Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Short Communication

Clinical Characteristics of Asymptomatic Patients with COVID-19: A Nationwide Cohort Study in South Korea

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ABSTRACT

Objectives: To delineate clinical characteristics of asymptomatic and symptomatic patients confirmed with COVID-19 in South Korea.
Methods: Data were obtained from the Korean National Health Insurance Service database linked to the Korea Centers for Disease Control and Prevention data.
Results: Among 10,237 patients (mean [SD] age, 45.0 [19.8] years; 60.1% female) who met the eligibility criteria for the study, 6,350 (62.0%) patients were asymptomatic, and 3,887(38.0%) patients were symptomatic. The mean and median age were similar between asymptomatic and symptomatic patients. Notably, we observed a U-shaped association between age group and the proportion of asymptomatic patients, with the nadir at 57.3% in the 40-49 age group. This U-shaped distribution was largely similar between men and women. The overall prevalence of asymptomatic individuals was higher, regardless of sex, residential area, income levels, and comorbid conditions.
Conclusions: In this national cohort of over 10,000 patients with COVID-19, more than 60% of all cases in South Korea reported no symptoms at the time of diagnosis. Expanding criteria for contact tracing and testing to capture potential transmission before symptom onset should be urgently considered to inform control strategies for COVID-19.

Introduction

In South Korea, the first coronavirus disease 2019 (COVID-19) case was confirmed on January 20, 2020 (Korea Ministry of Health and Welfare and Center for Disease Control and Prevention, 2020). With proactive containment efforts, comprehensive contact tracing, and extensive testing of symptomatic or high risk individuals for COVID-19, South Korea was able to flatten the curve of new COVID-19 infections by mid-March (Korea Ministry of Health and Welfare and Center for Disease Control and Prevention, 2020; Song et al., 2020). However, studies of various sub-populations have raised important concerns regarding possible transmission of the virus by asymptomatic or presymptomatic infected persons (Song et al., 2020; Bai et al., 2020; He et al., 2020). Hence, to better inform the global medical community during the current worldwide pandemic, we sought to delineate the clinical characteristics of asymptomatic and symptomatic patients in a national cohort comprised of over 10,000 patients confirmed with COVID-19 from the Korean National Health Insurance Service (NHIS) database linked to Korea Centers for Disease Control and Prevention (KCDC) data.

Methods

The cohort included all patients confirmed with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections by a positive result on polymerase chain reaction test of a nasopharyngeal or oropharyngeal sample between January 24, 2020 and April 9, 2020, in South Korea. After excluding 207 patients who were not enrolled in the 2015-2019 NHIS database (e.g., foreigners or long-term foreign residents), a total of 10,237 patients were included in

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the final analysis. We characterized patients by socio-demographics, comorbid conditions, and presence/absence of symptoms. Information on presenting symptoms was collected by telephone interviews within the first 24 hours following a positive test for SARS-CoV-2 as part of contact tracing. Comorbidities were assessed using the *International Classification of Disease, Tenth Revision*, which were ascertained by the presence of at least two or more diagnostic codes identified up to five years prior to diagnosis of COVID-19. The Charlson comorbidity index score was also calculated as a proxy of disease burden and illness severity (Quan et al., 2005). Data from descriptive analyses were summarized using means (standard deviations, SD), medians (inter-quartile range), or proportions. The Institutional Review Board of the NHIS Ilsan Hospital approved this study and waived the requirement for informed consent as only de-identified data were examined.

Results

As of July 23, 2020, South Korea had confirmed 13,938 cases (including 2,145 imported cases) of SARS-CoV-2 infection (Korea Ministry of Health and Welfare and Center for Disease Control and Prevention, 2020). Among 10,237 patients (mean [SD] age, 45.0 [19.8] years; 60.1% female) who met the eligibility criteria for the study, 6,350 (62.0%) patients were asymptomatic, and 3,887 (38.0%) patients were symptomatic (Table 1). The mean and median age was similar between asymptomatic and symptomatic patients. Notably, we observed a U-shaped association between age group and the proportion of asymptomatic patients, with the nadir at 57.3% in the 40-49 age group. This U-shaped distribution was largely similar between men and women (Figure 1). The overall prevalence of asymptomatic individuals was higher, regardless of sex, residential area, income levels, and comorbid conditions.

Discussion

Despite deployment of aggressive public health measures, COVID-19 has infected more than fifteen million people and continues to spread rapidly around the world (Korea Ministry of Health and Welfare and Center for Disease Control and Prevention,

Table 1
Clinical Characteristics of the Study Population.

Characteristics	Overall	Presenting symptoms at diagnosis	
		Asymptomatic	Symptomatic
Number (%)	10,237	6,350 (62.0)	3887 (38.0)
Age, years			
Mean (SD)	45.0 (19.8)	45.2 (20.5)	44.6 (18.6)
Median (IQR)	46.0 (26.0-60.0)	46.0 (26.0-60.0)	45.0 (27.0-58.0)
Age intervals, number (%)			
0–19 years	481 (4.7)	337 (70.1)	144 (29.9)
20–29 years	2,858 (27.9)	1,789 (62.6)	1,069 (37.4)
30–39 years	1,089 (10.6)	649 (59.6)	440 (40.4)
40–49 years	1,327 (13.0)	760 (57.3)	567 (42.7)
50–59 years	1,879 (18.4)	1,125 (59.9)	754 (40.1)
60–69 years	1,385 (13.5)	853 (61.6)	532 (38.4)
≥70 years	1,218 (11.9)	837 (68.7)	381 (31.3)
Sex, number (%)			
Men	4,088 (39.9)	2,665 (65.2)	1,423 (34.8)
Women	6,149 (60.1)	3,685 (59.9)	2,464 (40.1)
Residential area, number (%)			
Large city	7,525 (73.5)	4,720 (62.7)	2,805 (37.3)
Small city	2,100 (20.5)	1,249 (59.5)	851 (40.5)
Rural area	612 (6.0)	381 (62.3)	231 (37.7)
Income quantiles, number (%)			
First quantile (lowest)	3,210 (31.4)	1,998 (62.2)	1,212 (37.8)
Second quantile	1,362 (13.3)	828 (60.8)	534 (39.2)
Third quantile	1,532 (15.0)	924 (60.3)	608 (39.7)
Fourth quantile	1,775 (17.3)	1,096 (61.7)	679 (38.3)
Fifth quantile (highest)	2,358 (23.0)	1,504 (63.8)	854 (36.2)
Comorbidities, number (%)			
Hypertension	782 (7.6)	559 (71.5)	223 (28.5)
Diabetes	624 (6.1)	416 (66.7)	208 (33.3)
Ischaemic heart disease	197 (1.9)	135 (68.5)	62 (31.5)
Heart failure	119 (1.2)	87 (73.1)	32 (26.9)
Dyslipidaemia	642 (6.3)	397 (61.8)	245 (38.2)
Cerebrovascular disease	360 (3.5)	265 (73.6)	95 (26.4)
Hemiplegia	139 (1.4)	114 (82.0)	25 (18.0)
Dementia	312 (3.0)	265 (84.9)	47 (15.1)
Peripheral vascular disease	42 (0.4)	25 (59.5)	17 (40.5)
Liver disease	144 (1.4)	78 (54.2)	66 (45.8)
Chronic pulmonary disease	312 (3.0)	218 (69.9)	94 (30.1)
Connective tissue disease	57 (0.6)	39 (68.4)	18 (31.6)
Peptic ulcer disease	253 (2.5)	167 (66.0)	86 (34.0)
Chronic kidney disease	47 (0.5)	34 (72.3)	13 (27.7)
Malignancy	237 (2.3)	156 (65.8)	81 (34.2)
CCI scores, number (%)			
0	8,722 (85.2)	5,334 (61.2)	3,388 (38.8)
1	669 (6.5)	430 (64.3)	239 (35.7)
2	354 (3.5)	225 (63.6)	129 (36.4)
≥3	492 (4.8)	361 (73.4)	131 (26.6)

Definition of abbreviations: SD = standard deviation; IQR = inter-quartile range; CCI = Charlson comorbidity indexs.

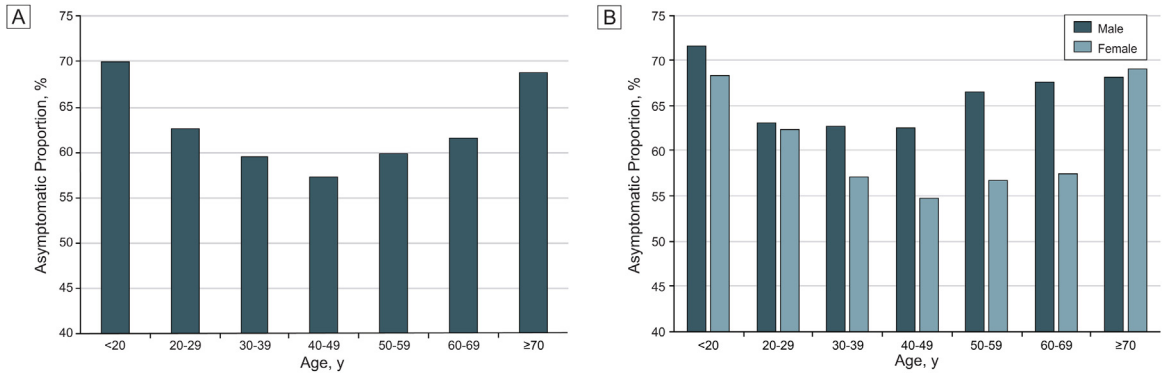

Figure 1. Asymptomatic Proportions across Age Groups among Patients with COVID-19 in South Korea. (*A*) Total population, (*B*) Stratified by sex.

2020). A major challenge to containing the spread of COVID-19 is that asymptomatic people are also infectious, with proportions of these asymptomatic cases as high as 80%, depending on different clinical contexts (Casey et al., 2020). Of note, comparing the proportion of positive COVID-19 cases that were asymptomatic between countries is influenced by potential confounders such as different phases of disease outbreak, variations in the mean age of the affected population, different containment strategies implemented by different countries, or variations in COVID-19 testing practices. Moreover, even within a country, the proportions of asymptomatic cases varied according to different exposure settings. In fact, one recent study evaluated the prevalence of asymptomatic infections in a community facility designated for the isolation of patients with COVID-19 in Daegu city (i.e., city with the highest prevalence of COVID-19 in South Korea), South Korea and showed that 41 (19.2%) of 213 confirmed cases were asymptomatic until admission (Kim et al., 2020). In another cluster of the Ministry of Oceans and Fisheries, Sejong city, South Korea, the KCDC reported that the asymptomatic case proportion was 33.3% at the time of confirmation (Korea Ministry of Health and Welfare and Center for Disease Control and Prevention, 2020). Meanwhile, a study of a call center cluster in Seoul, South Korea found that 8 (8.2%) of 97 case-patients had no symptoms at the time of testing, where half of the patients eventually showed symptoms within the 14-day quarantine period, and only 4 case-patients remained asymptomatic even after 14 days of isolation (Park et al., 2020). Hence, it is important to note that detailed information including chronological follow-up of symptoms is essential in differentiating “asymptomatic” from “pre-symptomatic” patients (Workman, 2020).

In this national cohort of over 10,000 patients with COVID-19, more than 60% of all cases in South Korea reported no symptoms at the time of diagnosis. While it is uncertain whether these patients eventually went on to develop symptoms, our findings again highlight that a significant proportion of confirmed COVID-19 cases are asymptomatic at the time of testing, and therefore, symptom-based screening alone may fail to control transmission during the infected but asymptomatic stage. Expanding criteria for contact tracing and testing to capture potential transmission before symptom onset should be urgently considered to inform control strategies for COVID-19.

Conflict of interest

None declared.

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Author contributions

TI Chang and DW Kim have full access to all data in the study and take responsibility for the integrity of the data and accuracy of the analysis.

Study concept and design: CY Jung, TI Chang.

Acquisition, analysis, or interpretation of data: TI Chang, H Park.

Drafting of the manuscript: CY Jung, TI Chang.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: TI Chang, H Park.

Administrative, technical, or material support: DW Kim, YJ Choi, SW Kim.

Study supervision: TI Chang, YJ Choi, SW Kim.

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References

Korea Ministry of Health and Welfare, Center for Disease Control and Prevention. The updates on COVID-19 in Korea: for press release. 2020 Available from: https://www.cdc.go.kr/board/board.es?mid=a30402000000&bid=0030. [Accessed July 2 2020].

Song JY, Yun JG, Noh JY, Cheong HJ, Kim WJ. Covid-19 in South Korea - Challenges of Subclinical Manifestations. N Engl J Med 2020;382:1858–9.

Bai Y, Yao L, Wei T, Tian F, Jin DY, Chen L, et al. Presumed Asymptomatic Carrier Transmission of COVID-19. JAMA 2020;323:1406–7.

He X, Lau EHY, Wu P, Deng X, Wang J, Hao X, et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. Nat Med 2020;26:672–5.

Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Med Care 2005;43:1130–9.

Casey M, Griffin J, McAloon CG, Byrne AW, Madden JM, McEvoy D, et al. Pre-symptomatic transmission of SARS-CoV-2 infection: a secondary analysis using published data. medRxiv 2020; 202005.08.20094870.

Kim GU, Kim MJ, Ra SH, Lee J, Bae S, Jung J, et al. Clinical characteristics of asymptomatic and symptomatic patients with mild COVID-19. Clin Microbiol Infect 2020;26:948.e1–3.

Park SY, Kim YM, Yi S, Lee S, Na BJ, Kim CB, et al. Coronavirus Disease Outbreak in Call Center, South Korea. Emerg Infect Dis 2020;26:1666–70.

Workman J. The proportion of COVID-19 cases that are asymptomatic in South Korea: Comment on Nishiura et al. Int J Infect Dis 2020;96:398.