Impact of the COVID-19 pandemic on racial and ethnic minorities in Japan

Hidetoshi Nomoto[1,2] (iD), Yusuke Asai[1,3], Kayoko Hayakawa[1,3], Nobuaki Matsunaga[3], Satoshi Kutsuna[1,4], Eiichi N. Kodama[5] and Norio Ohmagari[1,2,3]

[1]Disease Control and Prevention Center, National Center for Global Health and Medicine, Tokyo, Japan; [2]Emerging and Reemerging Infectious Diseases, Graduate School of Medicine, Tohoku University, Miyagi, Japan; [3]AMR Clinical Reference Center, National Center for Global Health and Medicine, Tokyo, Japan; [4]Department of Infection Control, Graduate School of Medicine, Osaka University, Osaka, Japan and [5]Division of Infectious Diseases, International Research Institute of Disaster Science, Graduate School of Medicine, and Tohoku Medical Megabank Organization, Tohoku University, Miyagi, Japan

Abstract

This study compared clinico-epidemiological characteristics between Japanese and non-Japanese coronavirus disease 2019 (COVID-19) patients under the pandemic in Japan. We retrospectively analysed nationwide data of hospitalised COVID-19 patients before 31 March 2021. Epidemic curves were constructed to identify the case distribution over time. A total of 28 093 patients were Japanese and 1335 patients were non-Japanese. The major racial and ethnic minorities were East Asians ($n = 521$), South Asians ($n = 260$) and Latin Americans ($n = 270$). Non-Japanese patients were younger and more likely to travel to COVID-19 endemic countries (7.7%), had meals with other people (17.8%), stayed in crowded places (17.9%) and worked mainly in restaurants (6.6%) and service facilities in nightlife businesses (5.2%). In the matched cohorts, we found no clear disparities in time to admission and clinical prognoses. The epidemic curve for non-Japanese patients showed a small peak in the first wave and no definite waves for the second or third waves. Racial and ethnic minorities were at less risk of severe disease but were at a greater risk of COVID-19 exposure; however, the healthcare system in Japan may provide them with equal opportunities to access inpatient care with Japanese. Further research on their social determinants of health in Japan is required.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has affected ethnic and racial minorities disproportionately [1]. Ethnic and racial minorities have been reported to be more vulnerable in terms of socioeconomic status and health inequality [2]. In the United States, racial and ethnic minorities such as Blacks, Hispanics and American Indians were shown to be more at risk of infection because they tend to live in crowded environments and multigenerational households and employed in essential work that cannot be done remotely [3]. Besides the high prevalence of comorbidities associated with severe COVID-19, there are multiple barriers to access to healthcare, including inadequate health care literacy and lack of insurance, which could further put them at a disadvantage [4, 5].

The major ethnic group in Japan is the Japanese. However, the number of foreign workers has increased rapidly. The Immigration Services Agency of Japan reported approximately 2.9 million foreign residents in Japan as of June 2020, from which the majority were from East and Southeast Asian countries such as Vietnam, China, the Philippines and Nepal [6]. The environment surrounding these racial and ethnic minorities has changed drastically during the COVID-19 pandemic. Nevertheless, little is known about how these foreign residents were affected by the pandemic in Japan.

In this study, we investigated how racial and ethnic minorities in Japan were affected by the COVID-19 pandemic, particularly in terms of their access to healthcare and clinical prognoses using the nationwide registry data of hospitalised COVID-19 patients. Additionally, we compared the epidemiological characteristics of Japanese and racial and ethnic minority COVID-19 patients.

Methods

Study design and patients

This retrospective observational study used data from the COVID-19 Registry Japan (COVIREGI-JP), which was launched on 2 March 2020 [7]. As of 2 July 2021, 594 facilities

from all over Japan were registered in the COVIREGI-JP. The eligibility criterion for case enrolment was as follows: a case with any positive test for COVID-19 on or before admission to a medical facility. Some patients were excluded for the following reasons: (i) cases transferred from other hospitals and (ii) cases infected on a cruise ship.

Data collection

Patient data were collected using a case report form (CRF) developed for the COVIREGI-JP. The CRF utilised the modified International Severe Acute Respiratory and Emerging Infection Consortium CRF for COVID-19 [8]. Data were managed using Research Electronic Data Capture, a secure web-based application for online surveillance hosted at the Japan Clinical Research Assist Center of the National Center for Global Health and Medicine (NCGM) [9]. We extracted data on hospitalised cases before 31 March 2021, and all major data items were collected as of 2 July 2021. Patient background information, including basic demographics, possible contact histories with COVID-19 within 14 days before onset, and occupation, was collected. In addition, we collected clinical information about time to admission, supportive therapies at and during admission, outcomes at discharge and complications during admission to assess the patients' clinical courses.

Categorisation of racial and ethnic minorities

We divided racial and ethnic categories into eight groups according to the patients' registered information in the CRFs. The groups were Japanese and racial/ethnic minorities including East Asian, South Asian, West Asian, Latin American, Black, White and Arabian. Data of racial and ethnic minorities of unknown origin were excluded from the analysis.

Epidemic curves

We constructed epidemic curves for Japanese and non-Japanese patients to identify differences in the distribution of cases over time. In addition, we constructed epidemic curves for each racial and ethnic group other than the Arabian, where the number of cases was very small, for subgroup analysis.

Statistical analyses

Continuous variables are presented as medians with interquartile ranges (IQRs), and categorical variables as numbers of cases with percentages. We evaluated the differences between Japanese and non-Japanese COVID-19 patients using the chi-square test for categorical variables and the Mann–Whitney U test for continuous variables. Statistical significance was set at a P-value of <0.05. Propensity score (PS) matching was performed to adjust for confounding factors. PS was defined as the probability of being Japanese or non-Japanese and estimated using a multivariable logistic regression model. The baseline variables included in the model were sex, age, BMI (>25 kg/m^2) and risk factors for severe COVID-19, including cardiovascular disease, cerebrovascular disease, dementia, chronic respiratory disease, liver disease, hypertension, diabetes mellitus, renal dysfunction/dialysis, solid and haematological malignancies, leukemia/lymphoma and human immunodeficiency virus [10]. Patients were matched at a fixed ratio of 2:1 using the optimal matching method, which

selects all matches simultaneously without replacement. R version 4.0.2 (R Core Team, 2020) and the matching library were used for all statistical analyses and PS matching [11].

Ethics consideration

This study was approved by the NCGM Ethics Review Committee (approval number: NCGM-G-004108-00). The opt-out recruitment method was used, and the requirement for informed consent was waived. Details about the entire study are disclosed on the website [7].

Results

Epidemiological characteristics of Japanese and non-Japanese patients

In total, 29 428 patients from 546 hospitals were included in the analysis. Among them, 28 093 were Japanese and 1335 were non-Japanese. The epidemiological characteristics of all patients are shown in Table 1. Of the racial and ethnic groups studied, the largest groups were East Asian ($n = 521$), followed by South Asian ($n = 260$) and Latin American ($n = 270$). Non-Japanese patients were significantly younger than Japanese patients (58 [39, 74] years old for Japanese and 36 [25, 48] years old for non-Japanese patients, $P < 0.001$). The time from onset to hospitalisation did not differ between the groups. Approximately half of the Japanese and non-Japanese patients had possible contact history with COVID-19 within 14 days before onset (56.1% for Japanese and 56.8% for non-Japanese). Considering details regarding their contact histories, non-Japanese patients were more likely to travel to COVID-19 endemic countries (1.1% for Japanese and 7.7% for non-Japanese, $P < 0.001$), have meals with other people (14.6% for Japanese and 17.8% for non-Japanese, $P < 0.001$) and stay in crowded places (14.1% for Japanese and 17.9% for non-Japanese, $P < 0.001$). Latin Americans characteristically had more contact with COVID-19 through their family members ($n = 117$, 43.3%). Regarding occupations, non-Japanese patients were likely to work in restaurants (3.4% for Japanese and 6.6% for non-Japanese, $P < 0.001$) and service facilities in nightlife businesses, such as a night club (2.4% for Japanese and 5.2% for non-Japanese, $P < 0.001$).

Table 2 shows disease severity, supportive care and outcomes from admission to discharge. Non-Japanese patients were less likely to require oxygen support both at admission ($P < 0.001$) and during admission ($P < 0.001$), although the majority of patients in both groups did not need oxygen support. In addition, other supportive care including admission to an intensive care unit, inotropic agents, renal replacement therapy and blood transfusions were not likely to be used for non-Japanese patients. Regarding the outcomes, the death rate was lower among non-Japanese patients than among Japanese patients (4.4% for Japanese and 0.7% for non-Japanese). Bacterial pneumonia and acute respiratory distress syndromes were more prevalent among Japanese patients.

Next, we compared the Japanese and non-Japanese patients using a matched cohort (Table 3). A total of 2182 Japanese and 1091 non-Japanese patients were included in the analysis. The factors used for the matching are shown in Supplementary Figure S1. In the matched cohort, we did not observe a significant difference between Japanese and non-Japanese patients in demographics, disease severity, supportive care or any outcomes, except

Table 1. Characteristics of Japanese and non-Japanese patients

	Japanese and non-Japanese			By race and region						
	Japanese	Non-Japanese	P-value	East Asia	South Asia	West Asia	Latin America	White	Black	Arabic
Demographics	28 093	1335		521	260	16	270	41	24	8
Age	58 [39, 74]	36 [25, 48]	<0.001	37 [27, 53]	32 [23, 42.25]	36.5 [28, 47.75]	36 [21.25, 46]	33 [28, 45]	39 [30.5, 48.25]	39 [30.5, 48.25]
Male Sex	15 652 (55.7)	695 (52.1)	0.028	228 (43.8)	139 (53.5)	11 (68.8)	151 (55.9)	31 (75.6)	20 (83.3)	3 (37.5)
BMI, kg/m^2	23.2 [20.6, 26.2]	24.2 [21, 27.7]	<0.001	23.4 [20.6, 26.7]	23.7 [20.7, 27.4]	26.6 [23.7, 28.8]	25.4 [21.7, 28.8]	26.5 [22.4, 28.1]	27.2 [24.3, 31.3]	28.4 [23.5, 35.2]
Symptomatic on admission	25 116 (90.6)	1125 (84.7)	<0.001	450 (86.7)	208 (80.3)	16 (100)	221 (82.2)	39 (100)	22 (91.7)	6 (75)
Days from symptom onset to hospitalisation	4 [2, 7]	4 [2, 7]	0.422	5 [3, 7]	4 [2, 7]	6 [3.75, 8]	4 [2, 7]	5 [2, 7]	5 [3.25, 6.75]	5 [1.25, 8]
Contact history within 14 days before onset										
Contact with COVID-19 patients	15 758 (56.1)	758 (56.8)	<0.001	266 (51.1)	142 (54.6)	7 (43.8)	197 (73)	18 (43.9)	9 (37.5)	3 (37.5)
Family	6161 (21.9)	327 (24.5)		93 (17.9)	70 (26.9)	0 (0)	117 (43.3)	3 (7.3)	0 (0)	1 (12.5)
Non-family cohabitant	297 (1.1)	55 (4.1)		18 (3.5)	12 (4.6)	0 (0)	9 (3.3)	1 (2.4)	3 (12.5)	0 (0)
Workplace	2897 (10.3)	194 (14.5)		80 (15.4)	37 (14.2)	4 (25)	37 (13.7)	4 (9.8)	1 (4.2)	1 (12.5)
Medical institution and/or long-term care facility	4061 (14.5)	24 (1.8)		16 (3.1)	1 (0.4)	1 (6.2)	2 (0.7)	0 (0)	0 (0)	0 (0)
Educational facility	221 (0.8)	26 (1.9)		9 (1.7)	11 (4.2)	0 (0)	3 (1.1)	0 (0)	0 (0)	0 (0)
Travel to COVID-19 countries	311 (1.1)	103 (7.7)	<0.001	34 (6.5)	38 (14.7)	1 (6.2)	4 (1.5)	8 (19.5)	1 (4.2)	2 (25)
Presence in a medical institution where COVID-19 patients were managed	1986 (7.1)	9 (0.7)	<0.001	6 (1.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (12.5)
Meals with more than 3 persons (except for family members)	4037 (14.6)	236 (17.8)	<0.001	96 (18.6)	49 (18.9)	2 (12.5)	49 (18.1)	7 (18.4)	4 (17.4)	1 (12.5)
Stays in crowded space	3880 (14.1)	237 (17.9)	<0.001	95 (18.4)	40 (15.4)	2 (12.5)	51 (18.9)	10 (26.3)	4 (17.4)	0 (0)
Occupation										
Work in a medical institution	1629 (5.9)	15 (1.1)	<0.001	10 (1.9)	3 (1.2)	0 (0)	1 (0.4)	0 (0)	0 (0)	0 (0)
Work in a restaurant	930 (3.4)	87 (6.6)	<0.001	44 (8.5)	26 (10.1)	1 (6.2)	3 (1.1)	2 (5.3)	1 (4.3)	0 (0)
Work in nightlife businesses	651 (2.4)	69 (5.2)	<0.001	45 (8.7)	11 (4.3)	1 (6.2)	4 (1.5)	0 (0)	0 (0)	0 (0)
Commercial sex worker	52 (0.2)	0 (0)	<0.001	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Abbreviations: COVID-19, coronavirus disease 2019.
The variables in each category depend on the number of missing values.

Table 2. Disease severity, supportive care and outcomes from admission to discharge

	Japanese and non-Japanese			By race and region						
	Japanese	Non-Japanese	P-value	East Asia	South Asia	West Asia	Latin America	White	Black	Arabic
	28 093	1335		521	260	16	270	41	24	8
Supportive therapy at admission										
Oxygen support			<0.001							
No oxygen	24 978 (89.6)	1251 (96.2)		494 (95.4)	244 (98)	15 (93.8)	244 (96.8)	38 (92.7)	23 (95.8)	8 (100)
Oxygen	2821 (10.1)	49 (3.8)		24 (4.6)	5 (2)	1 (6.2)	8 (3.2)	3 (7.3)	1 (4.2)	0 (0)
IMV/ECMO	54 (0.2)	0 (0)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Supportive therapy during admission										
Oxygen support			<0.001							
No oxygen	19 011 (67.7)	1145 (85.8)		425 (81.6)	241 (92.7)	15 (93.8)	237 (87.8)	35 (85.4)	22 (91.7)	7 (87.5)
Oxygen	8251 (29.4)	174 (13)		86 (16.5)	18 (6.9)	0 (0)	31 (11.5)	5 (12.2)	2 (8.3)	1 (12.5)
IMV/ECMO	821 (2.9)	16 (1.2)		10 (1.9)	1 (0.4)	1 (6.2)	2 (0.7)	1 (2.4)	0 (0)	0 (0)
Stay in ICU	1400 (5)	26 (1.9)	<0.001	15 (2.9)	3 (1.2)	1 (6.2)	2 (0.7)	1 (2.4)	0 (0)	0 (0)
Inotropic	429 (1.5)	10 (0.7)	0.020	7 (1.3)	1 (0.4)	0 (0)	2 (0.7)	0 (0)	0 (0)	0 (0)
RRT or dialysis	269 (1)	5 (0.4)	0.027	2 (0.4)	0 (0)	0 (0)	1 (0.4)	0 (0)	0 (0)	0 (0)
Blood transfusion	356 (1.3)	3 (0.2)	<0.001	2 (0.4)	1 (0.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Outcome at discharge										
Discharge or transfer	26 847 (95.6)	1325 (99.3)	<0.001	516 (99)	258 (99.2)	16 (100)	268 (99.3)	41 (100)	24 (100)	8 (100)
Details of outcome										
Death	1224 (4.4)	10 (0.7)		5 (1)	2 (0.8)	0 (0)	2 (0.7)	0 (0)	0 (0)	0 (0)
Discharge to home	21 335 (76)	1186 (88.8)		453 (86.9)	230 (88.5)	15 (93.8)	246 (91.1)	39 (95.1)	20 (83.3)	8 (100)
Transfer to different hospital	2758 (9.8)	53 (4)		25 (4.8)	12 (4.6)	0 (0)	9 (3.3)	1 (2.4)	2 (8.3)	0 (0)
Transfer to non-medical facility	1474 (5.3)	81 (6.1)		36 (6.9)	16 (6.2)	1 (6.2)	13 (4.8)	1 (2.4)	1 (4.2)	0 (0)
Transfer to long-term care facility	1280 (4.6)	5 (0.4)		2 (0.4)	0 (0)	0 (0)	0 (0)	0 (0)	1 (4.2)	0 (0)
Complications during admission										
Bacterial pneumonia (including HAP/VAP)	1245 (4.4)	15 (1.1)	<0.001	9 (1.7)	1 (0.4)	0 (0)	2 (0.7)	0 (0)	2 (8.3)	0 (0)
MRSA infection	80 (6.4)	1 (6.7)	1	1 (11.1)	0 (0)	0 (0)	0 (0)	0 (–)	0 (0)	0 (0)
ARDS	877 (3.1)	16 (1.2)	<0.001	10 (1.9)	1 (0.4)	1 (6.2)	2 (0.7)	1 (2.4)	0 (0)	0 (0)
Bacteraemia	149 (0.5)	2 (0.1)	0.002	1 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Clostridioides difficile infection	40 (0.1)	1 (0.1)	0.054	0 (0)	0 (0)	0 (0)	1 (0.4)	0 (0)	0 (0)	0 (0)

IMV, invasive mechanical ventilation; ECMO, extracorporeal membrane oxygenation; ICU, intensive care unit; RRT, renal replacement therapy; HAP, hospital-acquired pneumonia; VAP, ventilator-associated pneumonia; MRSA, methicillin-resistant *Staphylococcus aureus;* ARDS, acute respiratory distress syndrome.
The variables in each category depend on the number of missing values.
The number is shown with the percentage.

Table 3. Demographics, disease severity, supportive care and outcomes among matched patients

	Japanese 2182	Non-Japanese 1091	*P*-value
Demographics			
Age	37 [25, 49]	37 [25, 49]	0.938
Male sex	1163 (53.3)	570 (52.2)	0.578
BMI, kg/m^2	23.8 [20.5, 27.4]	24.2 [21, 27.7]	0.108
Symptomatic on admission	1963 (91)	924 (85)	<0.001
Days from symptom onset to hospitalisation	4 [2, 7]	4 [2, 7]	0.515
Supportive therapy at admission			
Oxygen support			0.867
No oxygen	2066 (95.8)	1013 (95.7)	
Oxygen	88 (4.1)	45 (4.3)	
IMV/ECMO	2 (0.1)	0 (0)	
Supportive therapy during admission			
Oxygen support			0.765
No oxygen	1833 (84)	927 (85)	
Oxygen	321 (14.7)	150 (13.7)	
IMV/ECMO	27 (1.2)	14 (1.3)	
Stay in ICU	69 (3.2)	24 (2.2)	0.146
Inotropic	8 (0.4)	9 (0.8)	0.119
RRT or dialysis	12 (0.6)	4 (0.4)	0.601
Blood transfusion	10 (0.5)	3 (0.3)	0.563
Outcomes at discharge			
Discharge or Transfer	2164 (99.3)	1082 (99.2)	0.832
Details of outcome			
Death	16 (0.7)	9 (0.8)	
Discharge to home	1890 (86.7)	977 (89.6)	
Transfer to different hospital	93 (4.3)	41 (3.8)	
Transfer to non-medical facility	174 (8)	61 (5.6)	
Transfer to long-term care facility	7 (0.3)	3 (0.3)	
Complications during admission			
Bacterial pneumoniae (incl. HAP/VAP)	26 (1.2)	10 (0.9)	0.595
MRSA infection	1 (4.3)	1 (11.1)	0.49
ARDS	25 (1.2)	13 (1.2)	1
Bacteraemia	5 (0.2)	2 (0.2)	1
Clostridioides difficile infection	1 (0)	1 (0.1)	1

IMV, invasive mechanical ventilation; ECMO, extracorporeal membrane oxygenation; ICU, intensive care unit; RRT, renal replacement therapy; HAP, hospital-acquired pneumonia; VAP, ventilator-associated pneumonia; MRSA, methicillin-resistant *Staphylococcus aureus*; ARDS, acute respiratory distress syndrome.
The variables in each category depend on the number of missing values.
The numbers are shown as percentages. Continuous variables are shown as medians [IQRs].

the presence of symptoms at onset. Japanese patients were more likely to be symptomatic than non-Japanese patients (91% for Japanese patients and 85% for non-Japanese patients, *P* < 0.001).

An epidemic curve was developed during the study period (Fig. 1). The epidemic curve for Japanese patients consisted of three waves, corresponding to the first, second and third waves of COVID-19 in Japan. In contrast, the epidemic curve for non-Japanese patients showed a small peak in the first wave and did not form definite waves corresponding to the second or third waves. The cumulative number of cases is shown in Supplementary Figure S2. Figure 2 shows the epidemic curves for each racial and ethnic minority group. There was a small peak of the first wave and no clear peak or drop thereafter for East Asian patients. The peaks for Latin American and South
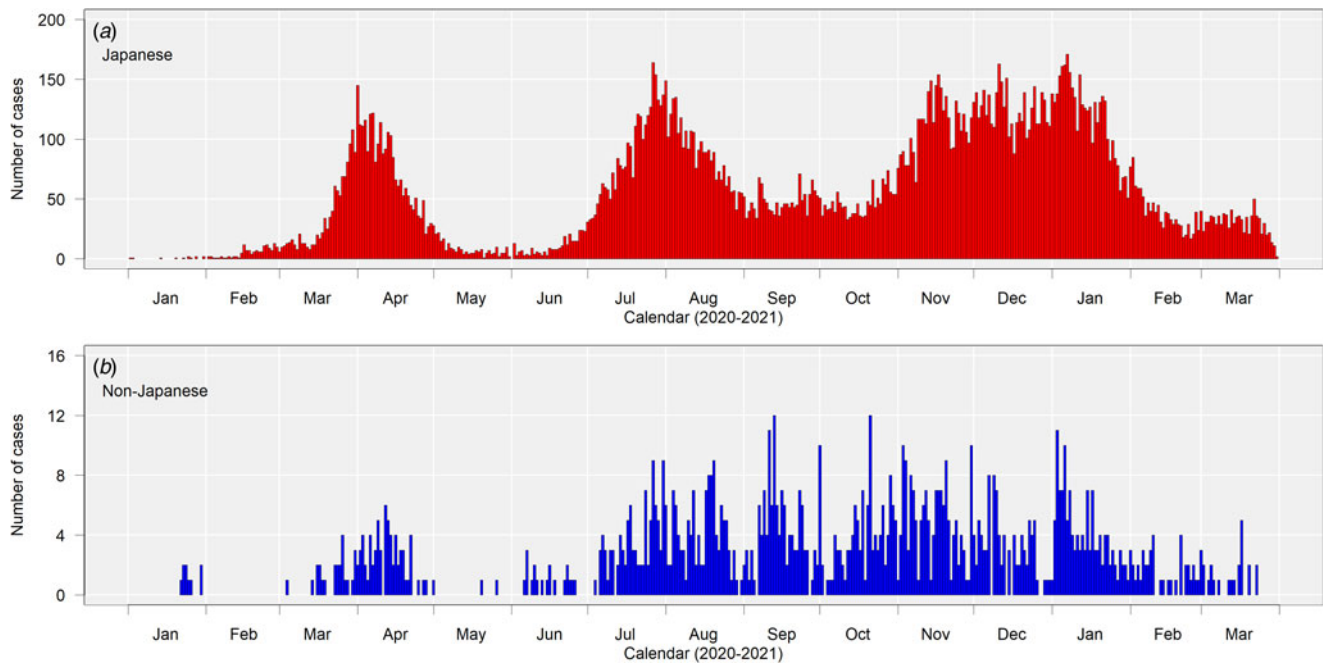
Fig. 1. COVID-19 epidemic curves of (a) Japanese and (b) non-Japanese patients in Japan from January 2020 to March 2021. The epidemic curve for Japanese patients shows three waves, corresponding to the first wave in April, the second wave in August and the third wave in December of COVID-19 in Japan. Abbreviations: COVID-19, coronavirus disease 2019

Asian patients occurred in September and November, respectively. No obvious peaks were observed in the other groups, which had a smaller number of cases.

Discussion

Our study revealed the differences in the clinical epidemiological characteristics of Japanese and racial and ethnic minorities during the COVID-19 pandemic in Japan, along with their epidemic curves. There have been reports on the impact of COVID-19 on racial and ethnic minorities in multiethnic Western countries. The majority of these were from the United States, although several are from European countries [12–14]. However, research on the impact of COVID-19 on racial and ethnic minorities in more racially homogeneous Asian countries is scarce [15, 16]. To the best of our knowledge, our study is the first to focus on the impact of racial and ethnic minorities using large multicentre cohort data under the COVID-19 pandemic in Japan.

According to the Immigration Services Agency of Japan, the main nationalities of foreign residents in Japan are East Asia (China, Korea, etc.) and Southeast Asia (Vietnam, Philippines, Nepal, Indonesia, Thailand etc.) [6]. Among Latin American countries, most of the patients were of Brazilian origin. This is likely because Brazilian labourers have migrated to Japan as migrant workers [17]. The nationalities of COVID-19 patients in our study likely reflect the composition of racial and ethnic minorities living in Japan.

Our results showed that Japanese and non-Japanese patients had different potential exposures to COVID-19. In our study, Japanese patients were likely to have contact history with COVID-19 patients in medical and/or long-term care facilities and be present in medical institutions where COVID-19 patients were managed, while non-Japanese patients had more opportunities to have meals in groups and tended to stay in crowded spaces.

Several social determinants of health affect the risk of exposure to COVID-19 among racial and ethnic minorities [18]. These factors include surroundings, housing, occupation, economic status and education. Crowded living environments are not conducive for infection control measures such as the isolation of patients. Low-income residents who are racial and ethnic minorities may share a single dwelling, or it may be common for family members of multiple generations to live in one residence. Disproportionate unemployment during the pandemic also increases the risk of eviction or house sharing among racial and ethnic minorities [19].

In our cohort, the Japanese participants were older than the non-Japanese individuals. Japan is a super-aging society with a high recorded average life expectancy in 2020: 87.7 years for females and 81.5 years for males [20]. Before COVID-19 vaccinations were prioritised for the elderly in Japan from April 2021, there were high rates of infection among the elderly and many cluster infections in long-term care facilities [21]. The high rate of exposure in healthcare facilities among Japanese individuals in our study may reflect the situation of elderly residents exposed to COVID-19 in long-term care facilities.

Regarding occupations, non-Japanese patients tended to work in restaurants or the service industry. Previous studies in other countries showed that racial and ethnic minorities were more likely to be engaged in essential work settings with a high risk of contracting COVID-19 [22, 23]. In 2020, in Japan, approximately one-third of foreign workers were engaged in workplaces such as the accommodation and food services industry or in the wholesale and retail industry [24]. In addition, the number of foreign workers in these industries has increased in recent years [25], meaning they may be more exposed to COVID-19 in their work settings. On the other hand, non-Japanese patients did not tend to work in healthcare facilities. People who worked in healthcare facilities have more opportunities to be exposed to COVID-19, and these facilities are one of the essential work environments
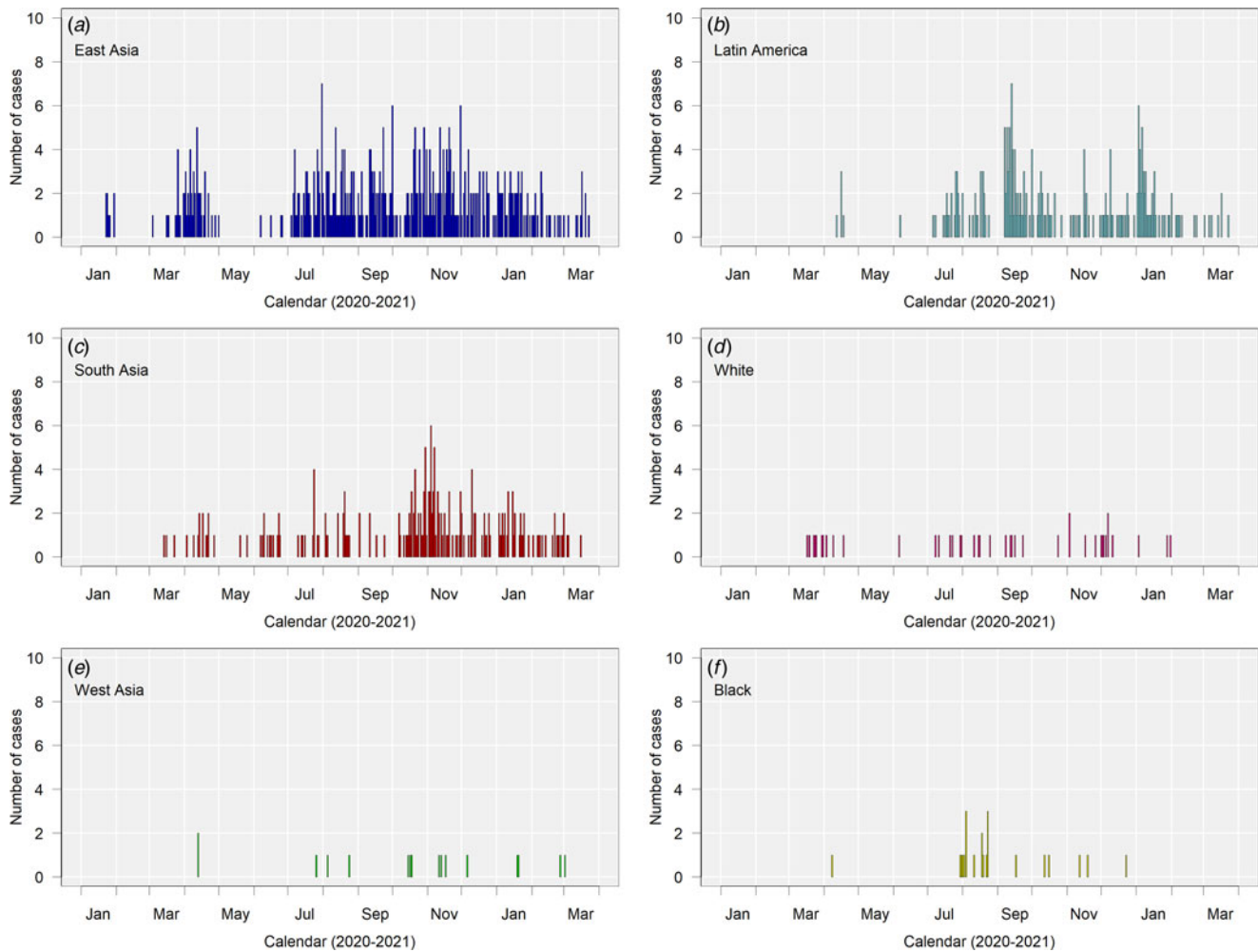
Fig. 2. COVID-19 epidemic curves by racial and ethnic minorities in Japan from January 2020 to March 2021. Each figure shows the epidemic curve of (a) East Asians, (b) Latin Americans, (c) South Asians, (d) Whites, (e) West Asians and (f) Blacks, respectively.

where racial and ethnic minorities are disproportionately represented in other countries [26]. In Japan, however, there are insufficient foreign labourers in the healthcare sector, despite promotion from the employment of health and welfare occupations under the Economic Partnership Agreement [27]. Accordingly, the racial composition of workers in healthcare facilities may have contributed to the results of our study.

Advanced age, obesity and some comorbidities associated with them can cause worse COVID-19 outcomes [28]. Therefore, we compared the two groups after adjusting for factors affecting their clinical course. Consequently, after adjusting for age, obesity and comorbidities associated with severe COVID-19, we found no clear racial disparities in the clinical indicators between Japanese and non-Japanese patients, except symptoms at onset. Additionally, our study did not identify any clear delays in admission to hospitals among racial and ethnic minorities. Studies have suggested that COVID-19 disproportionately affects the prognoses of racial and ethnic minorities. Systematic reviews and meta-analyses have suggested that these populations have a higher risk of severe disease and mortality rates in the United States [13, 14]. The high prevalence of risk factors such as hypertension, diabetes, obesity and cardiovascular disease can partially explain their poor prognoses. In addition, these health disparities may be magnified by inequities in the social determinants of health

among people of different racial backgrounds [29]. A study in the early stages of the pandemic suggested that Pacific Islander, Black or African American and Asian patients were more likely to require hospitalisation or intensive care than Caucasians, even after adjusting for known COVID-19 risk factors [30]. Multiple social determinants of health, such as resource disparities, health literacy issues and language ability affecting access to health care should be taken into account when evaluating the disproportionate effect of COVID-19.

In the post-matching analysis, the proportion of symptomatic non-Japanese patients was slightly lower than that of symptomatic Japanese patients. The reasons why each patient was tested for COVID-19 could not be determined. However, contact tracing had been strictly implemented in the early stage of COVID-19 pandemic in Japan. Therefore, if more cluster investigation for asymptomatic non-Japanese patients with close contact with other confirmed cases were performed, it may have led to the raised proportion of asymptomatic patients among non-Japanese.

Being a racial and ethnic minority could be associated with a lower socioeconomic status and may be a barrier to appropriate access to healthcare, leading to a delay in accessing COVID-19 treatment. The Japanese government has adopted a public expense system that covers the cost of COVID-19 testing for symptomatic patients and inpatient care. This system has allowed

for hospitalisation cost of uninsured patients to be covered by public expenses, as long as public health centres deemed their hospitalisation as patients with COVID-19 necessary. This means that there was less critical difference in financial burden between insured and uninsured patients in terms of co-payment for hospitalisation due to COVID-19. On the other hand, since consultation costs other than COVID-19 testing would be higher for uninsured outpatients, there may have been a difference in terms of access to the first test in outpatient clinics. Nevertheless, such a healthcare system in Japan during the pandemic might help reduce the disadvantages of racial and ethnic minorities who are potentially vulnerable to COVID-19. Conversely, the racial and ethnic minorities in our cohort were relatively young and less likely to be affected by severe COVID-19, i.e., their outcomes during hospitalisation might be underestimated. In addition, the uninsured may be hesitant to seek medical care because of concerns about expenses other than those related to COVID-19. Medical information may not fully reach them because of linguistic issues if racial and ethnic minorities only use their local languages. Our study did not adequately evaluate such inadequate health communication and healthcare systems for racial and ethnic minorities. Further research is needed on issues related to the social determinants of health and appropriate health communication methods for racial and ethnic minorities in Japan.

According to the epidemic curve, the total number of infected racial and ethnic minorities was relatively small, and this cohort's trend did not reflect the overall epidemic. On the other hand, race-specific epidemic curves showed periods of sporadic increases in the number of infections in racial and ethnic minorities. This may reflect the impact of cluster infections on specific foreign communities [31]. Young foreign residents sometimes share the same apartment with their colleagues to save on rent. These residential settings can become a site for contagious disease outbreaks in specific foreign communities [32]. On the other hand, some racial and ethnic minorities may value physical intimacy with family and countrymen. We should avoid situations in which an inadequate understanding of other people's lifestyles and cultures leads to condescension or xenophobia. Further investigations are required to provide clues for effective countermeasures against the spread of infection in foreigner communities.

This study has some limitations. First, because our study included only inpatients, it might not adequately reflect the situation of younger racial and ethnic minorities, many of whom may have only had mild illnesses and stayed at home without hospitalisation. We could not evaluate or access their diagnostic tests or the state of medical support outside of hospitalisation. Next, we were unable to distinguish between foreign residents and travellers. However, during the data collection period, travel from COVID-19 endemic countries was severely restricted, except for specific purposes. Only a small number of patients had a recent history of travel. Therefore, we estimated that the majority of foreigners in our cohort were long-term residents. Third, we might not have analysed the real state of racial and ethnic minorities with a small number of patients because such cases could not reflect the overall situation. In addition, many racial and ethnic minorities may have been constituted of young populations who required less hospitalisation. Therefore, the situation of outpatients of racial and ethnic minorities may be different from our result. Fourth, the data collection period was prior to the beginning of vaccinations for COVID-19. Furthermore, the first three waves of COVID-19 in Japan were mainly caused by conventional COVID-19 strains, because variants of concern (VOCs) have become major strains since the fourth wave [33]. Therefore, our study does not necessarily reflect the current situation where vaccines are widely available and VOCs are prevalent. Finally, categorisation of racial and ethnic minorities in this paper has been based on categories listed in CRFs of the registry. These CRFs did not collect data on specific race or country origins. Consequently, we could not collect detailed information about their race or ethnicity. This might have led to a potential risk of misclassification of racial and ethnic minorities included in this study.

To conclude, hospitalised non-Japanese patients had a lower risk of severe disease but were more exposed to crowded environments and tended to work in restaurants and the service industry in nightlife businesses. We found no clear disparities in clinical courses after adjusting for severe COVID-19 factors between Japanese and non-Japanese patients. The healthcare system in Japan may provide them with equal opportunities to access inpatient care with Japanese. Future research should focus on the issues of social determinants of health and appropriate health communication methods for racial and ethnic minorities in Japan.

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