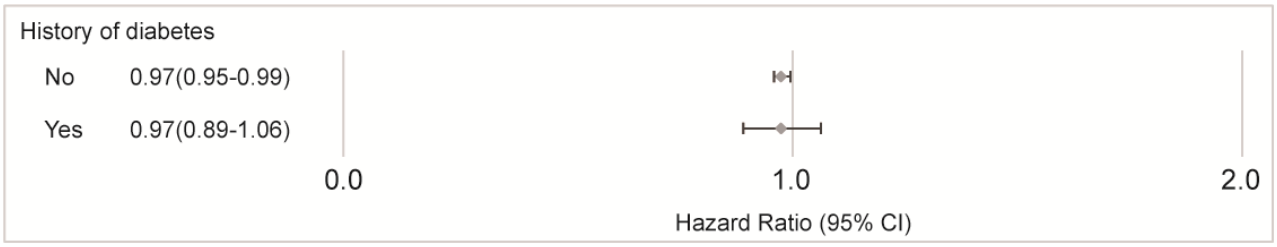

Figure 2. *Effect of scaling on tooth loss in patients with and without a history of diabetes.*

Notwithstanding the limitations of this study, one of its key advantages was the examination of a prospective association between regular scaling and tooth loss. The sample for this study was larger than those of previous studies. Also, data were followed up for 13~14 years.

The Korean NHIS has covered scaling once a year since July 2013, halving patients' out-of-pocket expenses. These data were intended to help dental-policy adoption and development. The effect of scaling and polish on dental health was unclear (Dannewitz *et al.*, 2006; Eickholz *et al.*, 2008). Conversely, other studies have shown positive effects of scaling. Most of these previous studies were of a specific group, small or clinical base. Our study has the strength of a 14-year follow-up with a large claim-based cohort of nearly 100,000 people, and whilst the data are compatible with a beneficial effect of scaling in preventing tooth loss, further research is needed to confirm that effect.

References

Axelsson, P., Nyström, B. and Lindhe, J. (2004): The long-term effect of a plaque control program on tooth mortality, caries and periodontal disease in adults: results after 30 years of maintenance. *Journal of Clinical Periodontology* **31**, 749-757.

Chambrone, L.A. and Chambrone, L. (2006): Tooth loss in well-maintained patients with chronic periodontitis during long-term supportive therapy in Brazil. *Journal of Clinical Periodontology* **33**, 759-764.

Dannewitz, B., Krieger, J.K., Hüsing, J. and Eickholz, P. (2006): Loss of molars in periodontally treated patients: a retrospective analysis five years or more after active periodontal treatment. *Journal of Clinical Periodontology* **33**, 53-61.

Eickholz, P., Kaltschmitt, J., Berbig, J., Reitmeir, P. and Pretzl, B. (2008): Tooth loss after active periodontal therapy. 1: Patient-related factors for risk, prognosis, and quality of outcome. *Journal of Clinical Periodontology* **35**, 165-174.

Faggion Jr, C.M., Petersilka, G., Lange, D.E., Gerss, J. and Flemmig, T.F. (2007): Prognostic model for tooth survival in patients treated for periodontitis. *Journal of Clinical Periodontology* **34**, 226-231.

Fardal, Ø., Johannessen, A.C. and Linden, G.J. (2004): Tooth loss during maintenance following periodontal treatment in a periodontal practice in Norway. *Journal of Clinical Periodontology* **31**, 550-555.

Graetz, C., Sälzer, S., Plaumann, A., Schlattmann, P., Kahl, M., Springer, C., Dörfer, C. and Schwendicke, F. (2017): Tooth loss in generalized aggressive periodontitis: Prognostic factors after 17 years of supportive periodontal treatment. *Journal of Clinical Periodontology* **44**, 612-619.

Griep, M.I., Mets, T.F., Collys, K., Ponjaert-Kristoffersen, I. and Massart, D.L. (2000): Risk of malnutrition in retirement homes elderly persons measured by the "mini-nutritional assessment". *J Gerontol A Biol Sci Med Sci* **55**, M57-M63.

Kaye, E.K., Valencia, A., Baba, N., Spiro III, A., Dietrich, T. and Garcia, R.I. (2010): Tooth loss and periodontal disease predict poor cognitive function in older men. *Journal of the American Geriatrics Society* **58**, 713-718.

Kim, Y.-T., Choi, J.-K., Kim, D.-H., Jeong, S.-N. and Lee, J.-H. (2019): Association between health status and tooth loss in Korean adults: longitudinal results from the National Health Insurance Service-Health Examinee Cohort, 2002–2015. *Journal of Periodontal & Implant Science* **49**, 158-170.

Lamont, T., Worthington, H.V., Clarkson, J.E. and Beirne, P.V. (2018): Routine scale and polish for periodontal health in adults. *Cochrane Database of Systematic Reviews* **12**, CD004625

Lee, J.-H., Lee, J.-S., Choi, J.-K., Kweon, H.-I., Kim, Y.-T. and Choi, S.-H. (2016): National dental policies and socio-demographic factors affecting changes in the incidence of periodontal treatments in Korean: a nationwide population-based retrospective cohort study from 2002–2013. *BMC Oral Health* **16**, 118.

Lee, J.-H., Lee, J.-S., Park, J.-Y., Choi, J.-K., Kim, D.-W., Kim, Y.-T. and Choi, S.-H. (2015): Association of lifestyle-related comorbidities with periodontitis: a nationwide cohort study in Korea. *Medicine* **94**.

Lee, J.-H., Oh, J.-Y., Choi, J.-K., Kim, Y.-T., Park, Y.-S., Jeong, S.-N. and Choi, S.-H. (2017): Trends in the incidence of tooth extraction due to periodontal disease: results of a 12-year longitudinal cohort study in South Korea. *Journal of Periodontal & Implant Science* **47**, 264-272.

Ogawa, H., Yoshihara, A., Hirotomi, T., Ando, Y. and Miyazaki, H. (2002): Risk factors for periodontal disease progression among elderly people. *Journal of Clinical Periodontology* **29**, 592-597.

Okoro, C.A., Strine, T.W., Eke, P.I., Dhingra, S.S. and Balluz, L.S. (2012): The association between depression and anxiety and use of oral health services and tooth loss. *Community Dentistry and Oral Epidemiology* **40**, 134-144.

Petsos, H., Ramich, T., Nickles, K., Dannewitz, B., Pfeifer, L., Zuhr, O. and Eickholz, P. (2021): Tooth loss in periodontally compromised patients: Retrospective long-term results 10 years after active periodontal therapy–tooth-related outcomes. *Journal of Periodontology* **92**, 1761-1775.

Pich, J. (2019): Supportive periodontal therapy for maintaining dentition in adults treated for periodontitis. *British Journal of Community Nursing* **24**, 450-451.

Pihlstrom, B.L., Michalowicz, B.S. and Johnson, N.W. (2005): Periodontal diseases. *The Lancet* **366**, 1809-1820.

Pretzl, B., Wiedemann, D., Cosgarea, R., Kaltschmitt, J., Kim, T.S., Staehle, H.J. and Eickholz, P. (2009): Effort and costs of tooth preservation in supportive periodontal treatment in a German population. *Journal of Clinical Periodontology* **36**, 669-676.

Rahim-Wöstefeld, S., Kronsteiner, D., ElSayed, S., ElSayed, N., Eickholz, P. and Pretzl, B. (2022): Development of a prognostic tool: based on risk factors for tooth loss after active periodontal therapy. *Clinical Oral Investigations* **26**, 813-822.

Ramsay, C.R., Clarkson, J.E., Duncan, A., Lamont, T.J., Heasman, P.A., Boyers, D., Goulão, B., Bonetti, D., Bruce, R. and Gouick, J. (2018): Improving the Quality of Dentistry (IQuaD): a cluster factorial randomised controlled trial comparing the effectiveness and cost-benefit of oral hygiene advice and/or periodontal instrumentation with routine care for the prevention and management of periodontal disease in dentate adults attending dental primary care. *Health Technology Assessment* **22**, 1-144

Ribeiro, L.S., Dos Santos, J.N., Ramalho, L.M., Chaves, S., Figueiredo, A.L. and Cury, P.R. (2015): Risk indicators for tooth loss in Kiriri Adult Indians: a cross-sectional study. *International Dental Journal* **65**, 316-321.

Saito, M., Shimazaki, Y., Fukai, K., Furuta, M., Aida, J., Ando, Y., Miyazaki, H. and Kambara, M. (2019): Risk factors for tooth loss in adult Japanese dental patients: 8020 Promotion Foundation Study. *Journal of Investigative and Clinical Dentistry* **10**, e12392.

Saito, M., Shimazaki, Y., Fukai, K., Furuta, M., Aida, J., Ando, Y., Miyazaki, H. and Kambara, M. (2020): A multilevel analysis of the importance of oral health instructions for preventing tooth loss: The 8020 Promotion Foundation Study of Japanese Dental Patients. *BMC Oral Health* **20**, 1-9.

Tonetti, M.S., Steffen, P., Muller-Campanile, V., Suvan, J. and Lang, N.P. (2000): Initial extractions and tooth loss during supportive care in a periodontal population seeking comprehensive care. *Journal of Clinical Periodontology* **27**, 824-831.

Vergnes, J.-N. and Mazevet, M. (2020): Oral diseases: A global public health challenge. *The Lancet* **395**, 186.

Vettore, M.V., Faerstein, E. and Baker, S.R. (2016): Social position, social ties and adult's oral health: 13 year cohort study. *Journal of Dentistry* **44**, 50-56.

Who, E.C. (2004): Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* **363**, 157.