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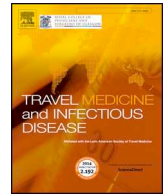
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# Travel Medicine and Infectious Disease

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## Mapping the incidence of the COVID-19 hotspot in Iran – Implications for Travellers

Dear Editor

After the first two months of the epidemics of Coronavirus Disease 2019 (COVID-19) in the world [1,2], caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), multiple epidemiological assessments in countries from Asia, Pacific, Europe, and North America have been published [3,4]. Nevertheless, there are countries, with a rapid increase and a high number of cases, with a lack of studies. This is the case of Iran in the Middle East. For these reasons, we have developed epidemiological maps of cases but also of incidence rates using official populations, by provinces, for COVID-19 in Iran using geographical information systems (GIS).

Surveillance cases data from February 19 to March 9, 2020, officially reported by the Iranian health authorities were used to estimate the cumulated incidence rates using reference population data on SARS-CoV-2 confirmed infections (cases/100,000 pop) and to develop the maps by provinces, using the GIS software Kosmo® 3.1.

During the first 20 days of epidemics, 7161 cases of COVID-19 were reported in the country, for a cumulated rate of 8.9 cases/100,000 population, reaching up to 1234 cases during March 6, 2020 (Fig. 1). All the provinces have been affected, and rates ranged from 0.8 (Boushehr) to 61.8 cases/100,000 population (Qom) (Fig. 1). At Qom, the first two cases were reported. COVID-19 arrived at Iran from China. The highest number of cases have been reported in Tehran, 1945 (Fig. 1), followed by Qom, 712, and by Mazandaran, with 633. Qom is the border with Markazi and Semnan, provinces with rates from 27.2 to 34.9 cases/100,000 population. From the GIS-based maps, it is clear that spreading in the country is occurring from north-central provinces such as Tehran and Qom. Till March 9, 2020, there have been 237 deaths (3.31%, case fatality rate). While the number of cases seems to decrease during the last three days, this is not occurring with fatalities (Fig. 1).

Iran is the third country with the highest number of reported COVID-19 cases after China, and Italy, up to March 16, 2020 with 14,991 cases, being the first in the Middle East region, and maybe becoming a significant source of imported cases in this area, in countries such as Iraq, Afghanistan, and Pakistan, among others. While the highest number of COVID-19 cases has been reported in the capital city, using GIS and estimating the incidence/attack rates per province, that one is placed as the seventh, having more cases per population at Qom, Semnan, and Markazi, among other provinces (Fig. 1).

A recent study, based on imported cases from Iran, estimated that

18,300 (95% confidence interval: 3770 to 53,470) COVID-19 cases would have had to occur in the country [5], assuming an outbreak duration of 1.5 months. Even if it were considered that all imported cases of Iran were identified in all states with certainty, the “best case” outbreak size was substantial (1820, 95% CI: 380–5320 cases), and far higher than reported case counts in February 2020. All confirmed cases in Saudi Arabia are imported from Iran and one from Iraq and other cases are close contacts to those confirmed cases. Imported cases from Iran have been diagnosed at Kuwait, Bahrain, Iraq, Oman, Qatar, among other Asiatic countries, but also Georgia, Estonia, Belarus, and even New Zealand [6].

The capital city of Khorasan Razavi (3.1 cases/100,000 population), Mashhad, is the second-largest holy city in the world, attracting more than 20 million tourists and pilgrims every year [7,8], many of whom come to pay homage to the Imam Reza shrine (the eighth Shi'ite Imam).

Regardless of this epidemiological scenario, the Iran outbreak of COVID-19 is still beginning and complex. Authorities have limited travel, and schools and universities have closed, as also have occurred in Italy and Spain, until the start of the holiday for Persian new year Nowruz on March 20, 2020, as measures for spreading of this coronavirus [7].

As there are severe limitations in the medical supplies available in the Iranian public health system to deal with the current SARS-CoV-2 outbreak, international support, additionally to be provided from the World Health Organization, is needed in the country to mitigate the impacts of this epidemic, and to avoid additional spreading. For the moment of the proofs correction of this article, Iran reached 14,991 cases, of them 3,774 in Tehran, 1,301 in Esfahan, and 1,023 in Qom (March 16, 2020).

### Credit

AJRM, Conceptualization; Data curation; Formal analysis; Methodology; Software; Writing - original draft; Writing - review & editing. ZAM, Data curation; Formal analysis; Methodology; Writing - review & editing. RS, Writing - review & editing. AAR, Writing - review & editing. KD, Writing - review & editing.

### Declaration of competing interest

We declare that we have no competing interests.

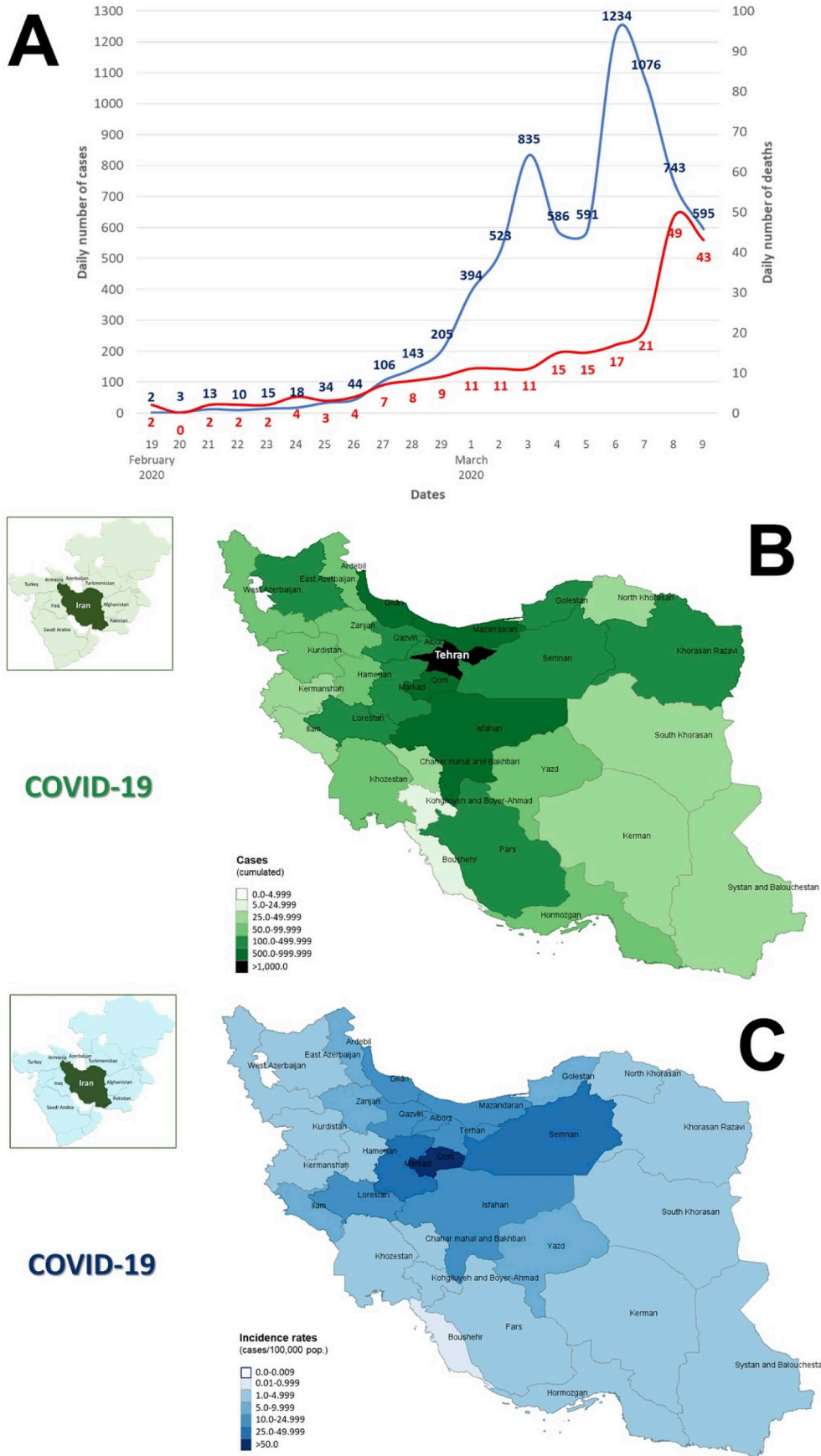


Fig. 1. COVID-19 situation in Iran, February 19 to March 9, 2020. A. Number of cases and deaths. B. Case distribution by provinces. C. Incidence rates, cases/100,000 population by provinces.

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Zahra Arab-Mazar

*Infectious Diseases and Tropical Medicine Research Center, Shahid Beheshti*

*University of Medical Sciences, Tehran, Iran*

Ranjit Sah

*Department of Microbiology, Tribhuvan University Teaching Hospital,  
Institute of Medicine, Kathmandu, Nepal*

Ali A. Rabaan

*Molecular Diagnostic Laboratory, Johns Hopkins Aramco Healthcare,  
Dhahran, Saudi Arabia*

Kuldeep Dhama

*Division of Pathology, ICAR-Indian Veterinary Research Institute, Izatnagar,  
243 122, Bareilly, Uttar Pradesh, India*

Alfonso J. Rodriguez-Morales\*

*Public Health and Infection Research Group, Faculty of Health Sciences,  
Universidad Tecnológica de Pereira, Pereira, Risaralda, Colombia  
Grupo de Investigación Biomedicina, Faculty of Medicine, Fundación  
Universitaria Autónoma de las Américas, Pereira, Risaralda, Colombia  
E-mail address: arodriguez@utp.edu.co*

\* Corresponding author.