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Disparities in periodontitis risk and healthcare use among individuals with disabilities in Korea: a retrospective cohort study

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Abstract

Background We analyzed the relationship between disability status and periodontal disease, focusing on disparities in healthcare utilisation, including outpatient visits and hospitalisation rates, among disability types and severities.

Methods This study used data from the National Health Insurance Service(NHIS) of Korea, which includes comprehensive records of the insured population. We examined 966,200 individuals with disabilities, grouped into five categories, and applied propensity score matching to compare with a matched control population. Periodontal disease was defined by the Korean Classification of Diseases criteria, and we used chi-square tests, t-tests, multivariate logistic regression, and negative binomial regression.

Results Individuals with disabilities had higher odds of hospitalisation for periodontitis (OR: 3.83, 95% CI = 3.59–4.08) but lower odds for outpatient visits (OR: 0.68, 95% CI = 0.68–0.69) and dental treatments (OR: 0.73, 95% CI = 0.72–0.73) compared to those without disabilities. The highest hospitalisation rates were among those with mental health disabilities (OR: 13.70, 95% CI = 12.26–15.30). Severe disabilities were associated with increased hospitalisation rates (OR: 7.14, 95% CI = 6.66–7.66) and fewer outpatient visits and treatments.

Conclusion Individuals with mental health disabilities or severe disabilities experience greater risks of hospitalisation for periodontitis and attend fewer outpatient visits and treatments. Targeted interventions are needed to improve dental care access and reduce disparities.

Keywords Dental treatments, Disabilities, Healthcare utilisation, Hospitalisation, Periodontitis, Propensity score matching

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Background

According to the World Health Organization (WHO, 2023), approximately 1.3 billion people (16% of the global population) live with disabilities. In Korea, this figure stands at around 2.65 million, representing 5% of the population [1]. Individuals with disabilities often face increased risks of chronic diseases, such as diabetes, hypertension, and cardiovascular conditions. These risks are exacerbated by limitations in daily life and social activities as well as adverse health behaviours, including obesity, alcohol consumption, smoking, and reduced physical activity [2]. Consequently, disabilities can render individuals in socially, economically, and medically vulnerable states, increasing their susceptibility to various diseases. Barriers to healthcare for people with disabilities include difficulties in accessing medical facilities, communication issues with healthcare providers, and lack of medical information. Of these, dental health is particularly impacted.

The prevalence of dental caries and edentulous tooth loss is higher among people with disabilities than their non-disabled counterparts [3]. Furthermore, individuals with disabilities often perceive their oral health to be worse than their overall health [4]. The oral cavity is crucial for food intake, and oral health issues can lead to nutritional deficiencies and significantly affect an individual's quality of life [5, 6]. Despite the importance of oral health, economic constraints, poor accessibility to dental services, and lack of awareness contribute to the worsening of dental diseases among individuals with disabilities because early treatment is often delayed [7].

Periodontitis is a prevalent oral health issue that affects > 50% of the global adult population [8, 9]. In 2022, gingivitis and periodontal disease accounted for 35.2% of dental outpatient cases in Korea [10], and these are among the most common dental diseases among individuals with disabilities [11]. Periodontitis is preventable with regular oral hygiene and dental checkups [12]; however, without proper management, it can progress unnoticed, leading to severe consequences, such as tooth loss, bad breath, and discomfort, ultimately affecting the quality of life [13]. Despite health insurance covering annual scaling for individuals aged ≥ 19 years, public interest remains low, with a tartar removal rate of only 29.7% [10]. This issue is more pronounced among individuals with disabilities, who are particularly vulnerable owing to physical and mental limitations that hinder proper dental care and treatment access [14, 15]. Thus, managing periodontitis is crucial for individuals with disabilities, as it can considerably impact their health and quality of life.

Therefore, we conducted this study to analyse the relationship between disability status and periodontal disease using a large-scale dataset from the National Health Insurance Service of Korea (NHIS), covering data from 2010 to 2019. Specifically, this study aimed to: (i) evaluate the impact of various types and severities of disabilities on outpatient visits, hospitalisations, and dental treatments related to periodontitis; (ii) identify differences in healthcare utilisation patterns for periodontitis between individuals with and without disabilities; and(iii) highlight the need for tailored public health strategies to reduce oral health disparities and improve the overall well-being of individuals with disabilities.

Method

Data collection and study participants

In Korea, healthcare services are predominantly covered under a single-payer public health insurance system operated by the National Health Insurance Service (NHIS), which covers approximately 97% of the population [16, 17]. Every visit to a healthcare provider, including clinics, hospitals, and dental offices, generates a medical claim that is systematically recorded in the NHIS database. These claims include detailed information such as diagnostic codes, treatment histories, prescriptions, disability status, and procedural records. The NHIS database also incorporates demographic and lifestyle data, including income level, body mass index (BMI), smoking and alcohol consumption, and results from periodic health examinations [18]. This system-wide integration of medical and administrative data provides a unique opportunity to study healthcare utilization patterns and disease outcomes on a national scale. The NHIS database is anonymized to protect individual privacy and is widely used in Korea for public health research.

The study population consisted of 966,200 individuals newly assigned a disability grade code between 2010 and 2019. To enable effective analysis and enhance clarity in interpreting the results, the research team grouped these individuals into five major disability categories (Table S1). Motor and Structural Disabilities (MSD) included physical disability, brain lesion disability, and facial disability. Sensory and Communication Disabilities (SCD) comprised visual disability, hearing disability, and speech disability. Developmental Disabilities (DD) encompassed intellectual disability and autism spectrum disorder. Mental Health Disabilities (MHD) referred to mental disability, while Internal Organ and Systemic Disabilities (IOSD) included renal, cardiac, respiratory, hepatic, ostomy, and epileptic disabilities. This classification was designed to simplify the analysis while capturing the diversity of disability types in the study population. Each category was further divided into severe (Grades 1–3) or mild (Grades 4–6) disability severity for the main analysis. Individuals classified under "other" categories, including Grade

10 or those with undetermined or missing disability grades, were excluded from the severity-based analysis but were included in the overall analysis (e.g., disability status, disability type).

Participants were classified into groups to evaluate differences in dental healthcare utilization patterns, which included Periodontitis(outpatient), Periodontitis(inpatient), and Dental Treatment. Periodontitis(outpatient) refers to outpatient care for managing periodontitis, reflecting mild symptoms or preventive treatment. Periodontitis(inpatient) represents cases of severe periodontitis requiring hospitalization for intensive treatment. Dental Treatment was defined as all dental procedures recorded in the NHIS database, regardless of periodontitis status, encompassing the overall utilization of dental healthcare services.

Propensity score matching (PSM) was applied in this study to ensure comparability between individuals with and without disabilities. By matching these groups based on key variables such as age, sex, residence, and insurance premium level, PSM minimized selection bias and enabled a balanced comparison. A total of 966,200 matched controls were included in this study (Fig. 1). All participants were followed up from the year after their first disability assignment between 2010 and 2019. Participants with incomplete follow-up data or those lost to follow-up during the observation period were excluded from the final analysis to maintain data integrity and ensure that all participants had consistent follow-up during the entire observation period. The observation period ranged from 2005 to 2019, with the wash-out period specifically applied from 2005 to 2009. This allowed for the exclusion of participants who had been diagnosed with periodontal conditions before their disability status was assigned.

Definition of periodontal disease

Periodontal disease was classified according to the Korean Classification of Diseases (KCD-8). The conditions included acute periodontitis (K05.28, and K05.29), chronic periodontitis (K05.30, K05.31, K05.32, K05.38, and K05.39), and other types of periodontitis (K05.4, K05.5, and K05.6). Individuals were included if they received a primary or secondary diagnosis of these conditions at least once during the study period. The dental treatments considered in the analysis, including dental scaling (U2231), calculus removal (U2232), root planing (U2240, U2244), curettage (U1010), and flap surgery (U1051, U1052), were coded using treatment codes that apply uniformly to individuals with and without disability. Participants who developed any of these periodontal conditions before the year of disability onset were excluded from the study (washout criteria).

Statistical analysis

In this retrospective cohort study, we observed the overall incidence rates of disabilities from 2010 to 2019 and analysed the risk of periodontitis by disability type, including MSD, SCD, DD, MHD, and IOSD. Trends in annual incidence rates were estimated. To compare periodontal health outcomes between individuals with and without disabilities, categorical variables were analysed using the chi-square test, and continuous variables were compared using t-tests. Furthermore, the impact of disability on periodontal health was examined using multivariate logistic regression and negative binomial regression analyses, considering disability grade as a key factor. All statistical analyses were conducted at a significance level of 0.05, utilising SAS Enterprise Guide 7.1 (SAS Institute Inc., Cary, NC, USA) and R 4.3.1 software (R Core Team, Vienna, Austria). The study was conducted in accordance

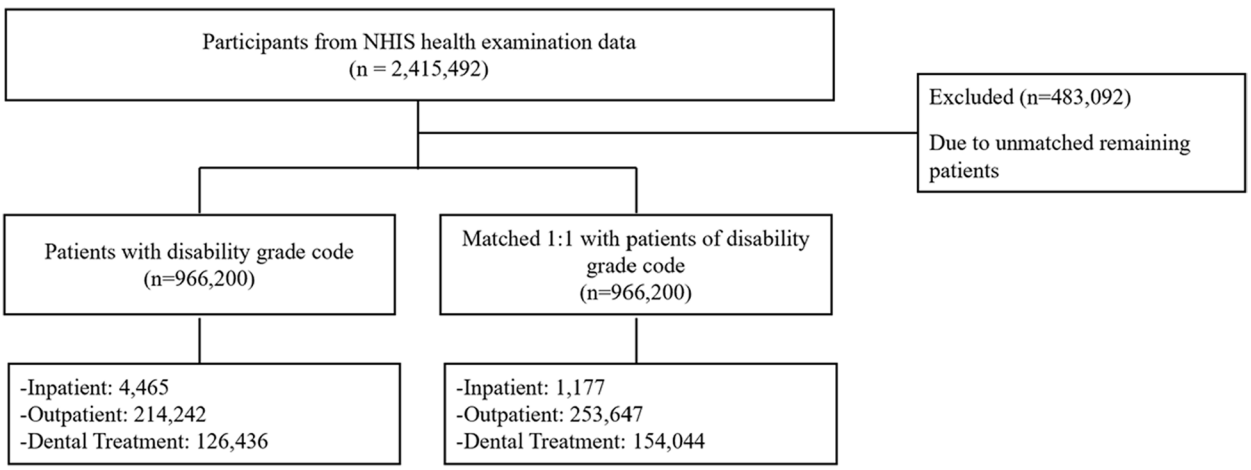

Fig. 1 Flow chart of study participants

with the Declaration of Helsinki and approved by the Institutional Review Board of Kyung Hee University (IRB No.: KHSIRB-21–330(EA)). The requirement for informed consent was waived owing to the retrospective nature of the study (Clinical trial number: not applicable).

Result

The distribution of disabilities among individuals with newly assigned disability grade codes from 2010 to 2019 ($n=966,200$) is shown in Table 1.

Patients with MSD accounted for the largest proportion of the total population (42.13%, $n=407,032$). Among them, 26.2% had severe disabilities ($n=106,639$), while the majority had mild disabilities (69.8%, $n=284,040$). A small proportion ($n=16,353$) belonged to the "other" category. The most prevalent disability within the MSD group was physical disability, affecting 235,555 individuals (24.38%), with the majority (87.5%) classified as having mild disability. Patients with SCD represented 33.25% of the total population ($n=321,220$). Most individuals with SCD had mild disabilities ($n=266,868$), whereas 29,956 had severe disabilities. Visual (8.92%) and hearing (22.91%) disabilities were the most common in this group, with the majority classified as mild. Speech disabilities were less common (1.42%), with 5,817 individuals classified as having severe disabilities. Patients with DD comprised 7.99% ($n=77,196$) of the study population, with the vast majority classified as having severe disability ($n=73,112$). Intellectual disability was the most common subtype (6.67%), followed by autism spectrum disorder (1.32%). Patients with MHD consist of 3.78% ($n=36,556$) of the study population, with nearly all patients (96.5%) classified as having severe disability ($n=35,283$). Meanwhile, patients with IOSD accounted for 12.85% of the population ($n=124,196$). Most (64.5%) had severe disabilities, whereas 37,329 had mild disabilities. The most common IOSD was renal disability (7.77%), and most cases were severe ($n=65,453$).

Table 2 presents the demographic characteristics of the population stratified by disability status and analysed using propensity score matching. The variables included the initial year of disability onset, age, sex, region, and insurance rank. The results indicated no significant differences between the disabled and non-disabled groups across these variables. The demographic characteristics of individuals with and without disabilities were analysed and stratified according to age, periodontitis status (inpatient and outpatient), and dental treatment (Table 3).

Table 1 Incidence rates of disability types in Korea (2010–2019) stratified by severity levels

Type of Disability	N ($n=966,200$)	Disability Grade		
		Severe (Grades 1–3) ($n=325,071$)	Mild (Grades 4–6) ($n=588,237$)	Other ($n=52,892$)
MSD	407,032 (42.13%)	106,639 (32.80%)	284,040 (48.29%)	16,353 (30.92%)
Physical Disability	235,555 (24.38%)	21,069 (6.48%)	206,146 (35.05%)	8,340 (15.77%)
Brain Lesion Disability	169,966 (17.59%)	85,372 (26.26%)	76,594 (13.02%)	8,000 (15.13%)
Facial Disability	1,511 (0.16%)	198 (0.06%)	1,300 (0.22%)	13 (0.02%)
SCD	321,220 (33.25%)	29,956 (9.22%)	266,868 (45.37%)	24,396 (46.12%)
Visual Disability	86,150 (8.92%)	8,539 (2.63%)	73,595 (12.51%)	4,016 (7.59%)
Hearing Disability	221,314 (22.91%)	15,600 (4.80%)	186,374 (31.69%)	19,340 (36.56%)
Speech Disability	13,756 (1.42%)	5817 (1.79%)	6899 (1.17%)	1,040 (1.97%)
DD	77,196 (7.99%)	73,112 (22.49%)	-	4,084 (7.72%)
Intellectual Disability	64,434 (6.67%)	61,129 (18.80%)	-	3,305 (6.25%)
Autism Spectrum Disorder	12,762 (1.32%)	11,983 (3.69%)	-	779 (1.47%)
MHD	36,556 (3.78%)	35,283 (10.85%)	-	1,273 (2.41%)
Mental Disability	36,556 (3.78%)	35,283 (10.85%)	-	1,273 (2.41%)
IOSD	124,196 (12.85%)	80,081 (24.63%)	37,329 (6.35%)	6,786 (12.83%)
Renal Disability	75,076 (7.77%)	65,453 (20.13%)	4,932 (0.84%)	4,691 (8.87%)
Cardiac Disability	3,103 (0.32%)	2,277 (0.70%)	694 (0.12%)	132 (0.25%)
Respiratory Disability	9,630 (1.00%)	8,737 (2.69%)	382 (0.06%)	511 (0.97%)
Hepatic Disability	11,804 (1.22%)	2,323 (0.71%)	8,875 (1.51%)	606 (1.15%)
Ostomy Disability	20,828 (2.16%)	653 (0.20%)	19,455 (3.31%)	720 (1.36%)
Epileptic Disability	3,755 (0.39%)	638 (0.20%)	2,991 (0.51%)	126 (0.24%)

Number (row %); *MSD* motor and structural disabilities, *SCD* sensory and communication disabilities, *DD* developmental disabilities, *MHD* mental health disabilities, *IOSD* internal organ and systemic disabilities

Table 2 Demographic characteristics of individuals with and without disabilities after propensity score matching

	Persons with Disabilities (PwD) (*n* = 966,200, col %)		Persons without Disabilities (Pw/oD) (*n* = 966,200, col %)		*p*-value*
Year of Disability Onset					
2010	132,646	(13.73%)	132,646	(13.73%)	1.00
2011	86,207	(8.92%)	86,207	(8.92%)	
2012	71,401	(7.39%)	71,401	(7.39%)	
2013	70,217	(7.27%)	70,217	(7.27%)	
2014	86,535	(8.96%)	86,535	(8.96%)	
2015	83,548	(8.65%)	83,548	(8.65%)	
2016	96,225	(9.96%)	96,225	(9.96%)	
2017	105,577	(10.93%)	105,577	(10.93%)	
2018	118,582	(12.27%)	118,582	(12.27%)	
2019	115,262	(11.93%)	115,262	(11.93%)	
Age					
< 10	14,636	(1.51%)	14,118	(1.46%)	0.34
10–19	43,667	(4.52%)	43,717	(4.52%)	
20–29	34,721	(3.59%)	34,765	(3.60%)	
30–39	30,669	(3.17%)	30,682	(3.18%)	
40–49	53,894	(5.58%)	53,876	(5.58%)	
50–59	105,380	(10.91%)	105,169	(10.88%)	
60–69	182,668	(18.91%)	183,093	(18.95%)	
70–79	198,577	(20.55%)	198,726	(20.57%)	
80–89	225,599	(23.35%)	225,669	(23.36%)	
90 ≥	76,389	(7.91%)	76,385	(7.91%)	
Sex					
Male	541,048	(56.00%)	540,367	(55.93%)	0.32
Female	425,152	(44.00%)	425,833	(44.07%)	
Region[a]					
Metropolitan Cities	561,641	(58.13%)	561,500	(58.11%)	0.84
Provinces	404,559	(41.87%)	404,700	(41.89%)	
Insurance Premium Level					
0-5th	287,912	(29.80%)	287,884	(29.80%)	1.00
6th-10th	161,467	(16.71%)	161,599	(16.73%)	
11th-15th	210,221	(21.76%)	210,142	(21.75%)	
16th-20th	306,600	(31.73%)	306,575	(31.73%)	

Number (column %); *Chi-square test, [a]Metropolitan Cities: Seoul, Busan, Daegu, Incheon, Gwangju, Daejeon, Ulsan, Sejong; Provinces: Gyeonggi, Gangwon, Chungcheong, Jeolla, Gyeongsang, Jeju

Between 2010 and 2019, 5,642 individuals (0.29% of the total population), excluding duplicates, were hospitalised with primary or secondary periodontitis. Additionally, 467,889 individuals (24.21%) visited outpatient clinics, and 280,480 individuals (14.51%) received dental treatment. Among those hospitalised, individuals in their 50 s comprised the highest proportion (0.38%), with men (0.30%) hospitalised more frequently than women. Geographically, individuals from metropolitan areas (0.30%) had a higher hospitalisation rate than those from provinces, and those in the 0–5th insurance premium group had the highest hospitalisation rates (0.35%). For outpatient visits, the highest proportion was found among individuals in their 30 s (34.05%), with women (24.59%) more likely to visit outpatient clinics than men. Residents of the provinces (24.73%) had a slightly higher rate of outpatient visits than those in metropolitan areas, and individuals in the 6th–10th insurance premium groups had the highest outpatient visit rates (25.57%). Regarding dental treatment, individuals in their 40 s comprised the highest proportion (19.79%), with men (14.77%) receiving more treatment than women. Individuals living in provinces (15.51%) were more likely to receive dental treatment than those living in metropolitan areas, and individuals in the 6th–10th insurance premium group had the highest rate of dental treatment (15.55%).

The results of the analysis of periodontitis-related hospitalisations, outpatient visits, and dental treatments categorised by disability type and severity are shown in Table 4.

Among individuals with disabilities, 4,465 (0.46%) were hospitalised for periodontitis, which was higher than the 1,177 individuals (0.12%) without disabilities. However, outpatient visits for periodontitis were lower among individuals with disabilities, with 214,242 (22.17%) individuals, compared to 253,647 (26.25%) individuals in the non-disability group. Similarly, individuals with disabilities ($n = 126,436$, 13.09%) had a lower frequency of dental treatment than those without disabilities ($n = 154,044$, 15.94%).

In terms of disability type, the highest number of hospitalisations due to periodontitis occurred in individuals with MHD ($n = 494$, 1.35%), followed by those with MSD ($n = 2,415$, 0.59%), IOSD ($n = 662$, 0.53%), DD ($n = 209$, 0.27%), and SCD ($n = 685$, 0.21%). Regarding outpatient visits related to periodontitis, the highest frequency was observed in individuals with MHD ($n = 11,105$, 30.38%), followed by those with MSD ($n = 108,505$, 26.66%), IOSD ($n = 27,427$, 22.08%), DD ($n = 13,691$, 17.74%), and SCD ($n = 53,514$, 16.66%). Regarding dental treatment, individuals with MHD had the highest frequency ($n = 6,488$, 17.75%), followed by those with MSD ($n = 62,413$, 15.33%), DD ($n = 11,083$, 14.36%), IOSD ($n = 15,296$, 12.32%), and SCD ($n = 31,156$, 9.7%).

When stratified by disability severity, individuals with severe disabilities (Grades 1–3) had higher hospitalisation rates for periodontitis ($n = 2,524$, 0.78%) than those of individuals with mild disabilities (Grades 4–6) ($n = 1,941$, 0.33%). However, the number of outpatient visits for periodontitis was lower in those with severe

Table 3 Demographic characteristics of individuals with and without disabilities by periodontitis and dental treatment status

	Periodontitis: Inpatient		Periodontitis: Outpatient		Dental Treatment[a]	
	No (*n* = 1,926,758)	Yes (*n* = 5,642)	No (*n* = 1,464,511)	Yes (*n* = 467,889)	No (*n* = 1,651,920)	Yes (*n* = 280,480)
Age (years)						
< 10	28,754 (100%)	0 (0%)	28,511 (99.15%)	243 (0.85%)	27,950 (97.20%)	804 (2.80%)
10–19	87,324 (99.93%)	60 (0.07%)	80,084 (91.65%)	7,300 (8.35%)	74,235 (84.95%)	13,149 (15.05%)
20–29	69,396 (99.87%)	90 (0.13%)	50,239 (72.30%)	19,247 (27.70%)	57,646 (82.96%)	11,840 (17.04%)
30–39	61,241 (99.82%)	110 (0.18%)	40,459 (65.95%)	20,892 (34.05%)	49,990 (81.48%)	11,361 (18.52%)
40–49	107,470 (99.72%)	300 (0.28%)	72,164 (66.96%)	35,606 (33.04%)	86,440 (80.21%)	21,330 (19.79%)
50–59	209,756 (99.62%)	793 (0.38%)	147,154 (69.89%)	63,395 (30.11%)	170,112 (80.79%)	40,437 (19.21%)
60–69	364,488 (99.65%)	1,273 (0.35%)	262,996 (71.90%)	102,765 (28.10%)	300,517 (82.16%)	65,244 (17.84%)
70–79	396,048 (99.68%)	1,255 (0.32%)	296,837 (74.71%)	100,466 (25.29%)	337,241 (84.88%)	60,062 (15.12%)
80–89	449,963 (99.71%)	1,305 (0.29%)	358,627 (79.47%)	92,641 (20.53%)	404,407 (89.62%)	46,861 (10.38%)
≥ 90	152,318 (99.70%)	456 (0.30%)	127,440 (83.42%)	25,334 (16.58%)	143,382 (93.85%)	9,392 (6.15%)
Sex						
Male	1,078,149 (99.70%)	3,266 (0.30%)	822,746 (76.08%)	258,669 (23.92%)	921,680 (85.23%)	159,735 (14.77%)
Female	848,609 (99.72%)	2,376 (0.28%)	641,765 (75.41%)	209,220 (24.59%)	730,240 (85.81%)	120,745 (14.19%)
Region						
Metropolitan Cities	1,119,804 (99.70%)	3,337 (0.30%)	855,355 (76.16%)	267,786 (23.84%)	968,158 (86.20%)	154,983 (13.80%)
Provinces	806,954 (99.72%)	2,305 (0.28%)	609,156 (75.27%)	200,103 (24.73%)	683,762 (84.49%)	125,497 (15.51%)
Insurance Premium Quota						
0-5th	573,760 (99.65%)	2,036 (0.35%)	431,216 (74.89%)	144,580 (25.11%)	490,362 (85.16%)	85,434 (14.84%)
6th-10th	322,180 (99.73%)	886 (0.27%)	240,442 (74.43%)	82,624 (25.57%)	272,843 (84.45%)	50,223 (15.55%)
11th-15th	419,260 (99.74%)	1,103 (0.26%)	316,787 (75.36%)	103,576 (24.64%)	357,297 (85.00%)	63,066 (15.00%)
16th-20th	611,558 (99.74%)	1,617 (0.26%)	476,066 (77.64%)	137,109 (22.36%)	531,418 (86.67%)	81,757 (13.33%)

Number (row %) [a]Dental Treatment: Dental treatments in this analysis include dental scaling (U2231), calculus removal (U2232), root planing (U2240, U2244), curettage (U1010), and flap surgery (U1051, U1052)

disabilities (*n* = 60,751, 18.69%) than in those with mild disabilities (*n* = 153,491, 26.09%). Similarly, dental treatment was less frequent in individuals with severe disabilities (*n* = 37,539, 11.55%) than in those with mild disabilities (*n* = 88,895, 15.11%).

Table 5 presents the associations between periodontitis-related hospitalisations, outpatient visits, and dental treatments according to disability type and severity, analysed using multiple logistic regression to calculate odds ratios (OR). The results showed that compared to individuals without disabilities, those with disabilities had a significantly higher likelihood of being hospitalised for periodontitis, with an OR of 3.83 (95% confidence interval 95% CI: 3.59–4.08). However, the odds of visiting an outpatient clinic were significantly lower (OR: 0.68, 95% CI: 0.68–0.68), as were the

Table 4 Periodontal disease outcomes and dental treatment utilisation by disability status, type, and severity

	Periodontitis: Inpatient[a]		Periodontitis: Outpatient[a]		Dental Treatment[a]	
	No (*n* = 1,926,758)	Yes (*n* = 5,642)	No (*n* = 1,464,511)	Yes (*n* = 467,889)	No (*n* = 1,651,920)	Yes (*n* = 280,480)
Disability Status[a]						
Individuals without disabilities	965,023 (99.88%)	1,177 (0.12%)	712,553 (73.75%)	253,647 (26.25%)	812,156 (84.06%)	154,044 (15.94%)
Individuals with disabilities	961,735 (99.54%)	4,465 (0.46%)	751,958 (77.83%)	214,242 (22.17%)	839,764 (86.91%)	126,436 (13.09%)
Disability Type						
MSD	401,762 (99.4%)	2,415 (0.60%)	123,154 (53.16%)	108,505 (46.84%)	204,657 (76.63%)	62,413 (15.33%)
SCD	319,621 (99.79%)	685 (0.21%)	85,521 (61.51%)	53,514 (38.49%)	162,256 (83.89%)	31,156 (9.70%)
DD	76,878 (99.73%)	209 (0.27%)	52,430 (79.29%)	13,691 (20.71%)	54,605 (83.13%)	11,083 (14.36%)
MHD	35,649 (98.63%)	494 (1.37%)	12,281 (52.51%)	11,105 (47.49%)	20,197 (75.69%)	6,488 (17.75%)
IOSD	122,531 (99.46%)	662 (0.54%)	37,086 (57.49%)	27,427 (42.51%)	66,132 (81.22%)	15,296 (12.32%)
Disability Grade						
Mild Disability	583,900 (99.67%)	1,941 (0.33%)	144,938 (48.57%)	153,491 (51.43%)	278,806 (75.82%)	88,895 (15.11%)
Severe Disability	320,052 (99.22%)	2,524 (0.78%)	150,616 (71.26%)	60,751 (28.74%)	202,899 (84.39%)	37,539 (11.55%)

Number (row %); *MSD* motor and structural disabilities, *SCD* sensory and communication disabilities, *DD* developmental disabilities, *MHD* mental health disabilities, *IOSD* internal organ and systemic disabilities

[a] For Periodontitis (Inpatient/Outpatient) and Dental Treatment: 'Yes': Presence of the condition (e.g., periodontitis-related inpatient admission, outpatient visit, or receiving dental treatment); 'No': Absence of the condition

Table 5 Odds ratios for periodontitis-related hospitalisations, outpatient visits, and dental treatments by disability status, type, and severity

	Periodontitis: Inpatient				Periodontitis: Outpatient				Dental Treatment			
	OR	95% CI		*P**	OR	95% CI		*P**	OR	95% CI		*P**
Disability Status												
No	1.00				1.00				1.00			
Yes	3.83	3.59	4.08	< .0001	0.68	0.68	0.69	< .0001	0.73	0.72	0.73	< .0001
Type of Disability												
MSD	4.89	4.56	5.25	< .0001	1.03	1.02	1.04	< .0001	0.97	0.96	0.98	< .0001
SCD	1.75	1.60	1.93	< .0001	0.56	0.56	0.57	< .0001	0.48	0.47	0.48	< .0001
DD	2.23	1.92	2.58	< .0001	0.61	0.60	0.62	< .0001	0.77	0.75	0.78	< .0001
MHD	13.70	12.26	15.30	< .0001	1.02	0.99	1.05	0.1519	0.93	0.90	0.95	< .0001
IOSD	4.39	4.00	4.83	< .0001	0.80	0.79	0.81	< .0001	0.69	0.67	0.70	< .0001
Disability Grade												
Mild Disability	2.59	2.41	2.78	< .0001	0.99	0.98	1.00	0.0148	0.96	0.95	0.97	< .0001
Severe Disability	7.14	6.66	7.66	< .0001	0.44	0.43	0.44	< .0001	0.52	0.51	0.52	< .0001

MSD motor and structural disabilities, *SCD* sensory and communication disabilities, *DD* developmental disabilities, *MHD* mental health disabilities, *IOSD* internal organ and systemic disabilities

[*] Multiple negative binomial regression adjusted by age, sex, region, insurance premium quota

odds of receiving dental treatment (OR: 0.73, 95% CI: 0.72–0.73).

The likelihood of hospitalisation due to periodontitis varies according to disability type. Individuals with MHD are 13.70 times more likely to be hospitalised (95% CI: 12.26–15.30), followed by those with MSD at 4.89 times (95% CI: 4.56–5.25), IOSD at 4.39 times (95% CI: 4.00–4.83), DD at 2.23 times (95% CI: 1.92–2.58), and SCD at 1.75 times (95% CI: 1.60–1.93). Additionally, the likelihood of outpatient visits for periodontitis increases by 1.03 times (95% CI: 1.02–1.04) in individuals with MSD, and by 1.02 times (95% CI: 0.99–1.05) in those with MHD; conversely, it significantly decreases for those with IOSD (0.80 times, 95% CI: 0.79–0.81), DD (0.61 times, CI: 0.60–0.62), and SCD (0.56 times, 95% CI: 0.56–0.57). Furthermore, the likelihood of receiving dental treatment is significantly lower in individuals with MSD (0.97 times, 95% CI: 0.96–0.98), MHD (0.93 times, 95% CI: 0.90–0.95), DD (0.77 times, 95% CI: 0.75–0.78), IOSD (0.69 times, 95% CI: 0.67–0.70), and SCD (0.48 times, 95% CI: 0.47–0.48).

When stratified by disability severity, individuals with mild disabilities had a 2.59 times higher likelihood (OR: 2.59, 95% CI: 2.41–2.78) of being hospitalised for periodontitis compared to those without disabilities, while those with severe disabilities had a 7.14 times higher likelihood (OR: 7.14, 95% CI: 6.66–7.66). For outpatient visits, the odds were similar between those with mild disabilities (OR: 0.99, 95% CI: 0.98–1.00) and those without disabilities. However, individuals with severe disabilities had significantly lower odds (OR, 0.44; 95% CI: 0.43–0.44). Regarding dental treatments, individuals with mild disabilities had slightly lower odds (OR: 0.96, 95% CI: 0.95–0.97) compared to those without disabilities, while those with severe disabilities had significantly reduced odds (OR: 0.52, 95% CI: 0.51–0.52).

An analysis based on the annual average number of visits using multiple negative binomial regression instead of visit occurrence yielded consistent findings (Fig. 2).

Discussion

This study examined how disability status, type, and severity are associated with the prevalence of periodontitis, hospitalisation risks, and healthcare utilisation patterns. The findings reveal that individuals with disabilities are significantly more likely to be hospitalised for periodontitis compared to those without disabilities, with the highest rates among individuals with MHD, MSD, and severe disabilities. In contrast, the frequency of outpatient visits and dental treatments was generally lower in the disabled group, except for those with MSD. The disabled group showed higher rates in both areas compared to their non-disabled counterparts. While periodontitis is usually treatable through outpatient care when detected early, delayed treatment can result in severe infections, sometimes necessitating hospitalisation. Such cases are considered potentially avoidable hospitalisations, where timely and appropriate care could have prevented disease progression. These findings highlight significant healthcare access disparities across different disability groups and emphasise the need for targeted interventions to address these gaps and reduce preventable hospitalisations.

Our study highlights the heightened risk of periodontitis among individuals with disabilities compared with their non-disabled counterparts, underscoring the significant challenges this population faces in maintaining oral health. These challenges are often exacerbated by physical limitations, coexisting medical conditions, and socioeconomic barriers hindering access to regular dental care [19]. As shown in Tables 4 and 5, individuals with disabilities had higher rates of hospitalisation for periodontitis but lower rates of outpatient visits and preventive dental services (or dental treatments). This aligns with previous studies suggesting that limited access to dental services contributes to the deterioration of oral health in this population [20]. Furthermore, the lack of attention to oral health by patients and caregivers and the broader societal neglect of the dental needs of individuals with disabilities compounded these disparities [21]. This issue is further compounded by the undervaluation of preventive dental care in public health strategies for individuals with disabilities, despite its crucial role in preventing severe oral health conditions. Therefore, there is an urgent need for targeted public health interventions that prioritise improving access to dental care and reducing oral health inequalities among individuals with disabilities [22, 23].

Individuals with disabilities have a higher risk of periodontitis; however, this risk differs depending on the type of disability. These populations often experience communication barriers, anxiety, and behavioural issues that can complicate dental visits and further worsen their oral health problems [24]. Those with MHD, for instance, demonstrated the highest odds of hospitalisation, suggesting that this group is particularly vulnerable to severe periodontal disease. Previous research has shown that mental disorders are associated with poor oral health outcomes, often due to the side effects of medication, neglect of oral hygiene, and barriers to accessing dental care [25]. Similarly, individuals with brain injuries may suffer from motor impairments and cognitive deficits that hinder their ability to maintain oral hygiene and seek regular dental care, thereby increasing their risk of developing severe periodontal conditions [26, 27]. Additionally, individuals with intellectual disabilities, epilepsy, and sensory impairments, such as hearing and visual

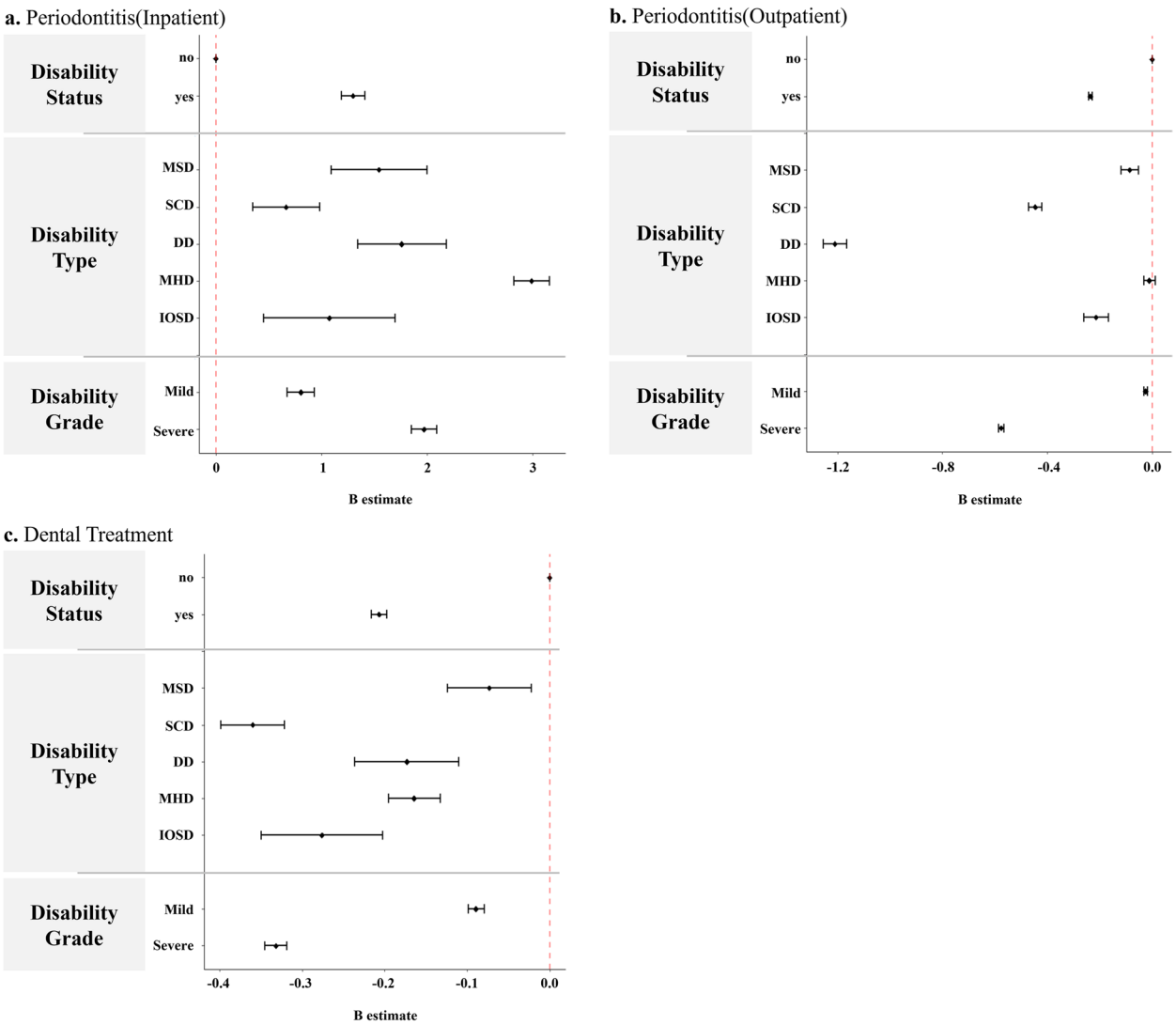

Fig. 2 Analysis of the annual average number of visits for periodontitis and dental treatment according to disability type and grade through multiple negative binomial regression. Multiple negative binomial regression adjusted by age, sex, region, and insurance premium quota. MSD, motor and structural disabilities; SCD, sensory and communication disabilities; DD, developmental disabilities; MHD, mental health disabilities; IOSD, internal organ and systemic disabilities

disabilities, face significant challenges in accessing and receiving adequate dental care [28].

Despite higher hospitalisation rates among individuals with brain lesions and mental disabilities, these groups were less likely to utilise outpatient services and dental treatments. This paradox can be attributed to the unique challenges faced in dental care [28]. Individuals with brain lesions and mental disabilities often face significant challenges that affect their ability to cooperate during dental procedures [29, 30]. For example, patients with brain lesions may experience involuntary movements and motor impairments, making it difficult for them to remain still during dental treatments [31]. This increases the complexity of care and often necessitates general anaesthesia even for routine procedures [32]. Similarly, individuals with mental disabilities frequently encounter communication difficulties that can hinder their ability to understand and cooperate with dental care, often requiring sedation or general anaesthesia to ensure their safety during treatment [33]. As a result, both groups are frequently classified as patients who require general anaesthesia for dental care [34], which could potentially contribute to the lower rates of outpatient visits and dental treatments observed among them. The requirement for more focused and resource-heavy care may cause delays in treatment, leading to the

worsening of periodontal conditions until hospitalisation is required. The higher rates of hospitalisation and lower rates of outpatient dental visits among these individuals can be attributed to the complex interplay between their specific disabilities and the challenges they face in accessing and receiving typical dental care. To reduce these disparities, it is crucial to implement tailored interventions that enhance access to regular dental services and ensure that oral health problems are addressed early, preventing them from progressing to more severe conditions that require hospitalisation.

In contrast, individuals with MSD were more likely to utilise outpatient services and receive dental treatment than the other disability groups. This suggests that once the physical barriers to accessing healthcare are overcome, these individuals may actively seek treatment for oral health issues before they worsen. Notably, access to preventive dental care remains a significant challenge [35, 36]. For instance, only 41% of patients with physical disabilities receive preventive dental treatments compared to 53% of patients without disabilities [37]. Although this rate is relatively high, considering the barriers faced by people with physical disabilities, the disparity underscores the need for improved access to dental services.

An important finding of this study is that periodontal disease is disproportionately observed in individuals with disabilities as well as in those with specific types of disabilities. Additionally, individuals with disabilities face numerous challenges in maintaining their oral health, including limited mobility, dependence on caregivers, and difficulties performing daily oral hygiene routines [38, 39]. These barriers necessitate improving the mobility rights of disabled individuals, ensuring that they have better access to dental care facilities and services that cater to their specific needs. In our study, we found that the rate of severe disability among hospitalised individuals with periodontitis was higher than that among those with mild disabilities, highlighting the need for targeted healthcare interventions for severely disabled individuals. Although policies introduced in 2024, such as the adjustment of dental treatment fees for individuals with brain lesions, intellectual disabilities, psychiatric disorders, and autism spectrum disorders to 300% of the standard points without increasing out-of-pocket expenses [37], do alleviate patients' financial burden, further efforts are needed to address the underlying healthcare challenges. Providing financial support alone may not be sufficient to eliminate these disparities, highlighting the need for more customised public health strategies that specifically address the oral health needs of vulnerable groups.

This study had several strengths and limitations. One limitation is that the observational design makes it difficult to determine a causal relationship between disability status and the risk of periodontitis. Second, the NHIS database does not capture data for individuals who are unable to access any form of dental care, which may contribute to an underestimation of unmet needs. Additionally, while we included various periodontal treatments in the analysis, specific surgical procedures such as gingivectomy were not independently analyzed. Moreover, although we aimed to conduct a thorough analysis of periodontitis risk, evaluating long-term outcomes such as tooth loss proved to be challenging. Additionally, our findings may be particularly relevant to the Korean healthcare system and population, which could limit the generalisability of the results to other settings with different healthcare systems and socioeconomic contexts. Despite these limitations, this study has significant strengths. Notably, it is among the few studies that provide a comprehensive evaluation of periodontitis risk across almost all disability types, giving a broad perspective on how various disabilities influence oral health. This approach enables nuanced analyses to guide targeted public health interventions. Furthermore, the inclusion of both outpatient and inpatient data highlights the treatment delays faced by individuals with disabilities, offering a clearer view of their healthcare utilization patterns and the challenges they encounter in accessing timely care. The study also utilised large-scale Korean big data, which increased the reliability of the findings due to the extensive sample size and longitudinal nature of the data. This approach contributes to producing statistically robust results that reflect real-world conditions, offering valuable insights for policymakers and healthcare professionals focused on improving oral health outcomes for individuals with disabilities.

Beyond these findings, Korea is currently developing initiatives such as home-visit dental services for people with disabilities who are unable to visit hospitals. These programs aim to improve access to dental care for individuals facing mobility challenges. Once such programs become fully established, they are expected to enhance the comprehensiveness and accuracy of dental care data within the NHIS system, allowing for more precise assessments of oral health disparities and healthcare utilization patterns in this population.

Conclusion

In conclusion, this study identified notable disparities in the risk of periodontitis and the use of healthcare services among people with disabilities, highlighting their increased susceptibility to severe oral health conditions. The results show that individuals with disabilities, especially those with MHD, MSD, and severe disabilities, are more frequently hospitalised or have outpatient visits for periodontitis but tend to receive fewer dental treatments.

This contrast underscores the multifaceted challenges faced by these individuals, such as physical, cognitive, and socioeconomic barriers that hinder access to regular dental care and worsen oral health issues. This study calls attention to the urgent need for specialised public health interventions that enhance dental care access for people with disabilities, helping to prevent oral health problems from reaching critical levels. Furthermore, the differences in healthcare use among disability types stress the importance of developing tailored public health approaches to address the specific needs of these groups and reduce the burden of periodontitis. These results provide key implications for healthcare policymakers and practitioners in designing strategies to improve the availability and quality of dental care services for people with disabilities. Future research should investigate disparities in healthcare access among people with disabilities, focusing on the geographic, socioeconomic, and systemic barriers that influence care availability. Given the retrospective nature of this study, a prospective cohort study would be a valuable approach to further explore causal relationships.

Abbreviations

DD	Developmental disabilities
IOSD	Internal organ and systemic disabilities
KCD-8	Korean Classification of Diseases
MHD	Mental health disabilities
MSD	Motor and structural disabilities
NHIS	National Health Insurance Service
SCD	Sensory and communication disabilities
WHO	World Health Organization

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

S.C. contributed to conceptualization, methodology, investigation, visualization, original draft writing, and review & editing. I.O. was responsible for conceptualization, validation, supervision, resources, original draft writing, and review & editing. J.B. contributed to conceptualization, review & editing, and visualization. J.S. handled methodology, software, data curation, formal analysis, validation, and visualization. Y.J. contributed to conceptualization, methodology, and review & editing. M.K. was responsible for conceptualization, methodology, and review & editing. J.L. contributed to writing – review & editing. S.P. managed conceptualization, supervision, funding acquisition, project administration, original draft writing, and review & editing. All authors approved the final version for publication.

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Data availability

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding authors. The data supporting the findings of this study were obtained from the National Health Insurance Service (NHIS) of South Korea. These data are not publicly available due to legal restrictions but can be accessed upon reasonable request and with permission from the NHIS. Researchers can apply for access through the NHIS Data Sharing Service (Full URL: https://nhiss.nhis.or.kr/).

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board (IRB) of Kyung Hee University (approval number: KHSIRB-21–330(EA)). This study was conducted in accordance with the principles of the Declaration of Helsinki. The requirement for informed consent was waived due to the use of de-identified secondary data.

Consent for publication

Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Competing interests

JL is a co-founder and major shareholder of Symbiotic AI, Inc. All other authors declare no competing interests.

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Further reading

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