Geographic correlation between the number of COVID-19 cases and the number of overseas travelers in Japan, January-February 2020

Keita Wagatsuma[1] , Wint Wint Phyu[1] , Hidekazu Osada[1,2], Julian W. Tang[3,4], Reiko Saito[1]

[1]Division of International Health, Graduate School of Medical and Dental Sciences, Niigata University, Niigata, Japan [2]Infectious Diseases Research Center (IDRC) of Niigata University in Myanmar, Graduate School of Medical and Dental Sciences, Niigata University, Niigata, Japan [3]Clinical Microbiology, University Hospitals of Leicester NHS Trust, Leicester, UK [4]Respiratory Sciences, University of Leicester, Leicester, UK
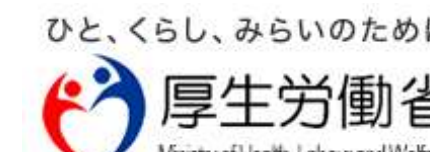
Background

◆ An outbreak of a novel coronavirus disease 2019 (COVID-19) in Wuhan, China, in December 2019 has spread globally. (Li Q et al, NEJM, 2020)

◆ In Japan, the first imported case was reported on January 16, and the geographical distribution in initial one month was not uniform and was largely concentrated in several prefectures.

Aim

To evaluate the geographic association between the number of overseas travelers, especially from mainland China, and the number of COVID-19 cases in 47 prefectures during the first month after the outbreak started in Japan.

Materials & Methods

● Data:

1. **COVID-19 case data in Japan**
Epidemiological information on 69 COVID-19 cases reported from the Ministry of Health, Labour and Welfare (MHLW) from January 16 and through February 21, 2020 was collected.

2. **Overseas travelers data** JNTO
The total number of travelers and the number of Chinese travelers, extracted from the Japan National Tourism Organization (JNTO) from January to November 2019.

3. **Genome sequence data of COVID-19** GISAID
- Full length sequences of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) sequence registered in Global Initiative on Sharing All Influenza Data (GISAID) were used.
- Japan (27): January 20, 2020 - March 12, 2020
- China (15): December 1, 2019 - March 31, 2020
- Italy, France, Brazil, Canada, US (1 at a time): December 1, 2019 - March 31, 2020

● Analysis

1. **Epidemic curve**
Epidemic curves by exposure history was created.

2. **Visualization with GIS**
A geographic information system (GIS) was used to determine the geographic and spatial distribution of COVID-19 cases and travelers.

3. **Correlation analysis**
The correlation between the number of COVID-19 cases at prefectural level and the number of overseas travelers was calculated using Spearman's rank test.

4. **Phylogenetic tree analysis**
A phylogenetic analysis by maximum likelihood estimation was performed to examine the lineages of COVID-19.

Results
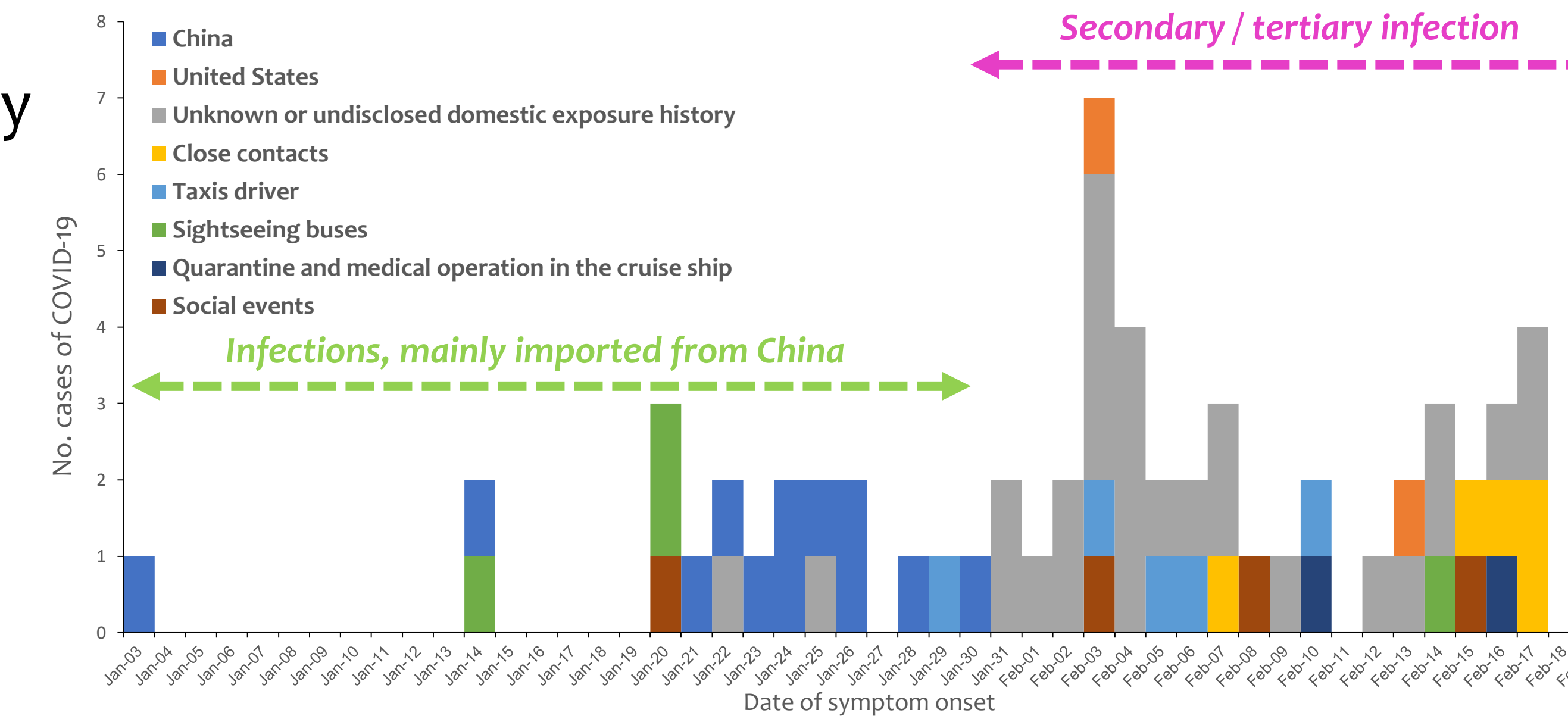
Fig.1 Epidemic curve by exposure history (N=61)

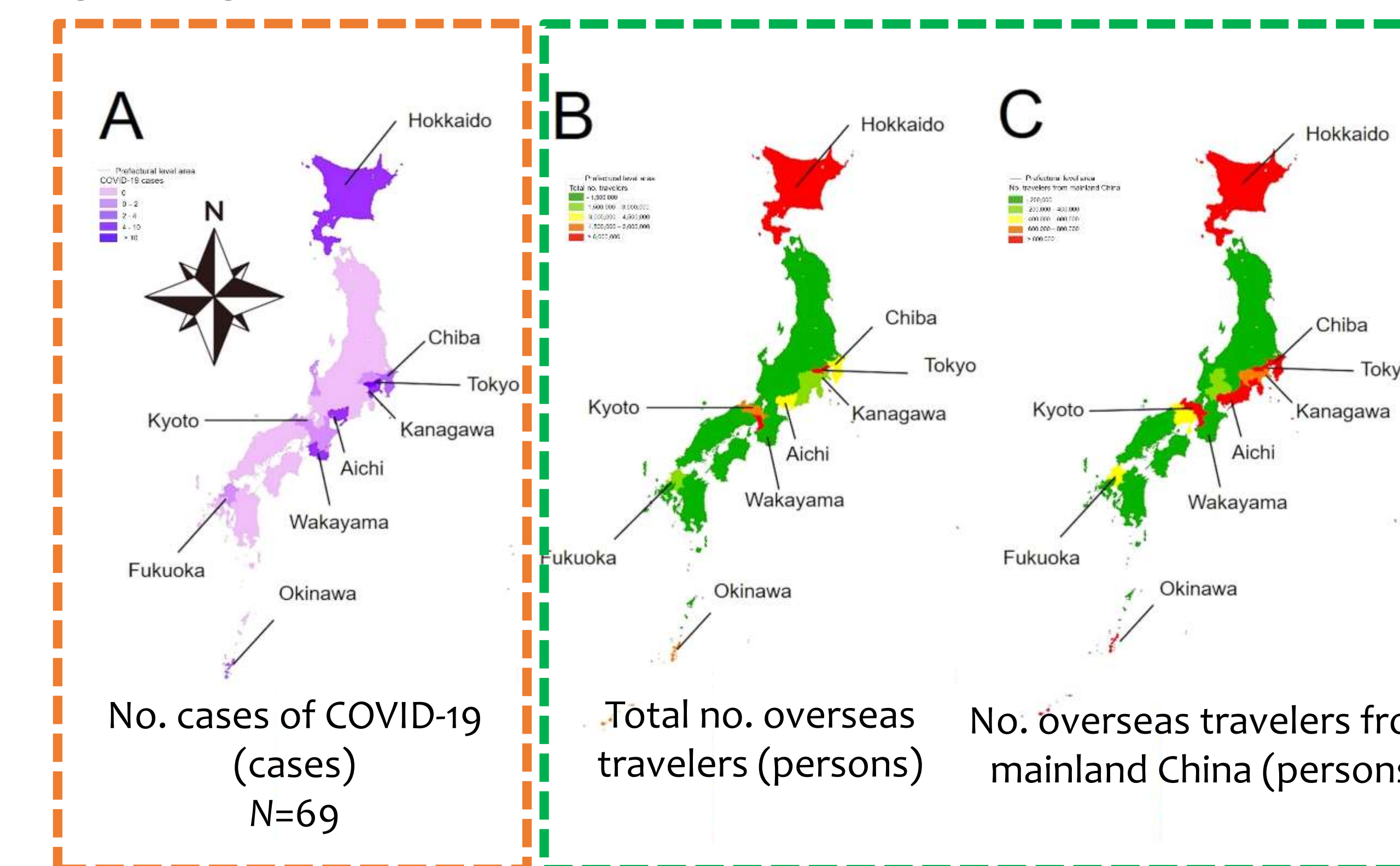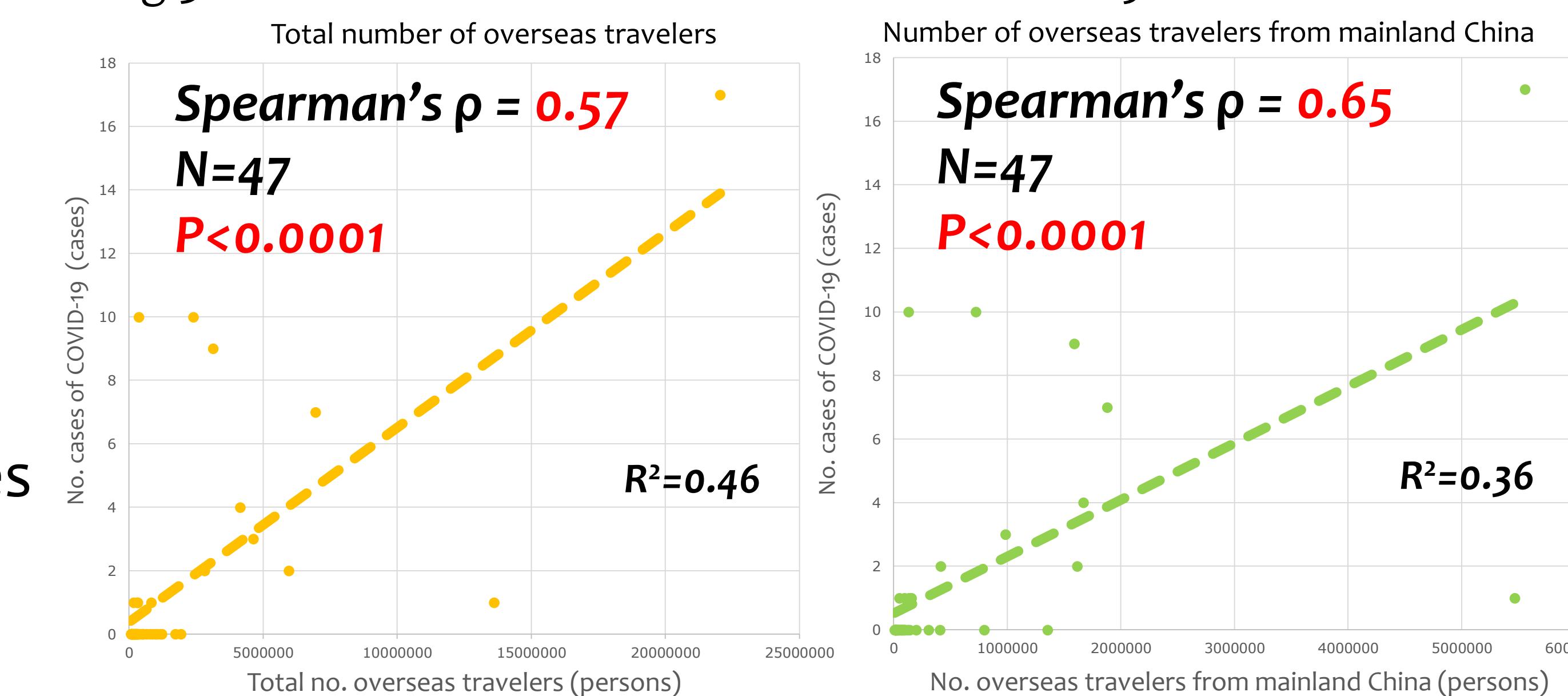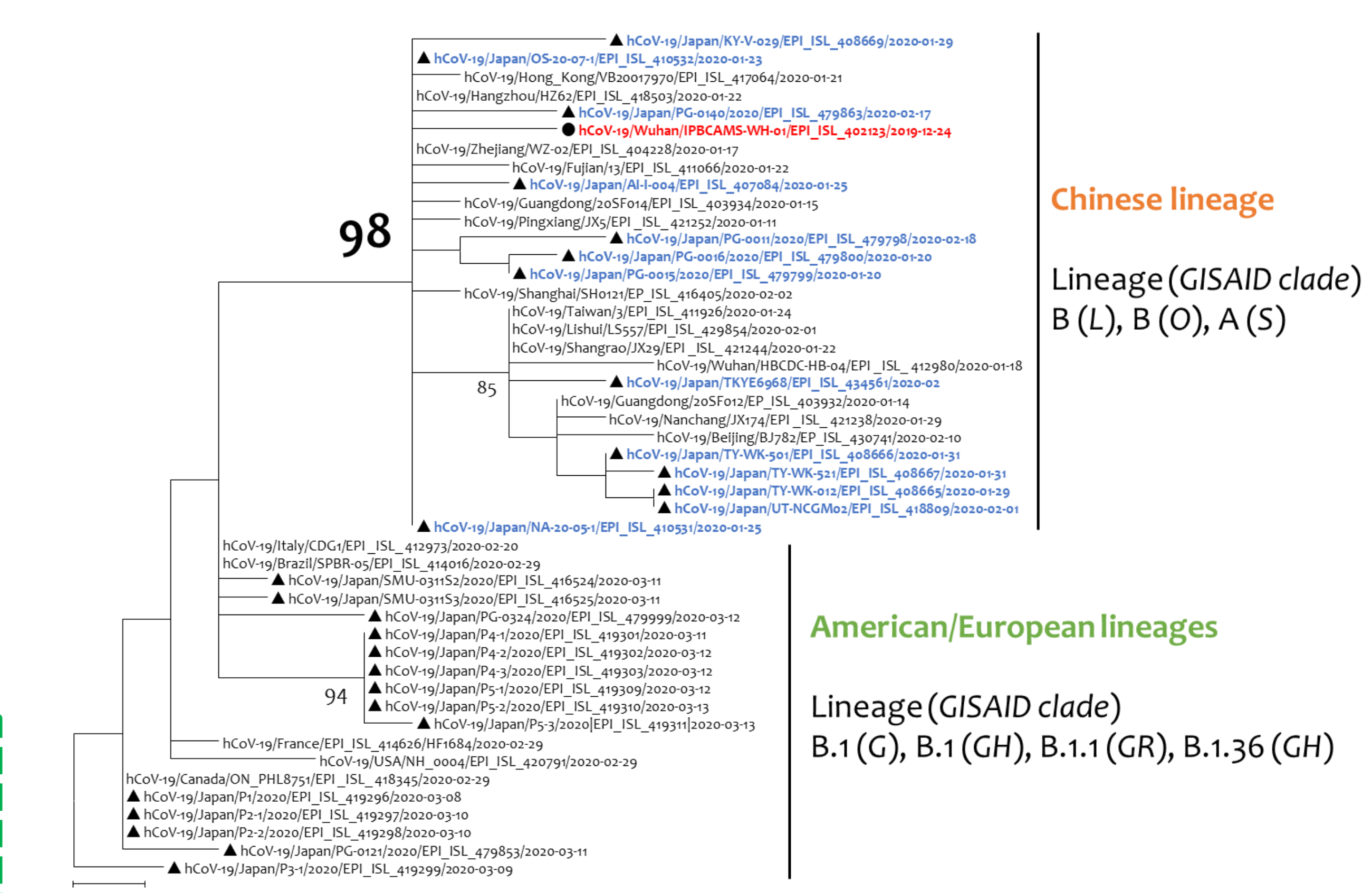Fig.2 Geographic distribution of COVID-19 cases and traveler numbers

A No. cases of COVID-19 (cases) N=69

B Total no. overseas travelers (persons)

C No. overseas travelers from mainland China (persons)

Fig.3 Correlation between the number of COVID-19 Cases and travelers

Total number of overseas travelers — Spearman's ρ = 0.57, N=47, P<0.0001, $R^2=0.46$

Number of overseas travelers from mainland China — Spearman's ρ = 0.65, N=47, P<0.0001, $R^2=0.36$

Results

Fig. 4 Phylogenetic tree analysis of COVID-19 in January-March 2020

Chinese lineage — Lineage (GISAID clade) B (L), B (O), A (S)

American/European lineages — Lineage (GISAID clade) B.1 (G), B.1 (GH), B.1.1 (GR), B.1.36 (GH)

Discussion

✓ Only 14 were infected overseas, accounting for 20.3%, while the remaining 55 (79.7%) were estimated to be infected domestically.

✓ The number of COVID-19 cases and the total number of overseas travelers and the number of Chinese travelers had strong positive correlations.

✓ The SARS-CoV-2 strains detected in Japan during January and February were classified as Chinese lineages.

✓ The initial border screening in Japan was not sufficiently effective, suggesting that secondary transmissions in the community may have occurred.

Acknowledgement