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Disability-related disparities in health outcomes among newly diagnosed diabetic patients: A retrospective cohort

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Abstract

Background A distinct gap in the literature persists regarding the health outcome of individuals with Type 2 diabetes who also have disabilities. This study aimed to investigate potential disparities in events occurrence among diabetes patients across various disability stages.

Methods We conducted a retrospective cohort study on patients newly diagnosed with diabetes in 2013 and 2014, aged ≥ 18 years, and followed them until December 2021, using data from the Korean National Health Insurance database. All-cause mortality and hospitalization for diabetes mellitus and cardio-cerebrovascular diseases (CVD) was assessed.

Results The study included 26,085 patients, encompassing individuals without disabilities and those with physical, visual, hearing and speech, intellectual and developmental, and mental disabilities. After adjustment, individuals with disabilities had a higher risk of all-cause death (adjusted hazard ratio [aHR]: 1.25, 95% CI: 1.07–1.48) compared to those without disabilities. In particular, severe disabilities and hearing and speech disabilities showed significantly higher risks of all-cause death (aHR: 1.40, 95% CI: 1.06–1.85 and aHR: 1.58, 95% CI: 1.17–2.15, respectively), with marginal significance for mild disabilities (aHR: 1.20, 95% CI: 0.99–1.45) and mental disorders (aHR: 1.92, 95% CI: 0.98–3.73). Patients with disabilities also had significantly increased risks of CVD-related first admissions (aHR: 1.30, 95% CI: 1.07–1.56) and diabetes-related first admissions (aHR: 1.31, 95% CI: 1.20–1.43) compared to those without disabilities.

Conclusions This study underscores the urgent need for public health policies to prioritize individuals with disabilities and diabetes, addressing the disparities in health outcome.

Keywords Persons with disability, Health disparities, Diabetes mellitus, Mortality, Hospitalization

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Background

The global prevalence of diabetes among the 20–79 year old demographic in 2021 was estimated at 10.5%, encompassing approximately 530 million people, with Type 2 diabetes accounting for over 90% of cases worldwide [1]. This epidemic is responsible for 6.7 million deaths worldwide and increases the risk of cardiovascular disease and mortality [2]. Concurrently, 1.3 billion people, constituting 16% of the global population, living with significant disabilities [3], among whom a higher prevalence of diabetes is observed. Given well-documented disability-related health inequalities [3], the burden of diabetes is particularly pronounced among persons with disabilities. Factors such as harmful behavior, limited access to healthy diets, and quality care, as well as delayed detection, may exacerbate this burden [4]. In addition, persons with disabilities may exhibit poor compliance with medical treatment due to physical limitations, socio-economic conditions, as well as hard to finding adequate physicians heightening the risk of diabetes complications and mortality [5–7].

While an existing study has reported an association between disabilities and poor health outcome among diabetic patients, it only focused on vision impairments and hearing disorders and fail to differentiate between disabilities caused by diabetes itself. Although patients with diabetes have a higher risk of death and hospitalization, the nuanced landscape of disability-related health inequalities has been overlooked among diabetic patients [8]. Furthermore, although an emerging body of literature has highlighted the importance of continuity of care (COC) and medication adherence in reducing diabetes-related complications and mortalities [9], their impact on the health outcomes of persons with disabilities and diabetes remain inadequately explored [10–12].

Despite existing research on health outcome of individuals with disabilities attributed to diabetes, a distinct gap in the literature persists with respect to comparisons based on disability itself, as well as its characteristics and types. In addition, studies integrating the elements of COC and medication adherence (proportion of days covered, PDC) into their analysis remain considerably limited. Addressing this gap is essential for understanding the health outcomes of persons with disabilities and diabetes and developing effective interventions. Thus, this study aimed to investigate potential disparities in the occurrence of fatal and non-fatal events among patients with diabetes across various stages of disability, while examining the influence of factors such as continuity of care and medication adherence. Utilizing national cohort data from the Korean National Health Insurance Service (NHIS) database, we specifically aimed to explore the association of disability status, severities, and types with mortality among adults with Type 2 diabetes, as well as hospitalization due to diabetic and cerebrovascular diseases (CVD).

Methods

Database and study population

The study population was derived from the NHIS database. The NHIS provides mandatory health care coverage for almost all Koreans, including National Health Insurance (NHI) enrollees (97%) and Medical Aid beneficiaries (3%), and covers most forms of health services, including emergency, inpatient and outpatient care, and medication prescriptions. The NHIS database contains the insurance claims of medical institutions and enrollee information, including disability type and severity, health coverage type, NHI contributions, and death records. A key advantage of the NHIS is that it is managed by a single insurer under the government, ensuring the databases includes nearly all medical use information recorded during the claims process [13].

For this study, 10,413,089 participants, representing 20% of the 2012 population, were sampled considering the sex, age, and region distribution from the NHIS database, which contains the insurance claims of medical institutions and enrollee information. We collected data from the NHIS database between January 2012 and December 2021 (data number: NHIS-2022-1-629) [13]. Disability status, including primary type of disability and severity of disability, health coverage type, and NHI contributions, was examined as of January of each year. Because this study used de-identified data provided by the NHIS after anonymization according to strict confidentiality guidelines, the requirement for ethics review was exempted by the Institutional Review Board (IRB) of Korea Institute for Health and Social Affairs (IRB number: 2022-004).

We defined the study population as newly diagnosed diabetes (E12) patients aged ≥ 18 years in 2014 and 2015, excluding those with internal organ impairments and epilepsy disability (who are more likely to be hospitalized unavoidably due to the disability itself) and those with facial disfigurement (a low proportion). Patients with newly diagnosed diabetes did not visit healthcare institutions for type 2 diabetes (E11) during the previous two years, but did visit with a diabetic diagnosis code in 2014 or 2015 with an oral antihyperglycemic prescription according to the International Classification of Disease 10th revision codes. The inclusion criteria included patients with a primary diagnostic code while the exclusion criteria included those with a whole diagnostic code. Among 31,331 newly diagnosed diabetic patients, we excluded 3,949 subjects who had medical records of CVD (I20-I25, I60-I64, I67 and I69) for the two years before the diagnosis. We also excluded 447 patients with diabetes who were hospitalized for 90 days or longer during the two years immediately after the diagnosis, which reflects a serious condition and affects PDC and COC assessment [12]. Then, 379 patients with diabetes were excluded because of missing values for the covariates. Finally, we excluded patients who experienced each event during the first two years depending on dependent variables (Fig. 1). All participants were followed from diagnosis until the outcome event or December 31, 2021, whichever came earliest.

Classification of disabilities

The level of disability was categorized into mild and severe according to the Ministry of Health and Welfare (MOHW) definition. We included eight types of disability based on the MOHW definition and categorized them into the following five groups: (1) physical disability–orthopedic impairment and brain injury; (2) visual disability; (3) hearing and speech disability; (4) intellectual and developmental disability–intellectual disability and autism spectrum disorder; and (5) mental disability (schizophrenia, schizoaffective disorder, bipolar affective disorder, recurrent depressive disorder, organic psychiatric disorder due to neurological damage, obsessive-compulsive disorder, Tourette's disorder, and narcolepsy) [14].

COC and PDC variables – modifying factors

We calculated the COC and PDC during the 2 years after the diagnosis to ensure longitudinal continuity and medication adherence. First, we used the Bice–Boxerman continuity of care index score (COCI), which is influenced by the distribution of visits to different healthcare providers, i.e., the total number of visits, total number of providers, and number of visits with each provider. This index measures the degree to which patients visit several providers by counting the total number of visits (N), the total number of visits to the i th provider (n_i), and the total number of providers (j) using the following formula:

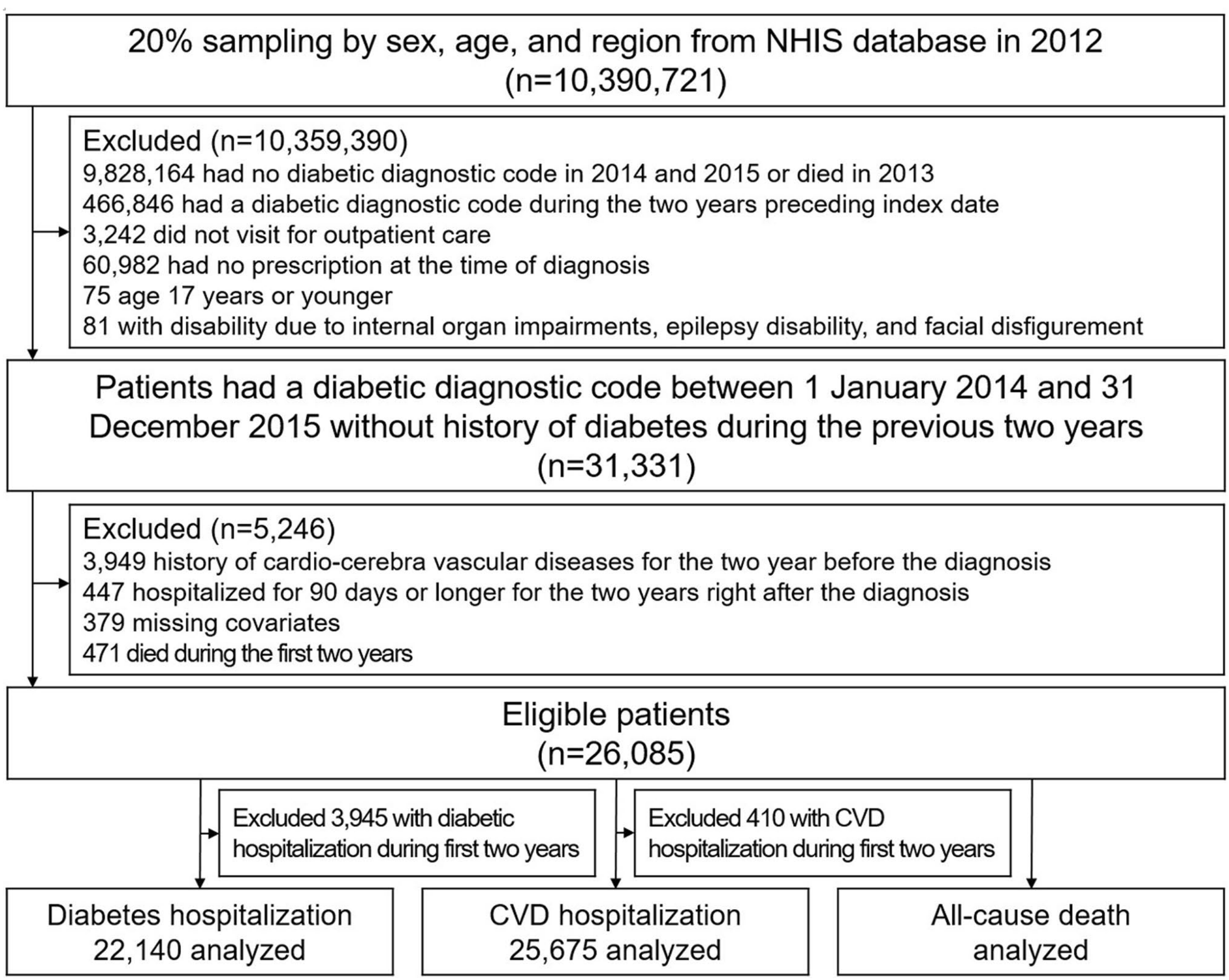

Fig. 1 Study population

$$\text{COCI} = \frac{\sum_{i=1}^{j} n_i^2 - N}{N(N-1)}$$

The COCI has a value between 0 and 1, with 1 indicating that all visits were to the same provider and 0 indicating full discontinuity of care. In this study, providers were defined as healthcare institutions.

Next, we assessed medication adherence using the PDC, the recently preferred method of measuring medication adherence [12, 15, 16]. The PDC was calculated based on the Anatomical Therapeutics Chemical (ATC) Code. Oral antihyperglycemic agents included biguanides (A10BA), sulfonamides, urea derivatives (A10BB), combinations of oral blood glucose-lowering drugs (A10BD), α-glucosidase inhibitors (A10BF), thiazolidinediones (A10BG), dipeptidyl peptidase 4 (DPP-4) inhibitors (A10BH), and other blood glucose-lowering drugs, excluding insulin (A10BX) [10, 12].

Although people with disability may have limited access to regular care, at least four and two visits are essential for calculating the COC and PDC, respectively. Thus, we created a combined variable of COC and PDC (COC–PDC), defining values ≥ 0.8 as high COC and high PDC, and classified them into five categories, creating another category for subjects with four or fewer visits: four or fewer outpatients visits, low COC and low PDC, high COC and low PDC, low COC and high PDC, and high COC and high PDC.

Confounding factors

Age, sex, health coverage type, income, and comorbidities were included as covariates. Age was employed as a continuous variable with age square. Healthcare coverage included NHI enrollees and Medical Aid (a subsidy program for the poor). Income level was categorized into the following five groups using contribution quintiles: Medical Aid and first, second, third, fourth, and fifth contribution quintiles. We calculated the Charlson Comorbidity Index (CCI) using the primary diagnosis codes in healthcare use records from 2018 to evaluate the level of comorbidities (0, 1, 2, or ≥3), referring to the definition of Charlson and colleagues [17].

Outcomes

The primary outcome was all-cause mortality. The secondary outcomes were hospitalization for diabetes for patients with diabetes and CVD. Hospitalization was determined when patients received medical services as inpatients with a primary diagnosis code for diabetes (E11) and CVD (cardiovascular: I20-I25 and stroke: I60-I64, I67, I69). All outcomes were recorded as dichotomous variables.

Statistical analysis

The chi-square test and analysis of variance were conducted for categorical and continuous variables, respectively, to compare the differences in the baseline distributions of covariates by disability status, severity and types. Multivariate Cox proportional hazard regression analyses with competing risk models were conducted to evaluate adjusted hazard ratios (aHRs) and 95% confidence intervals (CIs) for outcomes. The proportional hazard assumption was validated by including time-dependent covariates, which were created with interactions between the predictors and survival time, in the Cox proportional hazard regression models [18]. Stratified analyses of the association of disability types with outcomes were conducted according to the COC–PDC subgroups. All multivariate models were adjusted for the covariates listed above. Data analyses were performed using SAS Enterprise Guide 7.1 (SAS Institute, Cary, USA).

Results

Characteristics of the study population

Table 1 shows that most participants had no disability (92.7%). Among those with disabilities, 67.8% had mild disabilities, and 32.2% had severe disabilities. The distribution of disabilities included physical (64.3%), visual (11.3%), hearing and speech (12.1%), intellectual and developmental (5.6%), and mental disabilities (6.7%). The average age of individuals without disabilities was 53.4 years, while those with disabilities had a higher mean age of 58.7 years. As for COC–PDC, 19.1% of those without disability had less than four outpatient visits while 34.0% had a high COC and PDC. In contrast, among those with disabilities, 20.0% had less than four outpatient visits and 37.1% had a high COC and PDC (Table 1). Supplementary Table 1 presents the characteristics of the study population for each event (Table S1).

Cox proportional hazards regression analysis

Table 2 presents the results of the Cox proportional hazard regression analysis for death, first admissions related to diabetes, and CVD. After adjusting for factors including sex, age, monthly contribution, insurance type, medical institution type, CCI score, and COC–PDC, individuals with disabilities showed a significantly increased risk of all-cause death (aHR: 1.25, 95% CI: 1.07–1.48) compared to those without disabilities. When differentiating disability severity, individuals with severe disabilities exhibited a significantly higher risk of all-cause death with aHR of 1.40 (95% CI: 1.06–1.85) compared to those without disabilities. Mild disabilities demonstrated a marginally significant increase in the risk of all-cause death (aHR: 1.20, 95% CI: 0.99–1.45). Patients with hearing and speech disabilities showed an increased

Table 1 Descriptive statistics

	No disability *n* = 24,198	Disability *n* = 1887	*P*-value
Mild disability, n (%)	-	1,280 (67.8)	NA
Severe disability, n (%)	-	607 (32.2)	
Physical disability, n (%)	-	1,213 (64.3)	NA
Visual disability, n (%)	-	213 (11.3)	
Hearing and speech disability, n (%)	-	229 (12.1)	
Intellectual and developmental disability, n (%)	-	105 (5.6)	
Mental disability, n (%)	-	127 (6.7)	
Male, n (%)	15,578 (64.4)	1,254 (66.5)	0.07
Female, n (%)	8,620 (35.6)	633 (33.5)	
Age, mean (SD), y	53.4 (23.2)	58.7 (12.8)	< 0.001
National health insurance, n (%)	23,756 (98.2)	1,622 (86.0)	< 0.001
Medical Aid, n (%)	442 (1.8)	265 (14.0)	
Lowest quintile income, n (%)	4,397 (18.2)	608 (32.2)	< 0.001
2nd quintile income, n (%)	3,840 (15.9)	240 (12.7)	
3rd quintile income, n (%)	4,606 (19.0)	278 (14.7)	
4th quintile income, n (%)	5,189 (21.4)	374 (19.8)	
Highest quintile income, n (%)	6,166 (25.5)	387 (20.5)	
CCI = 0, n (%)	17,218 (71.2)	1,192 (63.2)	< 0.001
CCI = 1, n (%)	5,058 (20.9)	472 (25.0)	
CCI = 2, n (%)	1,432 (5.9)	158 (8.4)	
CCI ≥ 3, n (%)	490 (2.0)	65 (3.4)	
Four or fewer outpatient visits, n (%)	4,614 (19.1)	378 (20.0)	< 0.001
Low COC & low PDC, n (%)	3,504 (14.5)	232 (12.3)	
High COC & low PDC, n (%)	5,117 (21.2)	346 (18.3)	
Low COC & high PDC, n (%)	2,727 (11.3)	231 (12.2)	
High COC & high PDC, n (%)	8,236 (34.0)	700 (37.1)	

CCI: Charlson Comorbidity Index; COC: continuity of care; PDC: proportion of days covered

risk of death (aHR: 1.58, 95% CI: 1.17–2.15) while those with mental disabilities did so with marginal statistical significance (aHR: 1.92, 95% CI: 0.98–3.73). Those with other disabilities did not exhibit a significant association (Table 2).

Patients with disabilities showed a significantly increased risk of CVD-related first admissions (aHR: 1.30, 95% CI: 1.07–1.56) compared to those without disabilities. Patients with diabetes with mild disabilities had an increased risk of CVD-related admissions (aHR: 1.30, 95% CI: 1.07–1.56), while those with severe disabilities showed no significant association (aHR: 1.28, 95% CI: 0.94–1.80). In addition, patients with visual disabilities, but not those with other disabilities, showed an increased risk of CVD-related first admissions (aHR: 1.59, 95% CI: 1.02–2.48) (Table 2).

Moreover, patients with diabetes and disabilities had an elevated risk of diabetes-related first admission compared to those without disabilities (aHR: 1.31, 95% CI: 1.20–1.43). Both mild and severe disabilities showed higher risks of diabetic hospitalization (mild: aHR: 1.22, 95% CI: 1.04–1.43; severe: aHR: 1.59, 95% CI: 1.22–1.50). In addition, patients with diabetes with physical, visual, and intellectual and developmental disabilities had an increased risk of diabetes-related first admission (aHR: 1.31, 95% CI: 1.17–1.46; aHR: 1.46, 95% CI: 1.15–1.84; and aHR: 1.70, 95% CI: 1.22–2.36, respectively), whereas those with hearing and speech disabilities and mental disabilities showed no significant association (aHR: 1.09, 95% CI: 0.77–1.55) (Table 2).

For explanatory analyses, we incorporated interaction terms between disability severity and COC–PDC groups, which were categorized into three groups: (1) the low COC-PDC group, representing four or fewer outpatient visits or low COC and low PDC; (2) the middle COC-PDC group, comprising high COC and low PDC or low COC and high PDC; and (3) the high COC-PDC group, characterized by both high COC and PDC. The low COC-PDC group was associated with an increased risk of diabetes-related first admission for individuals without disabilities (aHR: 1.09, 95% CI: 1.03–1.16), but not for those with mild or severe disabilities (aHR: 1.00, 95% CI: 0.79–1.26; aHR: 1.03, 95% CI: 0.73–1.45, respectively). Similar associations were found for CVD-related admissions and death, where the low and middle COC-PDC groups were significantly associated with increased risk for individuals without disabilities, but not always for those with disabilities (Fig. 2).

COC: continuity of care; CVD: Cardio-cerebrovascular disease; PDC: proportion of days covered

Discussion

In this study, we examined the relationship between disability and the risk of all-cause death and admissions related to diabetes and CVD. After adjusting for COC and PDC, as well as demographic and health factors, individuals with disability were found to have an elevated risk of all-cause death compared to those without disability. In particular, individuals with severe disability exhibited a 40% increased risk of all-cause death compared to those without disability, while those with mild disability showed a less significant increase in risk. Among specific disabilities, hearing and speech impairments were associated with an elevated risk of death, with marginal significance observed for mental disabilities. For CVD-related admissions, mild and visual disabilities indicated an increased risk, whereas severe disability did not. The risk of diabetes-related admission remained elevated among persons with physical, visual, intellectual, and developmental disabilities. Our explanatory analyses showed that low COC-PDC was associated with a greater risk of all-cause death, diabetic and CVD hospitalization not consistently among those with disabilities.

Table 2 Risk of death and hospitalization in persons with disability compared to those without [*]

	Patients, No.	Event, No.	Person-years	Incidence rate	Crude HR (95% CI)			Fully adjusted HR (95% CI) [†]		
Death	26,085						*p-value*			*p-value*
Without disability	24,198	1,113	166,635	6.68	1.00			1.00		
With disability	1,887	175	12,717	13.76	2.06	(1.75, 2.41)	< 0.001	1.25	(1.07, 1.48)	0.006
Mild disability	1,280	120	8,595	13.96	2.08	(1.73, 2.52)	< 0.001	1.20	(0.99, 1.45)	0.061
Severe disability	607	55	4,121	13.34	2.00	(1.53, 2.63)	< 0.001	1.40	(1.06, 1.85)	0.018
Physical disability	1,213	94	8,287	11.34	1.70	(1.38, 2.10)	< 0.001	1.13	(0.92, 1.40)	0.257
Visual disability	213	20	1,444	13.85	2.09	(1.34, 3.26)	0.001	1.06	(0.68, 1.65)	0.807
Hearing and speech disabilities	229	45	1,493	30.14	4.67	(3.47, 6.29)	< 0.0001	1.58	(1.17, 2.15)	0.003
Intellectual/developmental disability	105	7	730	9.59	1.43	(0.68, 3.00)	0.349	1.82	(0.85, 3.86)	0.121
Mental disability	127	9	874	10.30	1.54	(0.80, 2.97)	0.195	1.92	(0.98, 3.73)	0.056
CVD hospitalization	25,675									
Without disability	23,835	1,033	161,807	6.38	1.00			1.00		
With disability	1,840	130	12,231	10.63	1.68	(1.40, 2.02)	< 0.001	1.30	(1.07, 1.56)	0.007
Mild disability	1,247	93	8,253	11.27	1.79	(1.44, 2.21)	< 0.001	1.30	(1.05, 1.61)	0.016
Severe disability	593	37	3,978	9.30	1.47	(1.06, 2.03)	0.023	1.28	(0.91, 1.80)	0.151
Physical disability	1,180	77	7,898	9.75	1.54	(1.22, 1.94)	< 0.001	1.18	(0.94, 1.49)	0.158
Visual disability	208	20	1,365	14.65	2.33	(1.50, 3.63)	< 0.001	1.59	(1.02, 2.48)	0.041
Hearing and speech disabilities	223	21	1,402	14.97	2.43	(1.58, 3.74)	< 0.001	1.43	(0.93, 2.22)	0.107
Intellectual/developmental disability	105	4	724	5.52	0.86	(0.32, 2.29)	0.762	1.28	(0.47, 3.47)	0.624
Mental disability	124	8	841	9.51	1.49	(0.74, 2.99)	0.262	1.70	(0.83, 3.45)	0.145
Diabetic hospitalization	22,140									
Without disability	20,633	5,427	128,581	42.21	1.00			1.00		
With disability	1,507	563	8,813	63.88	1.56	(1.43, 1.70)	< 0.001	1.31	(1.20, 1.43)	< 0.001
Mild disability	1,013	388	5,876	66.03	1.61	(1.46, 1.79)	< 0.001	1.35	(1.22, 1.50)	< 0.001
Severe disability	494	175	2,937	59.58	1.44	(1.24, 1.68)	< 0.001	1.22	(1.04, 1.43)	0.014
Physical disability	951	353	5,594	63.11	1.53	(1.38, 1.71)	< 0.001	1.31	(1.17, 1.46)	< 0.001
Visual disability	174	72	1,007	71.53	1.75	(1.39, 2.21)	< 0.001	1.46	(1.15, 1.84)	0.002
Hearing and speech disabilities	182	68	1,012	67.20	1.67	(1.32, 2.13)	< 0.001	1.16	(0.91, 1.47)	0.245
Intellectual/developmental disability	94	37	554	66.78	1.62	(1.17, 2.24)	0.003	1.70	(1.22, 2.36)	0.002
Mental disability	106	33	647	51.01	1.22	(0.87, 1.72)	0.252	1.09	(0.77, 1.55)	0.614

[*] Hazard ratios were estimated for disability severity and types using separated analyses

[†] Adjusted for sex, age, health coverage status, income, CCI (Charlson Comorbidity Index), and COC–PDC (continuity of care; proportion of days covered)

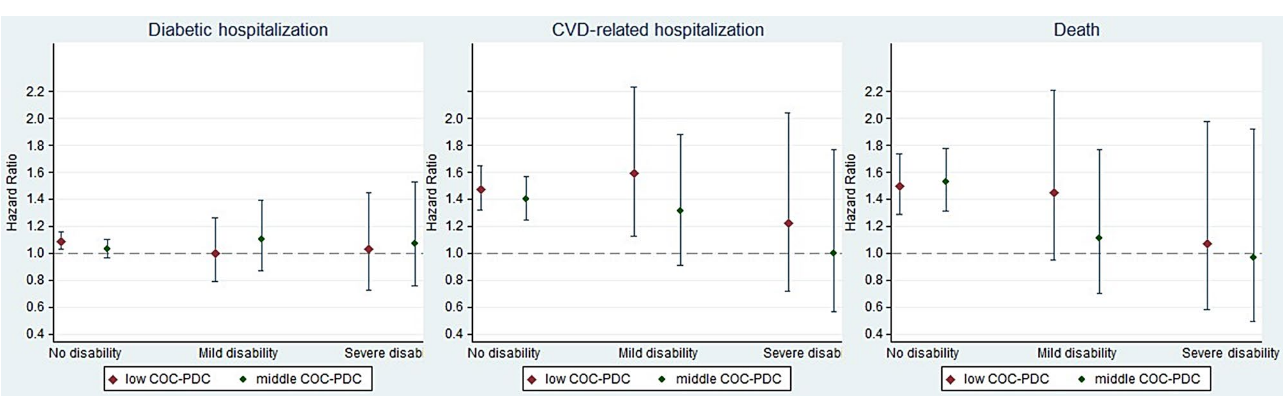

Fig. 2 Association of COC-PDC with diabetes- and CVD-related hospitalization and mortality risk by disability severity

In the present study, disability was associated with fatal results among newly diagnosed patients with diabetes, independent of major potential confounding factors. Considering that a large cohort study reported smoking and physical activity as the strongest predictors of death among patients with type 2 diabetes [19], a low physical activity rate among people with disabilities may be a significant risk factor for mortality among persons with disability and diabetes [20]. The heightened mortality risk observed among patients with diabetes and hearing and speech disabilities, as reported in this study, aligns with findings from previous research [8, 21]. Prior studies have suggested that the simultaneous presence of hearing loss and diabetes may synergistically increase the risk of all-cause and CVD mortality. Furthermore, a recent systematic review highlighted potential mechanisms linking hearing loss to mortality, including aversion to physical activity, frequent falls, depression, anxiety, cognitive impairment, and social isolation [22]. Concerning mental disorders, existing literature has pointed out barriers to receiving appropriate care. These barriers include an inadequate training in health professionals, limited mental health literacy among non-mental health providers, and poor socio-economic conditions exacerbate these challenges [23]. These factors collectively may contribute to higher mortality rates among patients with diabetes and hearing and speech disabilities, as well as mental disabilities.

When we consider CVD hospitalization, patients with disability had an increased risk of CVD hospitalization. Furthermore, additional analyses showed a high risk of hospitalization due to ischemic heart disease in people with disability (Table S2). While body mass index, glycated hemoglobin and physical activity are significant risk factors for these events among persons with type 2 diabetes (19), persons with disabilities and diabetes are more likely to have uncontrolled diabetes and undesirable daily lifestyle choices. In the context of varying levels of disability severity, there was no significant higher risk of CVD hospitalization for severe disability, which differs from all-cause mortality. Patients with severe disability may face challenges in accessing hospitalization even for significant health conditions. For example, a previous examination on disability and incident coronary heart disease reported that disability was associated with fatal events, but not non-fatal events such as hospitalization due to angina pectoris or myocardial infarction [24]. This implies that health care disparities and the limited ability of persons with disability to cope with an acute event increases their risk of death.

In this study, an increased risk for CVD-related admissions but not all-cause mortality in persons with visual disabilities was partially consistent with a previous study that showed that vision impairments increase the risk of cardiovascular events and death in patients with type 2 diabetes [8]. In contrast, a previous study included any patients with diabetes and thus may have also included those with visual disabilities due to worsened diabetes, as well as those with worsened diabetes-related diseases [25]. Similar to the current study, a previous study showed that a visual acuity problem was not associated with diabetes-related mortality or longer-term all-cause mortality among patients with newly diagnosed type 2 diabetes [25].

Patients with diabetes with mild or severe disability had an increased risk of hospitalization. In addition, patients with physical, visual, intellectual, and developmental disabilities had a higher risk of diabetes-related hospitalization. Individuals with mental, intellectual/developmental, and physical disabilities showed a higher risk for avoidable hospitalizations for hypertension and diabetes-related conditions in Korea because they had access problems in primary care [6]. Persons with disabilities face a higher risk of adverse health outcomes due to barriers in accessing healthcare services and engaging in healthy behaviors. For example, previous studies have suggested that physical barriers to health screening or primary care access, difficulties in communicating with medical staff, and a lack of a healthy diet and regular exercise can lead to high rates of avoidable hospitalizations in these populations [6]. Another study indicated that visual acuity problems were not associated with diabetes-related mortality or longer-term all-cause mortality in patients with newly diagnosed type 2 diabetes [26].

The present study found a diminished significance of COC-PDC among individuals with disabilities, relative to their counterparts without disability. This is in contrast to the consistent evidence of COC and PDC in the management of type 2 diabetes in the general population. When we used the Usual Provider Index instead of COC, another frequently used measure to assess care continuance, the results remained similar (Table S3). One explanation for this discrepancy is that COC and PDC did not accurately reflect appropriate diabetic care in individuals with disability. Although previous studies consistently suggested that better COC may have positive effects on health outcomes by ensuring better information sharing and higher medication adherence [10, 27], COC may not be linked to these positive benefits in patients with diabetes and disabilities. For example, a study on patients with diabetes with intellectual disability suggested that communication with health professionals about diabetes did not seem to occur [28]. In addition, although PDC represents the intention to treat and is directly linked to better medication adherence in the general population, individuals with disabilities are more likely to experience additional barriers to medication adherence. Even if individuals have been prescribed certain drugs, it does not confirm medication adherence or proper dosage management. They may not keep the proper frequency or dosage of medication at home because of a lack of health literacy or medication information provision [29]. This is particularly salient for persons with disabilities who need to manage complex and multimorbid conditions that may involve polypharmacy, thereby complicating medication adherence. Another explanation for the insignificant COC and PDC is the missed opportunity for early intervention to treat hyperglycemia, implement lifestyle changes, and address cardiovascular risk factors because of a delayed diagnosis of diabetes in individuals with disabilities. Inadequate care access and underscreening, both of which contribute to the prevalence of undiagnosed diabetes [30, 31], have been reported in individuals with disability.

Therefore, rigorous further analysis is necessary to ensure the effectiveness of maintaining continuity of care and high medication compliance across different types and severities of disability in reducing hospitalizations and mortality. Tailored interventions for improving diabetes self-care among people with visual impairment (TID-VI) and the holistic, patient-centered Integrated Personalized Diabetes Management (iPDM) model hold promise for enhancing self-care and optimizing treatment outcomes [32, 33]. To improve health outcomes and mitigate mortality risk among individuals with diabetes and disabilities, it is crucial to regularly manage blood glucose, blood pressure, cholesterol, and undergo annual screenings for complications. Lifestyle modifications, and adherence to necessary medications are also important [1].

Meanwhile, we excluded individuals with hospitalizations lasting 90 days or longer, potentially resulting in less pronounced associations within the subgroup of disabilities experiencing high hospitalization rates. Additional analyses incorporating these patients showed significant mortality and diabetic hospitalization and marginally significant CVD hospitalization for patients with mental disorders. We also found a significant high risk of mortality for persons with developmental disabilities when we included patients with long-term hospitalization (Table S4). This may be due to persons with severe conditions are more likely to be hospitalized; alternatively, the limited number of persons with these disabilities may weaken the statistical power. Future studies based on larger observations may improve our understanding. In our additional analysis, which included interaction terms between disability status encompassing both mild and severe disabilities and PDC-COC, we observed consistent results. Specifically, individuals with disabilities and high PDC-COC exhibited a lower risk of CVD hospitalization compared to those with low PDC-COC (Table S5). We acknowledge that studies with larger sample sizes would likely yield more robust results.

A notable limitation of the current study lies in its reliance on claims data analysis, which may not accurately capture the actual health behaviors of individuals with disabilities which can be potential influencing factors. For instance, although COC indicates regular interaction between patients and their physicians, the social support by family or caregivers of patients with severe disabilities may regularly visit physicians on the patient's behalf to obtain medicine prescription, meaning that there is no continuous patient–physician interaction. In addition, the claims data also lack details on essential aspects of daily health management, such as levels of physical activity, exercise regimes, dietary habits, and blood glucose or HbA1c levels, which are critical determinants of health outcomes in this population. This study also could not include the specific information of the duration and the type of hospital admissions, such as emergency department visits. Future studies should address these limitations. Moreover, mental health conditions like depression could contribute to reduced patient interest in self-care practices [34].

Conclusions

This comprehensive study deepens our understanding of how disability status, severity, and various types of disabilities relate to the risks of all-cause death and hospitalization for diabetes and cardiovascular disease among newly diagnosed diabetes patients. Our findings underscore that individuals with disabilities face a heightened risk of all-cause death compared to those without disabilities, with particular emphasis on those with severe disabilities, hearing and speech impairments, and mental disabilities. In addition, physical, visual, intellectual, and developmental disabilities were associated with increased rates of diabetes-related hospitalizations, while mild and visual disabilities were associated with a higher risk of CVD-related admissions. Our results also highlight the role of COC-PDC, in that lower COC-PDC levels were identified as potential risk factors for adverse outcomes among individuals without disabilities, but less consistently so for those with disabilities. Therefore, public health policies should prioritize individuals with disabilities and diabetes to address the disparities in health outcomes between those with and without disabilities. Moreover, there is an urgent need for a better understanding of the unique risk factors for diabetes among persons with disabilities.

Abbreviations

CVD	Cardio-Cerebrovascular diseases
COC	Continuity of care
PDC	Proportion of days covered
NHI National Health Insurance, NHIS	National health insurance service
MOHW	Ministry of health and welfare
COCI	Continuity of care index score
CCI	Charlson comorbidity index
aHRs	Adjusted hazard ratios
Cis	Confidence intervals

Supplementary Information

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Supplementary Material 1

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Not applicable.

Author contributions

S.K: Study conceptualization and design, data curation, formal analysis, methodology, writing – original draft, writing – reviewing and editing. B.J.: Study conceptualization and design, writing – original draft, writing – reviewing and editing.

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Data availability

The datasets analyzed during the current study are not publicly available due the restrictions apply to the use of data by NHIS. The use of current NHIS datasets is limited only for the permitted study and is not publicly available.

Declarations

Ethics approval and consent to participate

This study used de-identified data provided by the Korean National Health Insurance Service (NHIS) after anonymization according to strict confidentiality guidelines. For the usage of de-identified data, a waiver of informed consent has been approved by the Korea Institute for Health and Social Affairs Institutional Review Board (IRB number: 2022-004).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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