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Original Article

Risk of COVID-19 and major adverse clinical outcomes among people with disabilities in South Korea



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ABSTRACT

Background: Evidence regarding the risk of coronavirus disease (COVID-19) and the major adverse clinical outcomes of COVID-19 among people with disabilities (PwDs) is scarce.

Objective: This study investigated the association of disability status with the risk of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) test positivity and the risk of major adverse clinical outcomes among participants who tested positive for SARS-CoV-2.

Methods: This study included all patients (n = 8070) who tested positive for SARS-CoV-2 and individuals without COVID-19 (n = 121,050) in South Korea from January 1 to May 30, 2020. The study variables included officially registered disability status from the government, SARS-CoV-2 test positivity, and major adverse clinical outcomes of COVID-19 (admission to the intensive care unit, invasive ventilation, or death).

Results: The study participants included 129,120 individuals (including 7261 PwDs), of whom 8070 (6.3%) tested positive for SARS-CoV-2. After adjusting for potential confounding factors, PwDs had an increased risk of SARS-CoV-2 test positivity compared with people without disabilities (odds ratio [OR]: 1.36, 95% confidence interval [CI]: 1.24–1.48). Among participants who tested positive for SARS-CoV-2, PwDs were associated with an increased risk of major adverse clinical outcomes from COVID-19 compared to those without disabilities (OR: 1.43, 95% CI: 1.11–1.86).

Conclusions: PwDs had an increased risk of COVID-19 and major adverse clinical outcomes of COVID-19 compared with people without disabilities. Given the higher vulnerability of PwDs to COVID-19, tailored policy and management to protect against the risk of COVID-19 are required.

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Introduction

Globally, there were 115.7 million confirmed cases of coronavirus disease (COVID-19) by March 07, 2020, including 2.6 million deaths according to World Health Organization, and the spread of COVID-19 is predicted to increase worldwide.¹ Various risk factors for infection and severe outcomes of COVID-19 have been investigated.^{2,3} However, the wide-ranging effect of the COVID-19 pandemic on people with disabilities (PwDs) has received

relatively little attention, and the development of evidence-based guidelines on COVID-19 for PwDs are lagging behind and are being given lower priority than those for people without disabilities.⁴ Disability is a lack or restriction of ability to perform an activity in any domain of life.⁵ Approximately 15% of the world's population is estimated to live with some form of disability⁶ and the number of registered PwDs in South Korea has increased (from 1,134,177 in 2001 to 2,585,876 in 2018), which accounts for approximately 5% of the total population.⁷ Given the vulnerability of PwDs to COVID-19 due to their physical or mental impairments, the right of this population to be protected from COVID-19, and the increasing number of PwDs due to population aging and a global increase in the prevalence of chronic health conditions,⁸ there is a need to investigate the risk of COVID-19 among PwDs.

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Previous studies examined the association of disability characteristics with the incidence of COVID-19 and death using the U.S. regional data^{9–11}; however, personal data, such as sex, age, and chronic diseases, were not considered in these studies. Therefore, no evidence regarding the association between disability characteristics with COVID-19 incidence and death was found using personal data. Other previous studies have examined trends in COVID-19 and COVID-19-related deaths among people with intellectual and developmental disabilities.^{12–14} However, they included only a few types of disability and did not consider potential confounding factors, such as underlying comorbidities. In other words, there is no evidence for the association between disability status and risk of COVID-19. It is necessary to examine the association between disability status, including all types, and risk of COVID-19, after controlling individual characteristics.

This study assessed the association between disability status and risk of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) test positivity among all study participants. This study also investigated the relationship between disability status and risk of major adverse clinical outcomes (admission to the intensive care unit, invasive ventilation, or death) among participants who tested positive for SARS-CoV-2.

Methods

Data source and participants

This study used national data from the Korean National Health Insurance Service (NHIS), which provides mandatory health insurance for all Korean citizens. As Korea has a single-payer national health system, the NHIS has all insured individuals' demographic information (e.g., sex, age, household income, residential area, disability status); all medical records regarding diagnoses, treatments, and prescribed drugs; and death information.¹⁵ The Korea Centers for Disease Control and Prevention (KCDC) database has epidemiological information on all individuals who have been tested for SARS-CoV-2, and the information on SARS-CoV-2 test results in the KCDC dataset is linked to the NHIS database.¹⁶

The NHIS provided data on all patients who tested positive for SARS-CoV-2 between January 1 and May 30, 2020. The NHIS also provided data on comparison groups from the general population who did not test for SARS-CoV-2 during the same period. Among the general population, the comparison group was selected based on characteristics for sex, age, and residential area similar to those of the patients who tested positive for SARS-CoV-2 using simple stratified sampling. This study included 8070 patients who tested positive for SARS-CoV-2 and 121,050 controls.

Measures

This study used information on disability status as assessed by physicians and officially registered by the national government. For an individual to be registered as disabled, they needed to submit documents, including the diagnosis established by a physician, to a local National Pension Service office, which then notifies the applicant of the results, including the registered type and grade of the disability.¹⁷ The severity of disability is classified as mild (grades 4–6) or severe (grades 1–3) on the basis of functional losses and clinical impairment. Mild disability was defined as the ability to perform some daily tasks independently even though there may be a partial need for assistive devices or personal assistance. Severe disability was defined as increased dependence on assistive devices or personal assistance. The National Pension Service categorizes disabilities into 15 types, which include physical disability, disability due to brain injury, visual disability, hearing disability,

speech and language disability, intellectual disability, disability due to mental disorder, speech and language disability, and disability due to autism spectrum disorder, heart problems, respiratory problems, liver disease, facial disfigurement, excretory problems, and epilepsy.

The primary outcome in this study was SARS-CoV-2 test positivity among all study participants. The secondary outcome was major adverse clinical outcomes of COVID-19, which comprised admission to the intensive care unit, invasive ventilation, or death.

The potentially confounding factors included sex, age, residential area, household income, and comorbidities. During the initial epidemic period in South Korea, there was an explosive outbreak of COVID-19 in the Daegu and Gyeongbuk regions¹⁸; therefore, study participants were categorized as living in Daegu and Gyeongbuk or other regions. Household income was divided into quintiles. A history of diabetes mellitus (E10–14), hypertension (I10–15), dyslipidemia (E78), ischemic heart disease (I20–25), stroke (I60–63), chronic kidney disease (N18), chronic obstructive pulmonary disease (J43–J44, except J430), asthma (J45–J46), cancer (C00–97), mental illness (F00–99), and chronic liver disease (K704, K711, K713–K715, K721, K73, K743, K767–K769) were confirmed by the reporting of at least two claims within 1 year during the 3-year period before COVID-19 outbreak using the International Classification of Disease, Tenth Revision code.¹⁹

Statistical analysis

First, sociodemographic and clinical characteristics of all study participants were compared according to disability status using Pearson's chi-square tests. To explore the association of disability status and severity of disability with the risk of COVID-19, multivariable conditional logistic regression was performed after adjusting for household income and comorbidities. Second, among participants with COVID-19, Pearson's chi-square tests were used to compare sociodemographic and clinical characteristics with respect to disability status. To examine the association of disability status and the severity of the disability with the major adverse clinical outcomes from COVID-19, this study used multivariable conditional logistic regression models after adjusting for sex, age, residential area, household income, and comorbidities.

All data extraction and statistical analyses were performed using SAS v9.4 (SAS Institute Inc., Cary, NC). The Yonsei University Institutional Review Board approved this study (approval number: 7001988-202010-HR-1016-01 E).

Results

The general characteristics of the study participants according to COVID-19 status and major adverse clinical outcomes are shown in [Tables 1 and 2](#). [Table 1](#) shows that the proportion of PwDs was higher among people with COVID-19 than among those without COVID-19 (7.7% vs. 5.5%). [Table 2](#) shows that the proportion of PwDs was substantially higher among people with major adverse outcomes than among those without major adverse outcomes (23.9% vs. 6.6%).

Sociodemographic and clinical characteristics according to disability status are presented in [Table 3](#). This study identified 7261 PwDs and 121,859 people without disabilities. The proportions of men; older adults (≥ 60 years); individuals living in regions other than Daegu and Gyeongbuk; individuals with low household income; and individuals with certain medical conditions, including diabetes mellitus, hypertension, dyslipidemia, ischemic heart disease, chronic obstructive pulmonary disease, chronic kidney disease, cancer, asthma, mental illness, and chronic liver disease, were significantly higher among PwDs than among people without

Table 1
General characteristics of study participants according to COVID-19 status.

Variables	Total	With COVID-19		Without COVID-19		p-value
		N	%	N	%	
Total	129,120	8070	6.3	121,050	93.8	
Men	51,776	3236	40.1	48,540	40.1	1.000
Age group (years)						1.000
0–9	1296	81	1.0	1215	1.0	
10–19	4416	276	3.4	4140	3.4	
20–29	32,912	2057	25.5	30,855	25.5	
30–39	13,312	832	10.3	12,480	10.3	
40–49	16,576	1036	12.8	15,540	12.8	
50–59	25,072	1567	19.4	23,505	19.4	
60–69	19,184	1199	14.9	17,985	14.9	
70≤	16,352	1022	12.7	15,330	12.7	
Residential area						1.000
Daegu and Gyeongbuk	84,224	5264	65.2	78,960	65.2	
Other regions	44,896	2806	34.8	42,090	34.8	
Household income						<0.001
First quantile (lowest)	31,769	2401	29.8	29,368	24.3	
Second quantile	19,140	1101	13.6	18,039	14.9	
Third quantile	21,829	1311	16.2	20,518	17.0	
Fourth quantile	24,289	1348	16.7	22,941	19.0	
Fifth quantile (highest)	32,093	1909	23.7	30,184	24.9	
Disability status						<0.001
Yes	7261	619	7.7	6642	5.5	
No	121,859	7451	92.3	114,408	94.5	
Comorbidities						
Diabetes mellitus	17,288	1185	14.7	16,103	13.3	<0.001
Hypertension	26,716	1662	20.6	25,054	20.7	0.826
Dyslipidemia	35,702	2268	28.1	33,434	27.6	0.347
Ischemic heart disease	5818	399	4.9	5419	4.5	0.050
Stroke	3525	266	3.3	3259	2.7	0.001
Chronic obstructive pulmonary disease	1717	136	1.7	1581	1.3	0.004
Chronic kidney disease	1467	80	1.0	1387	1.1	0.205
Cancer	5764	361	4.5	5403	4.5	0.967
Asthma	14,258	953	11.8	13,305	11.0	0.023
Mental illness	26,176	1928	23.9	24,248	20.0	<0.001
Chronic liver disease	23,054	1500	18.6	21,554	17.8	0.076

Abbreviations: COVID-19, coronavirus disease.

disabilities.

The general characteristics of the study participants who tested positive for SARS-CoV-2 are shown according to disability status in Table 4, and 7.7% among them had disabilities. The proportions of men, young or middle-aged adults (≤59 years); those living in regions other than Daegu and Gyeongbuk; and those with low household income, diabetes mellitus, hypertension, dyslipidemia, ischemic heart disease, chronic obstructive pulmonary disease, chronic kidney disease, asthma, mental illness, or chronic liver disease among PwDs were significantly higher than those among people without disabilities.

Fig. 1 shows the association between disability status and risk of SARS-CoV-2 test positivity. After adjusting for potential confounders, PwDs (odds ratio [OR]: 1.36, 95% confidence interval [CI]: 1.24–1.48) had a higher risk of SARS-CoV-2 test positivity than those without disabilities. People with severe disability (OR: 1.82, 95% CI: 1.60–2.07) had a higher risk of SARS-CoV-2 test positivity than those without disabilities; however, there was no significant association between mild disability and the risk of SARS-CoV-2 test positivity compared with no disability (OR: 1.05, 95% CI: 0.92–1.18).

Fig. 2 shows the association between disability status and the risk of major adverse clinical outcomes of COVID-19 among patients who tested positive for SARS-CoV-2. After adjusting for potential

confounding factors, PwDs (OR: 1.43, 95% CI: 1.11–1.86) were associated with an increased risk of major adverse clinical outcomes of COVID-19 compared with people without disabilities. People with severe disability (OR: 1.60, 95% CI: 1.12–2.31) were associated with an increased risk of major adverse clinical outcomes of COVID-19 compared with people without disabilities; however, there was no significant association between mild disability and the risk of major adverse clinical outcomes of COVID-19 compared with no disability (OR: 1.29, 95% CI: 0.93–1.78).

Discussion

This nationwide study found that PwDs had an increased risk of SARS-CoV-2 test positivity compared with those without disabilities. Among people who tested positive for SARS-CoV-2, PwDs had a higher risk of major adverse clinical outcomes of COVID-19 than those without disabilities. People with severe disabilities had a higher risk of COVID-19 and major adverse clinical outcomes than those without disabilities; however, there was no significant association between mild disability and the risk of COVID-19.

There are several possible explanations for the increased risk of COVID-19 observed among PwDs. First, PwDs may have difficulty practicing routine prevention behaviors (e.g., washing hands and

Table 2
General characteristics of patients with COVID-19 according to major adverse clinical outcomes.

Variables	Total	With major adverse clinical outcomes		Without major adverse clinical outcomes		p-value
		N	%	N	%	
Total	8070	507	6.3	7563	93.7	
Men	3236	281	55.4	2955	39.1	<0.001
Age group (years)						<0.001
20–59	5849	108	21.3	5741	75.9	
60≤	2221	399	78.7	1822	24.1	
Residential area						<0.001
Daegu and Gyeongbuk	5264	285	56.2	4979	65.8	
Other regions	2806	222	43.8	2584	34.2	
Household income						<0.001
First quintile (lowest)	2401	165	32.5	2236	29.6	
Second quintile	1101	37	7.3	1064	14.1	
Third quintile	1311	77	15.2	1234	16.3	
Fourth quintile	1348	80	15.8	1268	16.8	
Fifth quintile (highest)	1909	148	29.2	1761	23.3	
Disability status						<0.001
Yes	619	121	23.9	498	6.6	
No	7451	386	76.1	7065	93.4	
Comorbidities						
Diabetes mellitus	1185	216	42.6	969	12.8	<0.001
Hypertension	1662	308	60.7	1354	17.9	<0.001
Dyslipidemia	2268	291	57.4	1977	26.1	<0.001
Ischemic heart disease	399	78	15.4	321	4.2	<0.001
Stroke	266	68	13.4	198	2.6	<0.001
Chronic obstructive pulmonary disease	136	41	8.1	95	1.3	<0.001
Chronic kidney disease	80	27	5.3	53	0.7	<0.001
Cancer	361	55	10.8	306	4.0	<0.001
Asthma	953	104	20.5	849	11.2	<0.001
Mental illness	1928	286	56.4	1642	21.7	<0.001
Chronic liver disease	1500	153	30.2	1347	17.8	<0.001

The major adverse clinical outcomes of COVID-19 comprised admission to the intensive care unit, invasive ventilation, or death.

Table 3
Characteristics of study participants according to disability status.

Variables	Total	People with disabilities		People without disabilities		p-value
		N	%	N	%	
Total	129,120	7261	5.6	121,859	94.4	
Men	51,776	3688	50.8	48,088	39.5	<0.001
Age group (years)						<0.001
0–9	1296	14	0.2	1282	1.1	
10–19	4416	52	0.7	4364	3.6	
20–29	32,912	458	6.3	32,454	26.6	
30–39	13,312	241	3.3	13,071	10.7	
40–49	16,576	455	6.3	16,121	13.2	
50–59	25,072	1239	17.1	23,833	19.6	
60–69	19,184	1670	23.0	17,514	14.4	
≥70	16,352	3132	43.1	13,220	10.8	
Residential area						0.003
Daegu and Gyeongbuk	84,224	4618	63.6	79,606	65.3	
Other regions	44,896	2643	36.4	42,253	34.7	
Household income						<0.001
First quintile (lowest)	31,769	2760	38.0	29,009	23.8	
Second quintile	19,140	669	9.2	18,471	15.2	
Third quintile	21,829	919	12.7	20,910	17.2	
Fourth quintile	24,289	1108	15.3	23,181	19.0	
Fifth quintile (highest)	32,093	1805	24.9	30,288	24.9	
Comorbidities						
Diabetes mellitus	17,288	2461	33.9	14,827	12.2	<0.001
Hypertension	26,716	3788	52.2	22,928	18.8	<0.001
Dyslipidemia	35,702	3986	54.9	31,716	26.0	<0.001
Ischemic heart disease	5818	1028	14.2	4790	3.9	<0.001
Stroke	3525	1041	14.3	2484	2.0	<0.001
Chronic obstructive pulmonary disease	1717	380	5.2	1337	1.1	<0.001
Chronic kidney disease	1467	496	6.8	971	0.8	<0.001
Cancer	5764	612	8.4	5152	4.2	<0.001
Asthma	14,258	1258	17.3	13,000	10.7	<0.001
Mental illness	26,176	3705	51.0	22,471	18.4	<0.001
Chronic liver disease	23,054	2440	33.6	20,614	16.9	<0.001

Table 4
Characteristics of patients with COVID-19 according to disability status.

Variables	Total	People with disabilities		People without disabilities		p-value
		N	%	N	%	
Total	8070	619	7.7	7451	92.3	
Men	3236	333	53.8	2903	39.0	<0.001
Age group (years)						<0.001
20–59	2058	228	36.8	1830	24.6	
≥60	6012	391	63.2	5621	75.4	
Residential area						0.015
Daegu and Gyeongbuk	5264	376	60.7	4888	65.6	
Other regions	2806	243	39.3	2563	34.4	
Household income						<0.001
First quintile (lowest)	2401	352	56.9	2049	27.5	
Second quintile	1101	36	5.8	1065	14.3	
Third quintile	1311	51	8.2	1260	16.9	
Fourth quintile	1348	70	11.3	1278	17.2	
Fifth quintile (highest)	1909	110	17.8	1799	24.1	
Comorbidities						
Diabetes mellitus	1185	215	34.7	970	13.0	<0.001
Hypertension	1662	319	51.5	1343	18.0	<0.001
Dyslipidemia	2268	347	56.1	1921	25.8	<0.001
Ischemic heart disease	399	73	11.8	326	4.4	<0.001
Stroke	266	106	17.1	160	2.1	<0.001
Chronic obstructive pulmonary disease	136	34	5.5	102	1.4	<0.001
Chronic kidney disease	80	35	5.7	45	0.6	<0.001
Cancer	361	30	4.8	331	4.4	0.640
Asthma	953	99	16.0	854	11.5	0.001
Mental illness	1928	396	64.0	1532	20.6	<0.001
Chronic liver disease	1500	195	31.5	1305	17.5	<0.001

social distancing) due to their physical or mental health problems, especially those relying on assistance with personal care. A previous study showed that those with disabilities were significantly less likely than those without any disability to report frequent hand-washing and surface disinfection.²⁰ PwDs also have inequities in access to public health messaging, possibly making their preventative actions for COVID-19 difficult. A previous study showed that PwDs felt that relevant health information is provided in a fragmentary

manner through several channels that have relatively low reliability.²¹ Second, PwDs may have limited access to healthcare services.²² A study showed that most PwDs were affected by a lack of access to facilities and equipment after COVID-19.²³ Finally, PwDs have more chronic medical conditions, as evidenced by the data in this study (higher prevalence of chronic diseases in PwDs compared to people without disabilities). These characteristics may be associated with an increased risk of COVID-19 and worse

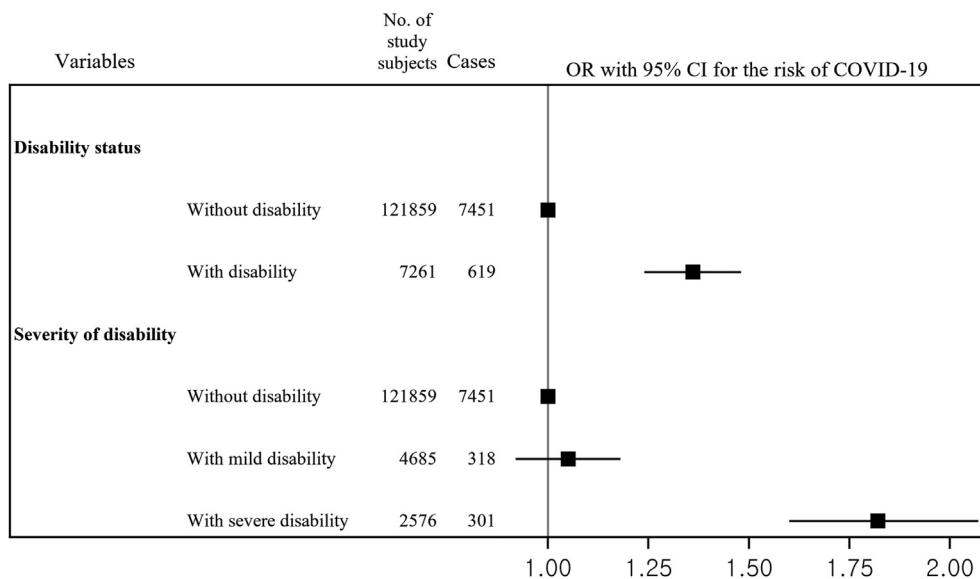


Fig. 1. Association between disability status and the risk of SARS-CoV-2 test positivity. The OR and 95% CI were calculated after adjusting for household income and comorbidities. Abbreviations: OR, odds ratio; CI, confidence interval; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

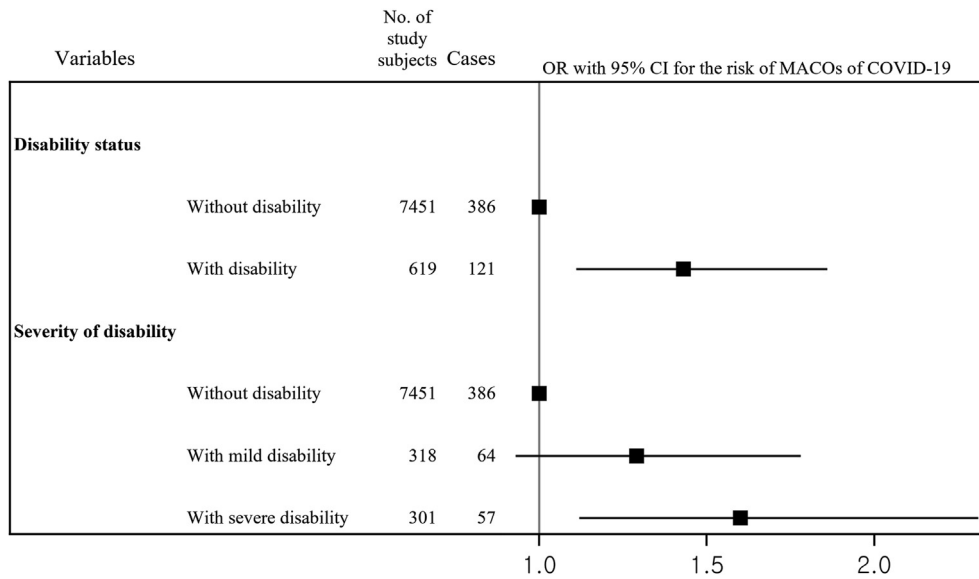


Fig. 2. Association between disability status and the risk of major adverse clinical outcomes among participants who tested positive for SARS-CoV-2. The major adverse clinical outcomes of COVID-19 comprised admission to the intensive care unit, invasive ventilation, or death. The OR and 95% CI were calculated after adjusting for sex, age, residential area, household income, and comorbidities. Abbreviations: OR, odds ratio; CI, confidence interval; MACOs, major adverse clinical outcomes; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; COVID-19, coronavirus disease.

outcomes during the COVID-19 pandemic.²⁴

This study suggests that the preparedness and response planning of COVID-19 must be inclusive of and accessible to PwDs by recognizing and addressing their challenges.^{4,25,26} Information on COVID-19 should be conveyed using formats accessible to people with specific types of disabilities, such as those who are blind, deaf, and have intellectual impairment. Additionally, strategies for vital in-person communication, such as sign language interpreters and wearing of transparent masks by healthcare providers to allow lip-reading, must be safe and accessible.

For PwDs with COVID-19, access to healthcare facilities, including hospitals, needs to be strengthened so that they can receive appropriate treatment for their underlying diseases, which predispose them to poorer outcomes of COVID-19. If there are no family members who can help PwDs with COVID-19, support from care workers should be provided to enable them to access healthcare services. At a policy level, the responsible authorities should give high priority and budgetary support to measures designed to reduce the risk of COVID-19 among PwDs. Healthcare staff should also be provided with rapid awareness training on the rights and diverse needs of PwDs and the need to maintain their dignity, safeguard against discrimination, and prevent inequities in care provision.

This study showed that severe disability was associated with an increased risk of COVID-19, but there was no significant association with mild disability. People with severe disability have a higher level of physical or mental functional impairment than those with mild disability, and they may experience more barriers during the COVID-19 pandemic, implying the need for specific measures for those with severe disability.²⁷

This study had some limitations. First, this study did not adjust for some potential confounding factors, such as obesity, which may have affected the response to SARS-CoV-2 infection.²⁸ Further studies that consider additional risk factors for COVID-19 are required. Second, this study did not determine the association between the type of disability (e.g., vision, hearing, and intellectual disability) and the risk of COVID-19 because of the data de-

identification policy of the NHIS. Further study is needed to investigate the risk of COVID-19 according to disability type. Finally, this study was conducted only in South Korea; therefore, further studies are warranted to explore the associations between disability and risk of COVID-19 in other populations and countries.

Conclusions

This large nationwide study found that PwDs were associated with an increased risk of SARS-CoV-2 test positivity compared with people without disabilities. Among patients who tested positive for SARS-CoV-2, PwDs were associated with an increased risk of major adverse clinical outcomes of COVID-19 compared with people without disabilities. This study suggests that PwDs should be included in the COVID-19 vaccination priorities. This study suggests that further research on the causes of high risk of COVID-19 among PwDs is required to create evidence for addressing their challenges.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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