Update: Current status and characteristics of variant virus outbreak in Republic of Korea in March 2021

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Abstract

Regarding the Coronavirus Disease 2019 (COVID-19) in Republic of Korea (Korea), the government intends to evaluate the domestic situation and respond to variant viruses by checking current status, dynamics, and the clinical characteristics of the COVID-19 on a monthly basis.

COVID-19 virus variant surveillance was conducted through full-length genome analysis and spike protein gene analysis for positive samples of confirmed cases related to various domestic outbreaks and imported cases.

The epidemiological and clinical characteristics were analyzed using initial and in-depth epidemiological investigation results reported through the Korea Disease Control and Prevention Agency's (KDCA) COVID-19 information management system; the information system for managing confirmed patients, wired monitoring. Clinical characteristics such as severity and the occurred of group cases were analyzed.

Among the number of confirmed cases during the March (13,288), 12.0% of isolates (1,589) was laboratory tested for identification of variants of SARS-CoV-2. A total of 113 accounting for 7.1% of the tested were confirmed as Variants of Concern (VOC). The rate of sequenced isolates of March were increased by 33% compared to that of Feburary. On the other hand, the detection rate of VOCs of March were decreased by 4.3% compared to that of February.

A total of 330 patients of Variants of Concern (VOCs) have been confirmed in Korea to April 5, 2021. The 330 VOC cases were divided into three groups: 501Y.V1, 501Y.V2 and 501Y.V3. 280 cases (84.9%) having the 501Y.V1, 42 cases (12.7%) having the 501Y.V2 (VOC originating from the South Africa), and 8 cases (2.4%) having the 501Y.V3 (VOC originating from the Brazil). Among the 330 cases, there were 204 imported cases (61.8%). The patients' average age was 38.1, By age group, people aged 71 cases (21.5%) each in their 20s, 30s. 233 cases (70.6%) were Korean nationals. 192 cases (58.2%) were symptomatic at diagnosis, 69 cases (20.9%) was mild respiratory symptoms with fever. Most symptoms of VOC patients in Korea were mild, but 9 case of the 501Y.V1 (VOC originating from the UK), and 1 of the 501Y.V2 (VOC originating from the South Africa) patients were severe/critical (including one death). The rate of severe/critical symptoms was 3.0%, and the fatality rate was 0.3%.

A total of 7 VOCs-related group cases were confirmed in March 2021, with 153 confirmed cases (32 laboratory confirmed cases, 121 epidemiological cases) lower than February 910 group cases, 195 confirmed cases [65 Laboratory confirmed cases, 130 epidemiological cases]). There were a total of 19 VOCs-related group cases and 394 confirmed cases (117 laboratory confirmed cases and 277 epidemiological related cases). By gender, there were 223 male cases (56.6%) and 78 female cases (19.8%) aged 20-29 years, and 128 (32.5%) cases were reported in Gyeonggi Province, followed by 120 cases (30.5%) reported in Ulsan Metropolitan City.

Keywords: Coronavirus Disease-19 (COVID-19), Variant of Concern (VOC), Variant of Interest (VOI), Whole Genome Sequencing, Clinical characteristic, Group cases

Introduction

Starting with a massive outbreak of pneumonia of unknown etiology in Wuhan, Hubei Province, China, in December 2019, coronavirus disease 2019 (COVID-19) expanded to become a global pandemic. In Repulic of Korea (hereafter, Korea), since the first confirmed case was reported on January 20, 2020, a total of 105,752 COVID-19 cases have been confirmed as of April 5, 2021. Well over a year has passed since the first outbreak of COVID-19, and the world is now facing another phase of the pandemic due to the emergence of variants. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which is the causative agent of COVID-19, is an RNA virus that continuously accrues mutations in the process of proliferation and transmission. Since most mutations occur in areas that are unfavorable to viral survival or do not affect the characteristics of the virus, they disappear quickly or do not lead to significant changes, but certain mutations contribute to increased transmissibility or cause changes in the characteristics of the virus, such as its pathogenicity. Since it was first reported on September 20, 2020 [1], the UK variant is rapidly spreading worldwide. Recently, various variants that originated in the UK and South Africa have been spreading in many countries, and these variants have been confirmed among international travelers in Korea.

Variants can be identified through genetic analyses. Recently, whole-genome sequencing has become widely used, and various genetic information related to variants is shared worldwide through the Global Initiative on Sharing All Influenza (GISAID) database (DB) on the web and the PANGO Lineages site [2,3].

In Korea, since the first person infected with the UK variant was identified in the quarantine stage in December 2020, a total of 330 people have been confirmed to be infected with the variant as of April 5. The UK variant is reported to have high transmissibility (1.5 times that of the original SARS-CoV-2 virus) [1,4], and the South African and Brazilian variants are also expected to have high transmissibility [5,8]. Although the possibility of immune evasion depending on the site of mutation has been reported [6,7], further research is still needed.

In order to stem the spread of variants in Korea, strengthened measures are enforced: those visiting from countries where variants of concern are prevalent are required to submit a written confirmation of a negative test and remain in a facility or private residence for quarantine after testing. However, it is necessary to establish preemptive measures for patient management based on regular and multilateral analyses of the characteristics of the everchanging variants.

Therefore, this report aims to describe the results of surveillance of variants of concern that have been confirmed in Korea, data of additional cases of transmission of the variants, and the epidemiological and clinical characteristics of patients infected with the variants. Through steady monitoring and characterization of these variants, we seek to help establish evidence-based response strategies to manage patients infected with variants and to prevent the spread of variants.

Methods

1. Status of variant surveillance in Korea

A. Subjects of analysis

In order to monitor the outbreak of variants in Korea, the Central Quarantine Countermeasures Headquarters has been conducting genetic analyses on representative specimens of domestic cases, considering the epidemiological association and regional distribution among large-scale and local sporadic outbreaks. For imported cases, genetic analyses are prioritized according to the agency's internal evaluation of the risk of each country based on the prevalence of variants, countries where variants have been identified, and countries with community outbreaks, which can be identified from the GISAID DB. In particular, in order to respond to the influx of variants from abroad and the spread of these variants in Korea, it has also strengthened the surveillance and analyses of variants by referring to the information on variants of concern (VOCs) and variants of interest (VOIs) provided by the World Health Organization (WHO).

B. Variants of concern (VOCs) and variants of interest (VOIs)

On February 25, 2021, the WHO classified VOCs and VOIs to recommend public health interventions against variants. A VOC is defined as a variant with (1) a confirmed increase in transmissibility or unfavorable epidemiological changes; and (2) increased pathogenicity or changes in the severity of clinical presentation; or (3) a confirmed decrease in the effectiveness of diagnostics, vaccines, and therapeutics or classification as a VOC by the WHO in consultation with the SARS-CoV-2 Virus Evolution Working Group. The WHO coordinates laboratory research on VOCs through the research group and conducts rapid risk assessments, communication of relevant information between member states, and revisions of guidelines. A VOI is defined as a variant with (1) a mutation in an amino acid that can show or induce different traits compared to the reference isolate and (2) community transmission, multiple infection cases, a large-scale outbreak, or detection in many countries or classification as a VOI by the WHO through consultation with the research group.

C. WHO's addition of VOIs

On March 30, 2021, the WHO added two variants originating in France and the Philippines to the list of VOIs [1,2]. The Philippine variant (B.1.1.28.3), which was first identified in the Philippines in February 2021, belongs to the B.1.1.28.3 (P.3) lineage of the GR clade, and is characterized by 7 amino acid mutations of the spike (S) protein (L141/G142/V143 deletion, E484K, N501Y, D614G, and P681H), and is currently confirmed in six countries including the Philippines, Japan, and the UK. The B.1.1.28.3 variant shares the E484K mutation, which is found in the South African and Brazilian variants, suggesting the possibility of immune evasion.

The French variant, which was first identified in France in January 2021, belongs to the B.1.616 lineage of the GH clade and is characterized by 9 amino acid mutations of the S protein (G142 deletion, D66H, Y144V, D215G, V483A, H655Y, G669S, Q949R, and N1187D), but additional confirmation and research are needed in relation to its transmissibility, virulence, and immune response.

D. Results of genotyping and surveillance of COVID-19 variants in Korea

As of April 5, 2021, the Korea Disease Control and Prevention Agency (KDCA) conducted genetic analyses of a total of 5,774 cases (4,567 domestic cases and 1,207 imported cases; 5.6% of all confirmed cases in Korea). In particular, since December 28, 2020, when overseas variants were first confirmed among incoming international travelers in Korea, the KDCA has been continuing to expand its analytical capacity: from late February, variant analyses have also been conducted at five regional disease response centers and a genetic analysis targeting only the S protein has been added to the whole-genome analyses, which contributes to the enhanced analytical capacity by shortening the analysis time (which takes at least 3 to 4 days). As a result, the number of analyses increased by approximately three times in March (1,589 cases are currently being analyzed as of late March) compared to January (587 cases were analyzed) (Figure 1).

As a result of the whole-genome analysis (4,319 cases) of the clades of SARS-CoV-2, various clades have been identified in imported cases, but overall, GH was the most common with 39.6%, followed by GR (31.4%), GRY (11.8%), and G (11.0%). Among imported cases, the proportion of the GRY clade increased significantly from 8.3% in December 2020 to 34.8% in February 2021 and 22.7% in March 2021. Among domestic cases, S and V clades were confirmed in many cases until April 2020, but the GH clade has accounted for the majority (90.7%) since the Itaewon club outbreak in May, indicating that it is still the predominant strain in Korea (Figure 2). The proportion of



Figure 1. The number of sequenced Coronavirus Disease–19 (COVID–19) virus and the rate of sequenced isolates among the confirmed cases



Figure 2. The distribution of the clades of Coronavirus Disease-19 (COVID-19) virus in domestic and imported cases

the GRY clade, which corresponds to the UK variant (501Y.V1), was found to be 1.3% in December 2020, 7.4% in February 2021, and 3.6% in March 2021. There was a significant difference in the clade distribution between the imported cases and domestic cases, and for overseas cases, it seems that the inflow of variants has occurred in proportion to the dominance of VOIs that are rapidly increasing in countries around the world, leading to the identification of the same variants in domestic cases.

From December 2020 to April 5, 2021, VOCs were confirmed in a total of 330 cases (8.5%) in Korea, of which the 501Y.V1 variant was found in 280 cases (7.2%), the 501Y.V2 variant in 42 cases (1.1%), and the 501Y.V3 variant in 8 cases (0.2%). Among the 1,589 specimens analyzed in March, VOCs were found in a total of 113 cases (7.1%), the 501Y.V1 variant in 93 cases (5.9%), the 501Y.V2 variant in 19 cases (1.2%), and the 501Y.V3 variant in 1 case (0.1%).

Since it was first confirmed in 14 cases (2.8%) in December 2020, the 501Y.V1 variant has been identified in 51 cases (8.7%) in January 2021, in 122 cases (10.3%) in February, and in 93 cases (5.9%) in March, indicating that it increased until February, but decreased slightly in March (Table 1, Figure 3). Of the total 280 cases with the 501Y.V1 variant, 164 cases (58.6%) were confirmed in imported cases and 116 cases (41.4%) were confirmed in domestic cases; thus, the variant was more commonly identified in imported cases. The imported cases were confirmed among international travelers from a total of 32 countries including Hungary (37 cases), the United Kingdom (19 cases), Poland (14 cases), UAE (12 cases), and Pakistan (12 cases) (Table 2). As for the domestic cases, the largest number of cases (48 cases, 10.9%) was detected in the Gyeongnam region (7 cases [9.5%] in January 2021, 19 cases [15.7%] in February, and 22 cases [11.6%] in March). As for the 501Y.V2 variant, 32 of 42 cases (76.2%) were related to the entry of international travelers from a total of 14 countries, including Tanzania (8 cases), Bangladesh (5), and UAE

(4 cases). All 8 cases with the 501Y.V3 variant were international travelers from a total of 4 countries including Brazil (5 cases), Canada (1 case), and Saudi Arabia (1 case) (Table 2).

The L452R.V1 variant, which is a VOI that originated in California, USA, has been identified in 193 cases since December 2020 (13 cases in December 2020 [2.6%], 21 cases in January 2021 [3.6%], 59 cases [5.0%] in February, and 100 cases [6.2%] in March), of which 29 cases were confirmed among international travelers from the USA (27 cases) and Mexico (2 cases), and among the 164 domestic cases with the variant, the largest number of cases (96 cases, 33.9%) was identified in the Gyeongbuk region. Of the 6 cases with the B.1.526 variant originating in New York, USA, 4 cases were confirmed among international travelers from the USA after February 2021. The 484K.V3 variant was confirmed in 7 cases among international travelers entering the country from Nigeria (4 cases) and Sudan (1 case) after February 2021, and the B.1.1.28.3 variant was confirmed in the international travelers from the Philippines (5 cases) after February 2021, indicating that the inflow of several variants has been confirmed during the surveillance process since February. The B.1.616 variant, which originated in France, has not been identified yet in Korea.

In recent months, several variants have spread rapidly around the world, raising concerns about the inflow of variants into Korea. To respond to this, it is necessary to steadily conduct surveillance and analyses of variants, as well as monitoring the occurrence of variants in each country.

			Desien	Number of VOC (Detection rate, %)*							
			negion	Total	Dec. 2020	Jan. 2021	Feb. 2021	Mar. 2021			
	Total	number o	of VOC	330 (8.5%)	15 (3.0%)	67 (11.4%)	135 (11.4%)	113 (7.1%)			
			Total	280 (7.2%)	14 (2.8%)	51 (8.7%)	122 (10.3%)	93 (5.9%)			
			Subtotal	116 (3.7%)	4 (1.1%)	21 (6.2%)	43 (4.5%)	48 (3.4%)			
			Capital	42 (2.7%)	4 (1.8%)	8 (4.8%)	14 (3.3%)	16 (2.2%)			
	501Y.V1	Dome	Kyungpook	15 (5.3%)	0 (0.0%)	0 (0.0%)	5 (4.9%)	10 (8.4%)			
	(GRY)	stic	Kyungnam	48 (10.9%)	0 (0.0%)	7 (9.5%)	19 (15.7%)	22 (11.6%)			
Variant of			Honam	11 (3.1%)	0 (0.0%)	6 (11.1%)	5 (3.5%)	0 (0.0%)			
Concern			Chungcheong	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)			
(VOC)			Imported	164 (21.8%)	10 (8.3%)	30 (12.0%)	79 (35.4%)	45 (28.5%)			
	50.00.00		Total	42 (1.1%)	1 (0.2%)	10 (1.7%)	12 (1.0%)	19 (1.2%)			
	501Y.V2 (GH)		Domestic	10 (0.3%)	0 (0.0%)	1 (0.3%)	4 (0.4%)	5 (0.3%)			
	(0.1.)		Imported	32 (4.3%)	1 (0.8%)	9 (3.6%)	8 (3.6%)	14 (8.9%)			
	50437.770		Total	8 (0.2%)	0 (0.0%)	6 (1.0%)	1 (0.1%)	1 (0.1%)			
	501Y.V3 (GR)		Domestic	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)			
	(GIT)		Imported	8 (1.1%)	0 (0.0%)	6 (2.4%)	1 (0.4%)	1 (0.6%)			
	Total	Total number of VOI			13 (2.6%)	21 (3.6%)	69 (5.8%)	108 (6.8%)			
			Total	193 (5.0%)	13 (2.6%)	21 (3.6%)	59 (5.0%)	100 (6.2%)			
			Subtotal	164 (5.3%)	11 (2.9%)	4 (1.2%)	55 (5.7%)	94 (6.4%)			
			Capital	54 (3.5%)	11 (5.0%)	3 (1.8%)	11 (2.6%)	29 (3.9%)			
	452R.V1	Dome	Kyungpook	96 (33.9%)	0 (0.0%)	1 (4.5%)	37 (36.3%)	58 (48.7%)			
	(GH)	stic	Kyungnam	4 (0.9%)	0 (0.0%)	0 (0.0%)	1 (0.8%)	3 (1.6%)			
			Honam	4 (1.1%)	0 (0.0%)	0 (0.0%)	4 (2.8%)	0 (0.0%)			
			Chungcheong	6 (1.2%)	0 (0.0%)	0 (0.0%)	2 (1.1%)	4 (1.6%)			
Variant of			Imported	29 (3.9%)	2 (1.7%)	17 (6.8%)	4 (1.8%)	6 (3.8%)			
(VOI)	P 1 506		Total	6 (0.2%)	0 (0.0%)	0 (0.0%)	3 (0.3%)	3 (0.2%)			
	(GH)		Domestic	2 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.1%)			
			Imported	4 (0.5%)	0 (0.0%)	0 (0.0%)	3 (1.3%)	1 (0.6%)			
	10112 1/2		Total	7 (0.2%)	0 (0.0%)	0 (0.0%)	5 (0.4%)	2 (0.1%)			
	4041C.V3 (G)		Domestic	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)			
	-		Imported	7 (0.9%)	0 (0.0%)	0 (0.0%)	5 (2.2%)	2 (1.3%)			
	B 1 1 00 0		Total	5 (0.1%)	0 (0.0%)	0 (0.0%)	2 (0.2%)	3 (0.2%)			
	B.1.1.28.3 (G)		Domestic	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)			
			Imported	5 (0.7%)	0 (0.0%)	0 (0.0%)	2 (0.9%)	3 (1.9%)			

Table 1. The regional occurrence of Coronavirus Disease-19 (COVID-19) variants in the Republic of Korea (Up to April 5, 2021)

* Detection rate of VOC (%) = (number of VOC / number of sequenced virus) $\times 100$



Figure 3. Monthly distribution of Coronavirus Disease-19 (COVID-19) variants

Table 2. The routes in which the Coronavirus Disease-19 (COVID-19) variants were identified in the Republic of Korea (Up to April 5, 2021)

Classification		Route	No. of countries	Countries
		Domestic	-	A total of 116
Variant of	501Y.V1 (GRY)	Imported	32	A total of 164 : Hungary (37), United Kingdom (19), Poland (14), UAE (12), Pakistan (12), Ghana (10), United States (9), Jordan (8), Philippines (7), France (4), German (3), Serbia (3), Slovakia (2), Iraq (2), Czechia (2), Mongolia (2), Montenegro (2), India (2), Netherlands (1), Ukraine (1), Bahrain (1), Kazakhstan (1), Morocco (1), Maldives (1), Nigeria (1), Norway (1), China (1), Libya (1), Ethiopia (1), Russia (1), Brazil (1), Denmark (1)
(VOC)		Domestic	_	A total of 10
	501Y.V2 (GH)	Imported	7	A total of 32 : Tanzania (8), Bangladesh (5), UAE (4), Mexico (3), South Africa (2), Philippines (2), Equatorial Guinea (1), Cameroon (1), Burundi (1), Zimbabwe (1), Malawi (1), Zambia (1), United States (1), Bahrain (1)
-	501Y.V3 (GR)	Domestic	-	-
		Imported	4	A total of 8 : Brazil (5), Canada (1), Saudi Arabia (1), United States (1)
	452R.V1	Domestic	-	A total of 164
	(GH)	Imported	2	A total of 29: United States (27), Mexico (2)
	B.1.526	Domestic	_	A total of 2
Variant of	(GH)	Imported	1	A total of 4: United States (4)
(VOI)	484K.V3	Domestic	_	-
	(G)	Imported	4	A total of 7: Nigeria (4), Sudan (1), UAE (1), Cameroon (1)
	B.1.1.28.3	Domestic	-	-
	(G)	Imported	1	A total of 5: Philippines (5)

2. Clinical and epidemiological characteristics of patients with VOCs

A. Analysis subjects and methods

After the first confirmed case infected with a variant in Korea in December 2020, 330 confirmed cases of VOCs were analyzed, including 168 patients 501Y.V1, 501Y.V2, and 501Y.V3 confirmed by April 5, in addition to the 162 patients with VOCs who had been included in the first round of analysis until March 1, 2021. The 330 subjects included 280 people with the 501Y.V3. V1, 42 people with the 501Y.V2, and 8 people with the 501Y.V3. The frequency analysis and chi-square test of epidemiological investigation records and clinical data of patients with basic variants were performed using SPSS, and epidemiologic and clinical characteristics were analyzed.

Result

1. Route of infection and detection

The route of infection and detection was investigated among a total of 330 people confirmed to have 501Y.V1, 501Y.V2, and 501Y.V3 from December 2020 to April 5, 2021. Regarding the route of infection, 204 patients (61.8%) were imported cases, of whom 116 patients (35.2%) were confirmed during home quarantine after entry, followed by 85 patients (25.7%) confirmed during entry screening and 3 patients (0.9%) confirmed through post-entry diagnostic tests. Among the 126 patients (38.2%) with locally acquired infections, the route of infection was contact with confirmed cases in 116 patients (35.2%) and under investigation in the remaining 10 patients (3.0%) (Table 3).

2. Epidemiological characteristics

A. 501Y.V1

Among the total confirmed cases of VOCs in Korea, the

																Unit	: n (%)
			Dec	2020			Jan	2021			Feb	2021			Mar	2021	
	Total	Total	501Y. V1	501Y. V2	501Y. V3												
Total	330 (100%)	15	14	1	0	67	51	10	6	135	122	12	1	113	93	19	1
Imported cases	204 (61.8%)	11	10	1	0	45	30	9	6	88	79	8	1	60	45	14	1
At entry screening	85 (25.7%)	5	4	1	0	19	13	4	2	36	32	4	0	25	18	6	1
During home quarantine	116 (35.2%)	6	6	0	0	26	17	5	4	49	44	4	1	35	27	8	0
Others*	3 (0.9%)	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0
Locally-acquired cases	126 (38.2%)	4	4	0	0	22	21	1	0	47	43	4	0	53	48	5	0
Contact with confirmed cases	116 (35.2%)	4	4	0	0	21	20	1	0	42	39	3	0	49	44	5	0
Under investigation (unclassified)	10 (3.0%)	0	0	0	0	1	1	0	0	5	4	1	0	4	4	0	0

Table 3. Route of infection and detection of VOCs in Republic of Korea

* Home quarantine exemption

501Y.V1 was the most common. Of the total 330 patients, 280 patients (84.9%) had the 501Y.V1, which was more prevalent in men (175 patients, 62.5%) than women (105 patients, 37.5%). The largest number of people was in the age group of 20 to 29 years (62 patients, 22.1%), followed by 30 to 39 years (57 patients, 20.4%) and 40 to 49 years (53 patients, 18.9%). The most frequently used isolation treatment facilities were hospitals (151 patients, 53.9%), followed by community treatment centers (126 patients, 45.0%) and others (2 patients, 0.7%). There were 9 (3.3%) critical/severe patients, including death (Table 4).

with VOCs. There were more men (27 patients, 64.3%) than women (15 patients, 35.7%), and the most common age group was 30 to 39 years (11 patients, 26.1%), followed by 20 to 29 years and 40 to 49 years, with 7 patients (16.7%) each. The most commonly used isolation treatment facilities were residential treatment centers (26 patients, 61.9%), followed by hospitals (16 patients, 38.1%). There was one (2.4%) with critical/severe patient (Table 4).

C. 501Y.V3

B. 501Y.V2

The 501Y.V2 was found in 42 (12.7%) of the 330 patients

Of the total of 330 patients confirmed to have VOCs in Korea, 8 (2.4%) had the 501Y.V3. There were more men (6 patients, 75.0%) than women (2 patients, 25.0%), and the number

Table 4. Epidemiological characteristics of VOCs in Republic of Korea

					Unit: n (%)
	Total	501Y.V1	501Y.V2	501Y.V3	<i>p</i> -value**
Total	330 (100.0%)	280 (84.9%)	42 (12.7%)	8 (2.4%)	
Gender					
Male	208 (63.0%)	175 (62.5%)	27 (64.3%)	6 (75.0%)	0.750
Female	122 (37.0%)	105 (37.5%)	15 (35.7%)	2 (25.0%)	0.700
Nationality					
Koreans	233 (70.6%)	198 (70.7%)	27 (64.3%)	8 (100.0%)	0 100
Foreigners	97 (29.4%)	82 (29.3%)	15 (35.7%)	0 (0.0%)	0.120
Age group(yrs)					
0-9	17 (5.1%)	14 (5.0%)	3 (7.1%)	0 (0.0%)	
10-19	21 (6.4%)	19 (6.8%)	2 (4.8%)	0 (0.0%)	
20-29	71 (21.5%)	62 (22.1%)	7 (16.7%)	2 (25.0%)	
30-39	71 (21.5%)	57 (20.4%)	11 (26.1%)	3 (37.5%)	
40-49	60 (18.2%)	53 (18.9%)	7 (16.7%)	0 (0.0%)	0.229
50-59	51 (15.5%)	48 (17.1%)	2 (4.8%)	1 (12.5%)	
60-69	29 (8.8%)	19 (6.8%)	8 (19.0%)	2 (25.0%)	
70-79	7 (2.1%)	5 (1.8%)	2 (4.8%)	0 (0.0%)	
80+	3 (0.9%)	3 (1.1%)	0 (0.0%)	0 (0.0%)	
Isolation place					
Residential treatment center	157 (47.6%)	126 (45.0%)	26 (61.9%)	5 (62.5%)	
Hospital	170 (51.5%)	151 (53.9%)	16 (38.1%)	3 (37.5%)	0.518
Home treatment	1 (0.3%)	1 (0.4%)	0 (0.0%)	0 (0.0%)	
Others*	2 (0.6%)	2 (0.7%)	0 (0.0%)	0 (0.0%)	

of patients aged 30 to 39 years was 3 (37.5%), those aged 20 to 29 years and 60 to 69 years were 2 (25.0%) each, and 1 patient (12.5%) was in the age range of 50 to 59 years. Residential treatment centers were the most common isolation treatment facilities, with 5 patients (62.5%), and hospitals were used in 3 patients (37.5%). There were no critical/severe patients including death (Table 4).

3. Clinical characteristics

Among the patients with VOCs in Korea, 192 patients (58.2%) reported symptoms and 138 patients (41.8%) were asymptomatic. Excluding asymptomatic cases, the most common symptom among the symptomatic cases was mild respiratory symptoms (cough, etc.) unaccompanied by fever in 69 patients

Table 5. Clinical characteristics of VOCs in Republic of Korea

(20.9%). There were 43 patients (13.0%) who complained of mild respiratory symptoms with fever, 28 patients (8.5%) had fever only, 24 patients (7.3%) had other symptoms only, 23 patients (7.0%) had other symptoms (chills, abdominal pain, etc.) accompanied by fever, and 5 patients (1.5%) lost their sense of smell or taste.

In Korea, patients who undergo isolation with highflow oxygen therapy, a ventilator, extracorporeal membrane oxygenation (ECMO), and continuous renal replacement therapy (CRRT) are classified as critical/severe. The main complaints of the patients with VOCs in Korea were mostly mild, but 9 (including 1 death) of those with the 501Y.V1 and 1 of those with the 501Y.V2 were critical/severe. The proportion of critical/severe (including death) among the patients with VOCs in Korea was 3.0% and the fatality rate was 0.3% (Table 5).

					Unit: n (%)
	Total	501Y.V1	501Y.V2	501Y.V3	<i>p</i> -value*
Total	330 (100.0%)	280 (84.9%)	42 (12.7%)	8 (2.4%)	
Symptom					
Symptomatic	192 (58.2%)	167 (59.6%)	20 (47.6%)	5 (62.5%)	0.007
Asymptomatic	138 (41.8%)	113 (40.4%)	22 (52.4%)	3 (37.5%)	0.327
Symptom classification					
Fever only	28 (8.5%)	17 (6.1%)	9 (21.4%)	2 (25.0%)	
Fever and respiratory symptoms	43 (13.0%)	41 (14.6%)	2 (4.8%)	0 (0.0%)	
Fever and other symptoms	23 (7.0%)	20 (7.1%)	3 (7.1%)	0 (0.0%)	
Respiratory symptoms without fever	69 (20.9%)	64 (22.9%)	3 (7.1%)	2 (25.0%)	0.021
Acute loss of sense of smell or taste	5 (1.5%)	4 (1.4%)	1 (2.4%)	0 (0.0%)	
Others	24 (7.3%)	21 (7.5%)	2 (4.8%)	1 (12.5%)	
Asymptomatic	138 (41.8%)	113 (40.4%)	22 (52.4%)	3 (37.5%)	
Severity					
Death	1 (0.3%)	1 (0.4%)	0 (0.0%)	0 (0.0%)	
Severe/critical	9 (2.7%)	8 (2.9%)	1 (2.4%)	0 (0.0%)	0 979
Milld/ asymptomatic	320 (97.0%)	271 (96.7%)	41 (97.6%)	8 (100.0%)	0.070

* χ^2 test

4. Current status of large-scale outbreaks related to VOCs

In March 2021, there were 7 confirmed large-scale outbreaks of VOCs and 153 confirmed cases related to VOCs (32 laboratory-confirmed cases and 121 epidemiologically related cases), exceeding the corresponding numbers confirmed in January (2 large-scale outbreaks; 46 confirmed cases [20 laboratory-confirmed cases and 26 epidemiologically related cases]), but reflecting lower numbers than those reported in February (10 large-scale outbreaks; 195 confirmed cases [65 laboratory-confirmed cases and 130 epidemiologically related cases]).

There were a total of 19 large-scale outbreaks of VOCs and 394 confirmed cases (117 laboratory-confirmed cases and 277 epidemiologically related cases), and the variant responsible for the 19 large-scale outbreaks was 501Y.V1 in 17 cases (89.5%) and 501Y.V2 in 2 cases (10.5%) (Table 6).

Regarding the demographic characteristics of the 394 cumulative confirmed cases in large-scale outbreaks of VOCs, there were more men (233 people, 56.6%) than women (171 people, 43.4%). The largest number of people was in the age range of 20 to 29 years (78 people, 19.8%), followed by 50 to 59 years (75 people, 19.0%), 30 to 39 years (65 people, 16.5%), 40 to 49 years, and 0 to 9 years (48 people, 12.2%). By region, Gyeonggi-

		Detient ecourrence				
		period	Total	Laboratory confirmed cases	Epidemiological cases	Virus type
January	Group 1	1.7-1.29.	38	13	25	501Y.V1
	Group 2	1.29-1.30.	8	7	1	501Y.V1
January subtotal (Group 1 – Group 22)			46	20	26	
February	Group 3	2.10-2.23.	31	7	24	501Y.V1
	Group 4	2.7-2.17.	7	2	5	501Y.V1
	Group 5	2.4-2.5.	5	3	2	501Y.V1
	Group 6	2.3-2.13.	11	3	8	501Y.V1
	Group 7	2.22-2.23.	3	3	0	501Y.V2
	Group 8	2.11-3.1.	62	24	38	501Y.V1
	Group 9	2.16-3.15.	24	1	23	501Y.V1
	Group 10	2.18-3.3.	18	3	15	501Y.V1
	Group 11	2.27-3.21.	25	14	11	501Y.V1
	Group 12	2.24-3.16.	9	5	4	501Y.V1
Febr	uary subtotal (Gro	up 3–Group 12)	195	65	130	
March	Group 13	3.6-3.16.	80	12	68	501Y.V1
	Group 14	3.8-3.10.	8	2	6	501Y.V1
	Group 15	3.20-3.23.	6	1	5	501Y.V1
	Group 16	3.17-3.25.	40	9	31	501Y.V1
	Group 17	2.24-3.12.	6	6	0	501Y.V2
	Group 18	3.19-3.21.	5	1	4	501Y.V1
	Group 19	3.21-3.24.	8	1	7	501Y.V1
Mar	ch subtotal (Group	9 13 – Group 19)	153	32	121	
	Total		394	117	277	

Table 6. Characteristics of variant of concern (VOC) viruses by group case

do was the hardest-hit (128 people, 32.5%), followed by the Ulsan metropolitan city (120 people, 30.5%), Gyeongsangnam-do (51 people, 12.9%), and Gyeongsangbuk-do (23 people, 5.8%).

In March 2021, the number of confirmed cases in largescale outbreaks related to the VOCs was 153. The largest number of people was in 20-29 years (42 people, 27.5%), followed by 30-39 years (26 people, 17.0%), 50-59 years (22 people, 14.4%), and 40 to 49 years (21 people, 13.7%). By region, the most prevalent areas were the Ulsan metropolitan city (75 people, 49.0%) and Gyeonggi-do (55 people, 35.9%) (Table 7).

Table 7. Demographic characteristics of patients with variant of concern virus population cases (including epidemiological cases)

		
	March	lotal
	N (%)	N (%)
Total	153 (100.0)	394 (100.0)
Sex		
Male	90 (58.8)	223 (56.6)
Female	63 (41.2)	171 (43.4)
Age group		
0-9	5 (3.3)	48 (12.2)
10–19	12 (7.8)	33 (8.4)
20–29	42 (27.5)	78 (19.8)
30-39	26 (17.0)	65 (16.5)
40-49	21 (13.7)	48 (12.2)
50-59	22 (14.4)	75 (19.0)
60-69	19 (12.4)	34 (8.6)
70–79	6 (3.9)	10 (2.5)
80+	0 (0.0)	3 (0.8)
Region		
Seoul	9 (5.9)	14 (3.6)
Busan	2 (1.3)	13 (3.3)
Daegu	1 (0.7)	3 (0.8)
Incheon	0 (0.0)	22 (5.6)
Gwangju	0 (0.0)	0 (0.0)
Daejeon	0 (0.0)	0 (0.0)
Ulsan	75 (49.0)	120 (30.5)
Sejong	0 (0.0)	0 (0.0)
Gyeonggi	55 (35.9)	128 (32.5)
Gangwon	0 (0.0)	3 (0.8)
Chungbuk	0 (0.0)	0 (0.0)
Chungnam	0 (0.0)	0 (0.0)
Jeonbuk	0 (0.0)	0 (0.0)
Jeonnam	0 (0.0)	17 (4.3)
Gyeongbuk	0 (0.0)	23 (5.8)
Gyeongnam	11 (7.2)	51 (12.9)
Jeju	0 (0.0)	0 (0.0)

Conclusion

The Central Quarantine Countermeasures Headquarters has continued to analyze the genetic characteristics of COVID-19 through whole-genome genetic analyses and has expanded its analytical capacity, leading to the identification of the VOCs (501Y. V1, 501Y.V2, and 501Y.V3) and VOIs (452R.V1, B.1.526, 484K. V3, and B.1.1.28.3). In recent months, several variants have been spreading rapidly abroad, thereby raising concerns about the inflow of these variants into Korea. To respond to this situation, it is necessary to perform ongoing surveillance and analyses of the variants, as well as monitoring the occurrence of variants by country.

Although VOCs have been reported to have increased transmissibility and fatality rate, no significant difference was noted in the severity rate and fatality rate between the patients with the existing virus and those with the VOCs in Korea. Nonetheless, studies on these variants are in progress, and infections with the variants continue to occur in Korea; thus, ongoing monitoring and analyses of the clinical characteristics of the patients infected with variants are necessary.

The 501Y.V1 variant was confirmed to be responsible for most of the large-scale outbreaks of VOCs in Korea. VOCs, including the 501Y.V1 variant, have been found in many countries around the world, and increased transmissibility and risk of death and the possibility of immune evasion have been reported [1]. In order to suppress the COVID-19 outbreak, Korea has been making efforts to prevent further spread through vaccinations and epidemiological investigations. In order to strengthen the management of variants, related information has been shared with local governments, testing has been expanded to the contacts of confirmed patients, and the surveillance of variants has been strengthened in local communities including areas with large concentrations of foreigners.

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Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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① What was known?

Since 162 people were confirmed to be infected with VOCs in Republic of Korea (Korea) as of March 31, 2021, 168 people have been additionally identified to have VOCs, which brings the total number of people with VOCs to 330, including 280 people with the UK variant, 42 people with the South African variant, and 8 people with the Brazilian variant.

② What does this study add?

Since it was first identified in 15 cases (3.0%) in December 2020, the 501Y.V1 variant has been confirmed in 51 cases (8.7%) in January 2021, 127 cases (10.7%) in February, and 87 cases (5.2%) in March. The L452R.V1 variant was also confirmed in 14 cases (2.8%) in December 2020, 21 cases (3.6%) in January 2021, 60 cases (5.1%) in February, and 98 cases (6.2%) in March. In addition, the B.1.1.28.3 variant, which was first identified in the Philippines, has been confirmed in 5 travelers from the Philippines since February 2021. Among the 330 people with variants, there were more men (208, 63.0%) than women (122, 37.0%). By age group, 20 to 29 years and 30 to 39 years were the most common with 71 people (21.5%) each and the average age was 38.1 years. Among the patients with VOCs in Korea, 192 (58.2%) were symptomatic and 138 (41.8%) were asymptomatic, and the largest number of people (69 cases, 20.9%) complained of only mild respiratory symptoms without fever. Nine severe cases (including 1 death) occurred among those with the 501Y.V1, as well as 1 critical/severe of the 501Y.V2.

③ What are the implications?

In order to stem the inflow and spread of variants in Korea, it is necessary to provide rapid response measures by strengthening the surveillance of variants and to establish a scientific basis through the analysis of the characteristics of variants. In particular, an evidence-based response strategy for the management of patients with variants should be established by comparing and analyzing the severity and fatality rates based on regularly monitoring the clinical conditions of patients with variants.

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