Early-onset stroke among people with disabilities: a national database study in South Korea from 2008 to 2017

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Summary

Background This study investigated 10-year trend in the incidence and prevalence of ischemic, hemorrhagic, and overall strokes according to the severity and type of disability between people with and without disabilities.

Methods This serial cross-sectional analysis was conducted using national health information data during a 10-year period from 2008 to 2017. Age-standardized incidence and prevalence were analyzed for each year, according to the presence, severity, and type of disability. The odds ratio (OR) of stroke was examined using multivariable logistic regression after adjusting for socio-demographic and clinical variables collected in 2017.

Findings In total, 413,398,084 people were enrolled between 2008 and 2017. In 2017, 43,552,192 people aged 19 or older were included and 5.8% was disabled. For 10 years, age-standardized incidence of ischemic and hemorrhagic stroke decreased significantly regardless of the presence of disability. However, age-standardized incidence of stroke in disabled were almost 2.5 times higher than the non-disabled in 2017. Stroke occurs 20 years earlier in people with disabilities than in those without disabilities. In 2017, people with disabilities had higher odds of stroke compared to those without disability (OR = 4.11, 95% confidence interval [CI]: 4.06–4.16), particularly among those with severe disabilities (OR = 4.75, 95% CI: 4.67–4.84). People with major internal organ impairment showed the highest incidence of stroke (OR = 5.95, 95% CI: 5.73–6.17). The main risk factors for stroke presented in this study were disability factors, chronic diseases, and advanced age.

Interpretation People with disabilities are at a greater risk of developing stroke incidence. Developing a public health policy and identifying the risk factors for stroke in people with disabilities would be beneficial.

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Keywords: Stroke; Disability; Disparity; Healthcare access; Korea

Introduction

Stroke is a life–threatening cardiovascular disease and prompt treatment is essential to reduce brain damage and related sequalae. In 2019, there were 6.6 million cases of stroke–related death worldwide, making it the second leading cause of death.[1] In Korea, the prevalence of stroke is increasing, and it was the fourth leading cause of death in 2019.[2] Although the absolute number of strokes has increased, age–standardized rates of stroke incidence, prevalence, and mortality worldwide have decreased by 17.0%, 6.0%, and 36.0%, respectively, from 1990 to 2019.[1] This downward trend suggests that the management of non–communicable chronic diseases, including hypertension and diabetes mellitus, and lifestyle modifications are effective. Indeed, during the same period, age–standardized prevalence of

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Research in context

Evidence before this study

The WHO South-East Asia Region is committed to strengthening health care services to prevent, treat and manage stroke, and to provide quality rehabilitative care for stroke-related disability. In order to achieve its goals, it is critical to identifying the vulnerable populations at risk of developing stroke. People with disabilities are more likely to develop secondary health conditions and their social determinants of health often overlap with the risk factors for developing stroke. To investigate the available evidence of links between disability and stroke, we searched PubMed for studies published in any language between January 1, 2000, and December 31, 2022, containing the following terms ("disabled persons" [MeSH Terms]) AND "stroke" [MeSH Terms]. Among 131 studies we identified, we searched for the studies, 1) which enrolled people with disability and 2) which assessed prevalence or incidence of stroke. None of 131 studies met these criteria.

Added value of this study

Our results have significant implications. A strength of this study is the large sample size based on a database that covers 25% of the South Korean population, which include almost all stroke prevalence. To the best of our knowledge, no previous study has evaluated the long-term trends in stroke among people with and without disabilities or analyzed the disability severity and type in stroke patients.

Implications of all the available evidence

WHO focuses on providing universal access to stroke care and prevention with greater attention to vulnerable and hard-to-reach populations. However, stroke issues among the disabled were not well highlighted during the past decades. People with disabilities often face barriers in reaching stroke care services and their health needs are under-recognised. WHO recommends that educational, emotional, and economic supports should be provided to enable stroke patients to complete the diagnostic process and full course of prescribed treatment. We identified that people with disabilities are at risk of stroke. We demonstrate not only critical lessons for stroke prevention and care in Korea, but also for other countries' stroke control and surveillance programmes with similar healthcare structures as well as international guidance.

hypertension and diabetes mellitus decreased. Because the five leading risk factors of stroke are high systolic blood pressure, diabetes, dyslipidemia, high body–mass index, and smoking,[3–5] failure to manage chronic diseases and improve lifestyle habits may lead to stroke–related death and complications.

However, the decreasing trend of stroke incidence and prevalence does not apply equally to all populations. Among people younger than 70 years or in low-income countries, stroke incidence, prevalence, and mortality increased.[1] Generally, persons with disabilities are more likely to experience barriers to accessing medical services,[6–9] although it is an important target for disease prevention and management.[10,11] Additionally, due to ineffective health management policies for people with disabilities, the prevalence of chronic and severe diseases is higher among disabled than non–disabled people.[12,13] Although disability that develops as a result of severe diseases, including stroke, has received significant attention, disability has not been adequately investigated as a risk factor of stroke.

People with disabilities comprise a heterogeneous group whose health needs vary according to their types of limitations and disabilities. Therefore, customized treatment and healthcare strategies are needed according to the disability severity and type.[14–16] However, previous studies have mainly focused on people with specific types of disabilities such as intellectual, physical disability, and people aged 65 and older. Because of the barriers to accessing healthcare and a high risk of severe cardiovascular diseases, such as stroke, in younger individuals with disabilities, the incidence and long-term trends of stroke should be evaluated in the entire population with disabilities. Information on stroke trends is important to establish evidence–based stroke care plans and resource allocation for people with disabilities. Our study aimed to elucidate the association between disability and stroke and to investigate trends in annual stroke incidence and prevalence according to the disability severity and type using a large nationwide cross-linked database.

Methods

Data sources and study population

We used the National Health Information Database (NHID), a public database maintained by the Korean National Health Insurance Service (KNHIS).[17] KNHIS records information related to healthcare utilization (diagnosis code, in-patient care, out-patient care, procedures, and medications), socio-demographic variables (age, sex, residential area, and insurance premium), and mortality for the entire population of South Korea. Additionally, we used the National Disability Registration data to extract information on disability severity and type. The database covered 94.1% of the total population with disabilities in 2017.[18] Using a personal identification number, the variables selected from the National Disability Registry were linked with the data from the NHID.[19] For this study, we retrospectively extracted population–based medical data for people aged 19 or older from the NHID from January 2008 to December 2017.

Definition of stroke and other variables

We used the International Classification of Diseases 10th Amendment (ICD–10–CM) codes I60–I64 to identify stroke cases, and classified them into ischemic and hemorrhagic strokes. Cases not specified as ischemic and hemorrhagic stroke were also included in the analysis. We constructed two datasets to analyze differences in stroke incidence and prevalence according to disability severity and type. Stroke incidence was defined as a main diagnosis or sub–diagnosis during hospitalization for the first time over the year. People in whom the stroke occurred before the initial disability registration date were classified as non-disabled. Stroke prevalence was defined as hospitalization or outpatient treatment more than twice during a year or before it. The study sample included 24,657,764 disabled and 388,740,320 non-disabled people from 2008 to 2017.

The national disability registration data categorize disability into fifteen groups. The study participants were reclassified into five categories of disabilities: physical, brain injury, communication (vision, hearing, or speech disability), intellectual or psychological (autism or mental disability), and major internal organ disorders (liver, lungs, heart, kidneys, and intestines). Almost 70% of the registered brain injury–related disabilities in South Korea are caused by stroke; therefore, brain injury–related disabilities were excluded from the analysis. Disability severity was graded from 1 (very severe) to 6 (very mild) based on the functional losses and clinical impairment as determined by the specialist physician according to government guidelines and predefined criteria.[20] In the present study, disability severity was classified as severe (grades 1–3) or mild (grades 4–6), according to government criteria. Other variables collected from the NHID included age, sex, insurance premium, residential area, comorbidity, and chronic diseases. As a proxy measure for actual household income, we used the insurance premium categories of medical aid provided by the NHIS to calculate the quintiles (I–V), with I being the lowest and V being the highest.[21] Residential areas were grouped into metropolitan, urban, and rural categories based on Korean ZIP codes. Based on the Charlson Comorbidity Index (CCI), the study participants were grouped into four categories (0, 1–2, 3–4, and ≥5), with ≥5 being the most severe.[22] Additionally, variables, such as hypertension, diabetes mellitus, and dyslipidemia, were analyzed to determine the risk of stroke due to chronic disease.

Statistical analysis

The baseline characteristics of the study participants were analyzed using descriptive statistics according to the disability status (present or absent). The mean age and CCI score according to the disability status were calculated using Student's t-test. Age–standardized incidence and prevalence of stroke (per 100,000 people) were calculated using the 2005 Population and Housing Census of Korea as the standard population. An age–standardized rate is a weighted average of crude age–specific rates, where the crude rates are calculated for different age groups and the weights are the proportions of persons in the corresponding age groups of a standard population.[23] The trends of stroke incidence and prevalence in disabled and non–disabled people according to stroke subtype and prevalence of diabetes mellitus and hypertension, the main risk factors for stroke, were analyzed. To examine the association between disability and stroke incidence, we conducted multivariable logistic regression after adjusting for age, income level, residential area, CCI score, hypertension, diabetes mellitus, and dyslipidemia using the most recent dataset available (2017). All analyses were performed using SAS software (version 9.3; SAS Institute, Cary, NC, USA). Two–sided p–values of 0.05 were considered statistically significant. This study was approved by the Institutional Review Board of Chungbuk National University (CBNU–202108–HRHR–0140).

Role of the funding source

The funders of the study had no role in the design or conduct of the study, including data collection, management, analysis, or interpretation of the results; preparation, review, or approval of the manuscript; or the decision to submit the manuscript for publication.

Results

In 2017, the numbers of people with and without disabilities were 2,537,596 and 41,014,596. The general characteristics of the two groups are shown in Table 1. Among people with disabilities, 36.8% had severe disabilities and the most frequent type was physical disability (51.8%). People with disabilities were older than non-disabled people (62.1 ± 16.0 vs. 46.8 ± 16.7 years, $p < 0.001$). Among non-disabled people, the fifth quartile was the most common, whereas among the disabled people, Medicaid and the first quartile were the most common ($p < 0.001$). People with disabilities had higher mean CCI score compared to non-disabled people (CCI score, 2.1 ± 2.2 vs. 0.8 ± 1.4, $p < 0.0001$). In total, 0.3% of patients without disability, and 2.7% of those with disability, were diagnosed with stroke ($p < 0.001$).

The trends in age–standardized incidence and prevalence of ischemic and hemorrhagic strokes between 2008 and 2017 are shown in Fig. 1A and B. People with disabilities had a higher incidence and prevalence of ischemic and hemorrhagic stroke compared to those without disabilities. Although the incidence of ischemic and hemorrhagic strokes were lower in 2017 than in 2008, the rates were 2.5 times higher in disabled people compared to the non–disabled. We also analyzed the annual incidence and prevalence of ischemic and hemorrhagic strokes according to the presence or absence of disability (Supplementary Table S1).

	Without disability (n = 41,014,596)	With disability (n = 2,537,596)
Disability grade		
Severe (grades 1–3)		933,278 (36.8)
Mild (grades 4–6)		1,604,318 (63.2)
Disability type		
Physical		1,314,988 (51.8)
Brain injury		237,456 (9.4)
Facial		2659 (0.1)
Visual		256,451 (10.1)
Hearing/Language		319,041 (12.6)
Intellectual/Autism		175,466 (6.9)
Mental		91,692 (3.6)
Renal disease		85,020 (3.4)
Heart disease		6803 (0.3)
Respiratory disease		12,740 (0.5)
Liver disease		11,791 (0.5)
Ostomy		16,355 (0.6)
Epilepsy		7134 (0.3)
Sex		
Male	20,191,500 (49.2)	1,466,618 (57.8)
Female	20,823,096 (50.8)	1,070,978 (42.2)
Age, years		
Mean ± SD	46.76 ± 16.73	62.09 ± 16.01
19–29	7,577,616 (18.5)	102,988 (4.1)
30–39	7,491,059 (18.3)	143,199 (5.6)
40–49	8,502,707 (20.7)	285,983 (11.3)
50–59	8,074,014 (19.7)	509,395 (20.1)
60–69	5,152,381 (12.6)	571,010 (22.5)
70–79	2,848,000 (6.9)	575,916 (22.7)
≥80	1,368,819 (3.3)	349,105 (13.8)
Income level		
Medical aid and first quartile (lowest)	6,904,497 (16.8)	835,959 (32.9)
Second quartile	6,509,109 (15.9)	295,720 (11.7)
Third quartile	7,477,601 (18.2)	338,473 (13.3)
Fourth quartile	8,603,358 (21.0)	434,888 (17.1)
Fifth quartile (highest)	10,600,173 (25.8)	598,061 (23.6)
Unknown	919,858 (2.3)	34,495 (1.4)
Residence		
Metropolitan	25,180,989 (61.4)	1,348,421 (53.1)
City	11,608,638 (28.3)	790,424 (31.1)
Rural	3,504,021 (8.5)	362,710 (14.3)
Unknown	720,948 (1.8)	36,041 (1.4)
Charlson comorbidity index		
Mean ± SD	0.85 ± 1.41	2.07 ± 2.23
0	23,518,738 (57.3)	759,225 (29.9)
1–2	13,331,770 (32.5)	934,099 (36.8)
3–4	3,014,783 (7.4)	506,894 (20.0)
≥5	1,149,305 (2.8)	337,378 (13.3)
Stroke incidence		
No	40,872,287 (99.7)	2,469,263 (97.3)
Yes	142,309 (0.3)	68,333 (2.7)

Values are expressed as mean ± SD and number (%). All factors according to the disability showed statistically significant differences ($p < 0.001$), and the p-value was calculated using Student's t-test for continuous data and the chi-squared test for categorical data.

Table 1: **Characteristics of the population with and without disabilities aged ≥19 years in 2017.**

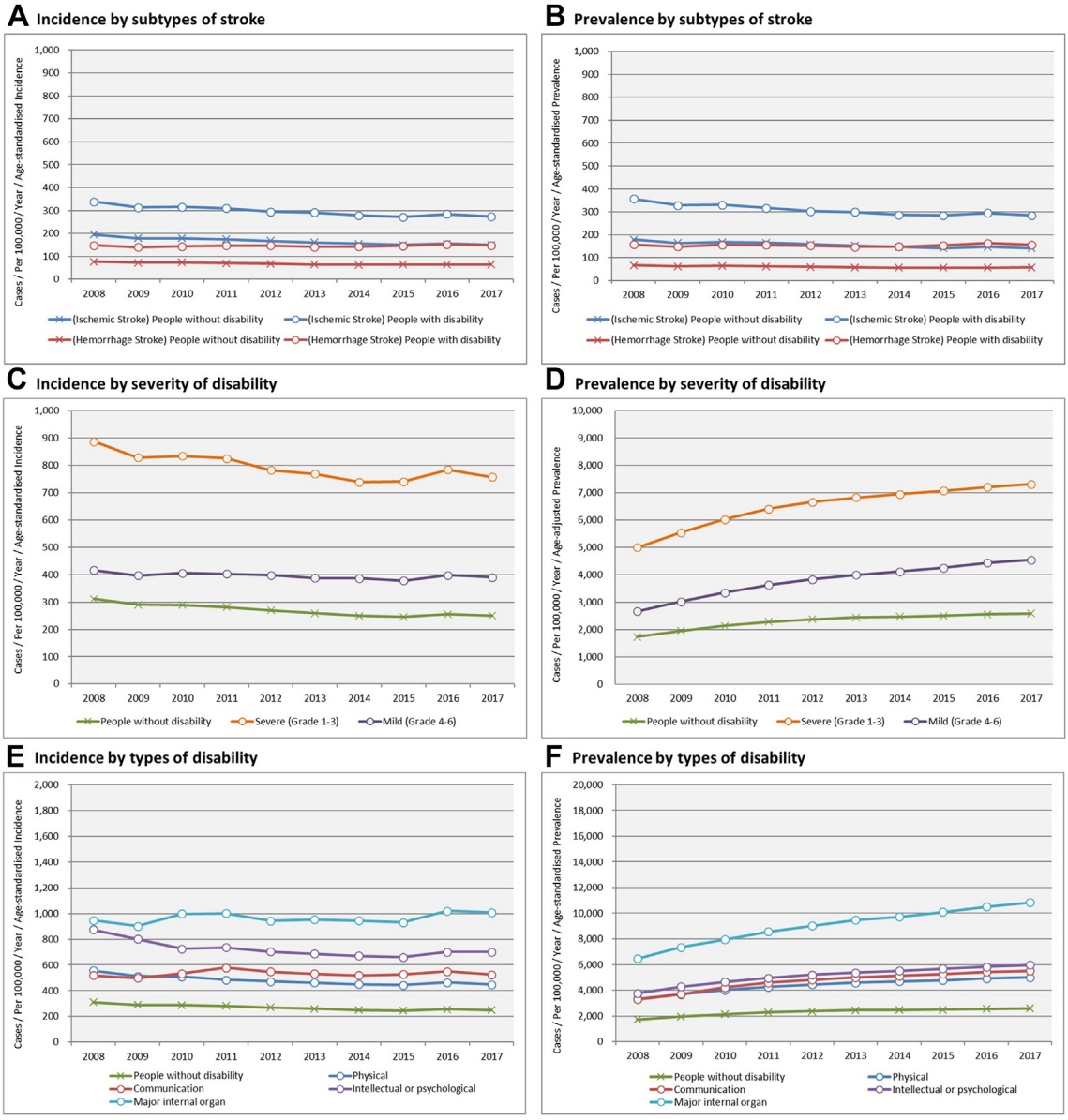

Fig. 1: Trends in the age-standardized incidence and prevalence of ischemic, hemorrhagic, and overall strokes according to the disability severity and type during 2008–2017.

As shown in Fig. 1C and D and Supplementary Table S2, the age–standardized incidence and prevalence of stroke were significantly different between severely disabled and non–disabled individuals. In particular, the age–standardized incidence of stroke was 3 times higher in severely disabled compared to non–disabled people (757.3 vs. 250.2). Additionally, the age–standardized prevalence of stroke was 2.8 times higher in severely disabled compared to non–disabled people (7308.1 vs. 2580.6). We also analyzed incidence and prevalence of stroke in each year according to disability type and the results are shown in Fig. 1E and F. In 2017, the age–standardized incidence of stroke was the highest at 1007.9 in people with major internal organ problems, followed by those with intellectual or psychological disabilities at 700.9 (Supplementary Table S3).

The difference in age at the time of stroke between disabled and non–disabled people from 2008 to 2017 is shown in Fig. 2. The study participants aged 19 or older by 10 years were classified into age groups, with intervals of 10 years. People with severe disabilities had

the highest incidence of stroke among all age groups. The difference between severely disabled and non–disabled people was the most significant in those age of 40 years. In 2017, the incidence of stroke among non–disabled people of all ages decreased slightly compared to 2008, whereas the incidence of stroke among people with mild disabilities showed a slight increase. People with severe disabilities had an increase in stroke incidence with increasing age. Although the average age of stroke occurrence for the disabled and the non-disabled was 70.76 ± 12.34 and 70.12 ± 14.14, respectively, which was at similar levels, the stroke incidence of people with disabilities in their 40s was 1648.0, similar to the stroke incidence of non–disabled people in their 70s. Therefore, disabled people experience stroke 20–30 years earlier than non–disabled people (Supplementary Table S4).

The effects of chronic diseases such as hypertension and diabetes mellitus on stroke incidence and prevalence among disabled and non–disabled people are presented in Fig. 3. During the same period, the stroke incidence and prevalence were higher among people with chronic diseases compared to those without chronic diseases. In particular, people with chronic diseases and disabilities had a decreasing stroke incidence over the past 10 years; however, the incidence remained higher than those without chronic diseases. Because chronic diseases are related to the function of internal organs, people with major internal organ disorders had the highest stroke incidence among disabled people.

The multivariable logistic regression analysis was sequentially adjusted for age, income level, residential area, CCI score, hypertension, diabetes mellitus, and dyslipidemia according to the disability severity and type in Table 2. People with disabilities had a higher stroke incidence compared to those without a disability (OR = 4.11, 95% CI: 4.06–4.16). The stroke incidence differed according to the disability severity and type. This difference was greater among severely disabled people (OR = 4.75, 95% CI: 4.67–4.84). All disability types were associated with an increased probability of stroke.

After adjusting for socio–demographic variables (age, income level, and residential area), severe disability was still associated with increased odds of stroke (adjusted OR [aOR] = 2.37, 95% CI: 2.33–2.42). Among the disability types, major internal organ and intellectual or psychological disability showed the strongest associations with stroke (aOR = 2.75, 95% CI: 2.65–2.85, and aOR = 2.55, 95% CI: 2.43–2.68). By contrast, after adjusting for socio–demographic and clinical variables (CCI score, hypertension, diabetes mellitus, and dyslipidemia), major internal organ disability was associated with decreased odds of stroke (OR = 5.95, 95% CI: 5.73–6.17, and aOR = 0.74, 95% CI: 0.71–0.77).

Discussion

To the best of our knowledge, this study is the first to analyze the differences in the stroke incidence between people with and without disabilities, according to individual characteristics. The stroke incidence was higher

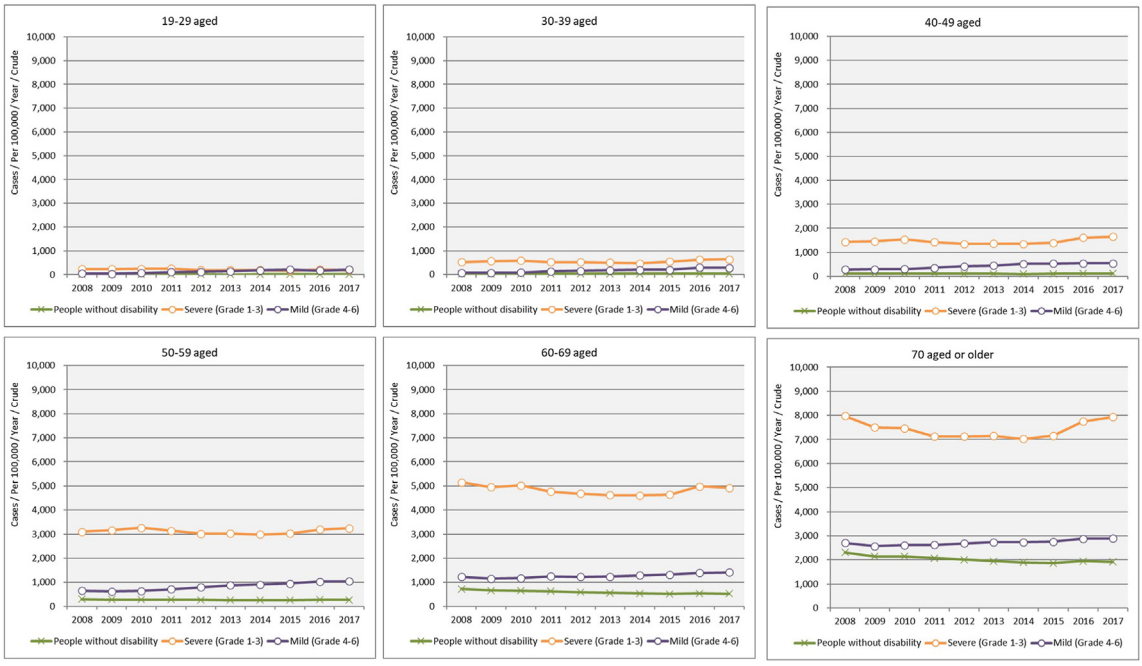

Fig. 2: Trends in the crude incidence of stroke according to disability severity and age during 2008–2017.

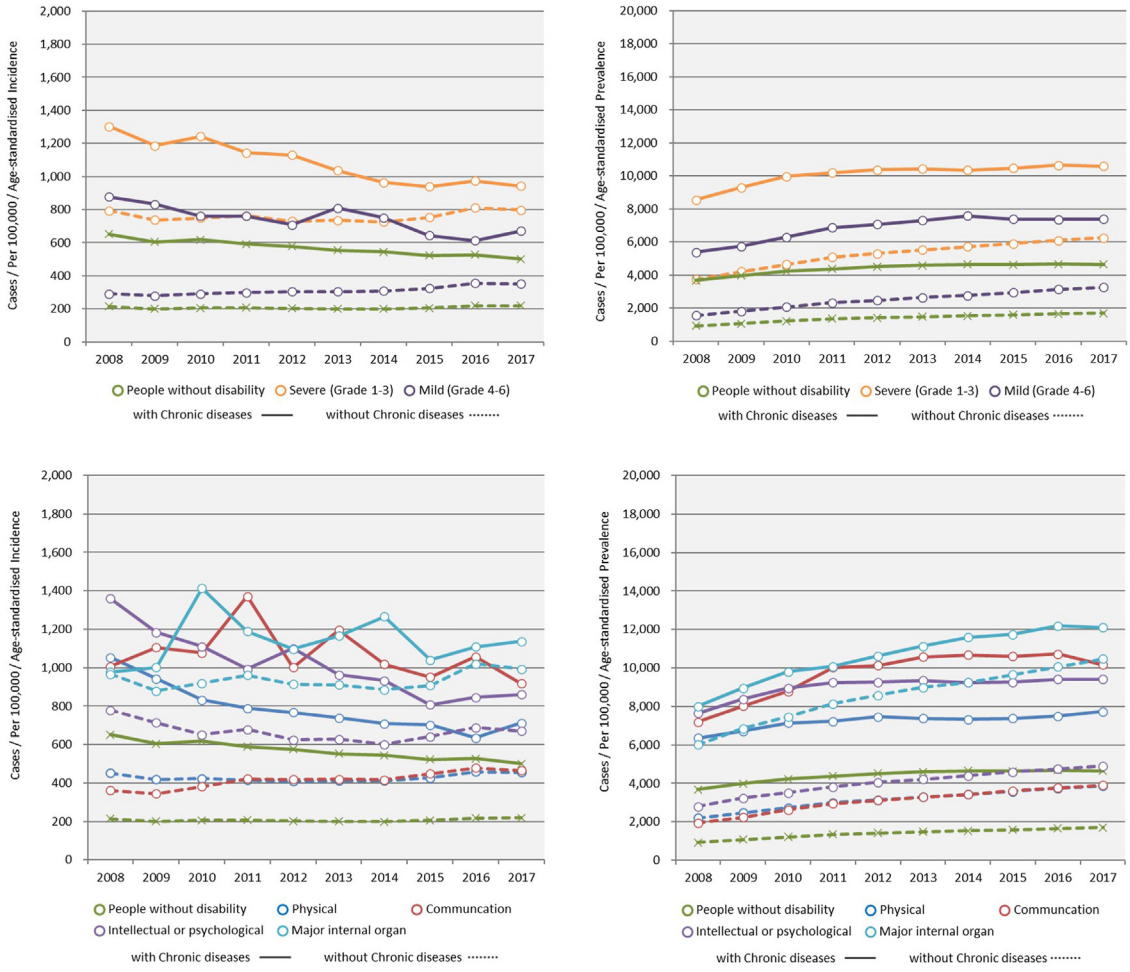

Fig. 3: Trends in the age-standardized incidence and prevalence of stroke according to disability severity and chronic diseases.

in people with disabilities than in those without disabilities. This difference was particularly significant among people with severe disabilities and those with internal organ impairment, intellectual or psychological, or communication disability.

There was a minimal decrease in the global age–standardized stroke incidence between 1990 and 2016; therefore, the burden of stroke is likely to persist in the foreseeable future.[1,24] However, few studies have evaluated stroke incidence among people with disability.[25] In the present study, although the age–standardized incidence of ischemic and hemorrhage stroke decreased over time in people with and without disabilities, people with disabilities still had a high stroke incidence. The age–standardized incidence of stroke in people with severe disabilities showed a rapid increase in 2016. This trend was similar to that observed for cardiovascular disease treatments and medical expenses reported in 2016 by the National Health Insurance Statistical Yearbook in South Korea.[26] These results are comparable to those for stroke incidence according to income level (medical benefits, low-income, middle-income, and high-income groups). The stroke incidence among non–disabled people decreased gradually according to income level between 2008 and 2017, whereas people on medical benefits showed a high stroke incidence with no obvious change. In particular, lower income and more severe disability were associated with a higher stroke incidence (Supplementary Table S5).

The stroke incidence varied according to the disability severity and type, including internal organ impairment, intellectual or psychological disability, and communication disability. People with internal organ impairment have more comorbidities than those with other types of disability, which is a risk factor for adverse events in critical illnesses.[27] A previous study found that the risk of stroke mortality was higher in patients with one or more comorbidities compared to that in the general population. After controlling for the National Institute of Health Stroke Scale score, sex, and

	Model 1 OR (95% CI)	Model 2[a] OR (95% CI)	Model 3[b] OR (95% CI)
Disability			
Yes (vs. No)	4.11 (4.06–4.16)	1.58 (1.56–1.60)	1.13 (1.11–1.14)
By disability severity			
Severe (vs. No)	4.75 (4.67–4.84)	2.37 (2.33–2.42)	1.42 (1.39–1.44)
Mild (vs. No)	3.78 (3.72–3.83)	1.30 (1.28–1.32)	1.00 (0.98–1.01)
By disability type (5)			
Physical (vs. No)	3.94 (3.88–4.00)	1.51 (1.49–1.54)	1.15 (1.13–1.16)
Communication (vs. No)	5.04 (4.94–5.15)	1.40 (1.37–1.43)	1.16 (1.13–1.18)
Intellectual or psychological (vs. No)	1.98 (1.89–2.07)	2.55 (2.43–2.68)	2.28 (2.17–2.39)
Major internal organ (vs. No)	5.95 (5.73–6.17)	2.75 (2.65–2.85)	0.74 (0.71–0.77)
By disability type and severe			
Physical			
Severe (vs. No)	5.58 (5.42–5.74)	2.41 (2.34–2.48)	1.68 (1.63–1.73)
Mild (vs. No)	3.52 (3.46–3.59)	1.31 (1.29–1.39)	1.01 (1.00–1.03)
Communication			
Severe (vs. No)	6.28 (6.06–6.50)	1.84 (1.78–1.91)	1.51 (1.46–1.56)
Mild (vs. No)	4.59 (4.48–4.71)	1.25 (1.22–1.28)	1.04 (1.01–1.06)
Intellectual or psychological (vs. No)			
Severe (vs. No)	1.98 (1.89–2.07)	2.56 (2.45–2.69)	2.29 (2.18–2.41)
Major internal organ			
Severe (vs. No)	7.97 (7.65–8.30)	3.34 (3.21–3.48)	0.81 (0.78–0.85)
Mild (vs. No)	2.43 (2.21–2.67)	1.37 (1.24–1.50)	0.49 (0.45–0.54)

Notes: 43,314,736 cases excluding brain injury used in the analysis. Abbreviations: OR, Odds ratio; CI, Confidence interval. [a]Adjusted age, income, residence. [b]Adjusted age, income, residence, CCI, hypertension, diabetes mellitus, dyslipidemia.

Table 2: **Multivariable logistic regression for disability characteristics in the most recent year (2017).**

nosocomial infections, the risk of stroke mortality was higher in patients with multiple comorbidities (adjusted hazard ratio [aHR] = 13.14, 95% CI = 4.84–35.73) compared to those without comorbidities,[27] which is in line with our results.

Stroke is a neurological defect caused by acute local damage to the central nervous system due to vascular causes.[28] Mental health conditions, such as depression and dementia, are also associated with stroke.[29,30] Our results are consistent with those of previous studies, which found that people with intellectual disability have a higher incidence of stroke (aOR = 3.57, 95% CI: 1.57–8.12),[31] and that depression increases the risk of stroke (HR = 1.45, 95% CI: 1.29–1.63).[32] People with communication impairment have a higher stroke risk compared to non–disabled people because it is difficult to communicate in emergency situations.[33,34] Therefore, healthcare professionals must maintain an encouraging attitude toward people with disabilities, provide sufficient time for such patients, and use repetition, precise explanations, and simple language.[35]

People with disabilities are at a higher risk of stroke compared to non–disabled people even after adjusting for age, income level, residence area, and comorbidities (aOR = 4.11, 1.58, and 1.13 for Models 1–3, respectively). In particular, people with severe disabilities had a 4.75-times higher stroke risk compared to non-disabled people. Furthermore, people with internal organ disabilities or communication disabilities had a markedly increased stroke risk (OR = 5.95 and 5.04, respectively). People with disabilities, including those with physical type are more likely to have more comorbidities compared to those without disabilities, so they are likely to be over adjustment in the regression model, but disabled people were still at higher risk of stroke than non-disabled people.[36] Our results showed that stroke was related to potentially modifiable risk factors, demonstrating the possibility to reduce the stroke burden by reducing exposure to the risk factors. There may be several reasons for these findings, including insufficient availability of customized healthcare for disabled people according to their disability severity and type, lack of supportive care, and difficulty in communication between people with disabilities, caregivers, and healthcare professionals. Previous studies have shown that people with disabilities not only underwent less diagnosis and treatment than non-disabled people, but also people with communication and brain/mental disabilities are exposed to relatively unequal clinical care.[9,17]

Our results have significant implications. A strength of this study is the large sample size based on a database that covers 25% of the South Korean population, which include almost all stroke prevalence. To the best of our knowledge, no previous study has evaluated the long-term trends in stroke among people with and without disabilities or analyzed the disability severity and type in stroke patients.

There were some limitations to the present study. First, because it was a serial cross-sectional study using claim database, it was not possible to collect data on all factors that could be associated with outcomes such as clinical factors (e.g., headache and dizziness). Since we only evaluated the risk of stroke due to disability without considering the factors for typical prodromal symptoms of stroke, future studies should clarify the causation relationships between stroke and disability by further investigating clinical factors that cause stroke incidence.[37] Second, since people with severe disabilities are vulnerable from moving or communication, it will be difficult to use medical services on their own compared to non-disabled and mild disabled, so socio-environmental factors must be considered when analyzing the risk of stroke incidence for disability. However, NHID is not collecting socio-environmental factors, so we could not ascertain whether some patients had an increased stroke risk due to reasons such as patient or family refusal to undergo treatment, economic and transportation problems, or clinical decision-making. Further studies using different research methods, including surveys and interviews, are required to determine how these factors affect the stroke incidence. Third, disease codes listed in the NHID may not represent the true disease status because the codes were created to claim health insurance for services provided to participants, an inherent limitation of insurance databases. Hence, it warrants careful interpretation.[38]

In conclusion, stroke incidence and prevalence were higher for people with severe, major internal organ, and intellectual or psychological disabilities compared to non–disabled people over the past 10 years. Stroke occurs 20 years earlier in people with disabilities, compared to those without disabilities. Therefore, public health policies should also focus on people with disabilities to reduce the disparities in health outcomes between people with and without disabilities. A better understanding of the possibly unique risk factors for stroke in people with disabilities is urgently needed, and specific national health care plans for the disabled should be presented by analyzing medical use patterns according to the types and severity of the disability in the future.

Contributors

HSY, SYK, MJJ, YYK and JHP designed the study. HSY, SYK, YYK and JHP contributed to data collection. HSY, SYK, and JHP cleaned and verified the dataset. HSY, SYK, and JHP did the statistical analysis, HSY and SYK wrote the manuscript. HSY, SYK, MJJ, and JHP reviewed and edited the manuscript. SYK and JHP supervised the work. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Data sharing statement

The datasets used and/or analyzed during the current study are available on reasonable request. The corresponding author should be contacted for the request accessing the raw data.

Declaration of interests

The authors declare that they have no competing interests.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lanwpc.2023.100819.

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