

Spatial Analysis of Global Variability in Covid-19 Burden

This article was published in the following Dove Press journal:
Risk Management and Healthcare Policy

Larry E Miller 
Ruemon Bhattacharyya
Anna L Miller

Department of Biostatistics, Miller
Scientific, Johnson City, TN, USA

Background: Since the first occurrence of coronavirus disease 2019 (Covid-19), a number of online tools have become available to assist with tracking Covid-19 prevalence. Yet we are unaware of resources that provide country-specific Covid-19 incidence data.

Methods: We undertook a descriptive analysis of the global impact of Covid-19 using data reported on March 17, 2020. The prevalence of Covid-19 cases, fatalities attributed to Covid-19, and the case fatality rate for each of the 238 countries were accessed from the World Health Organization global Covid-19 tracking site, and we additionally calculated Covid-19 incidence based on country-specific population data. We determined the country-specific point prevalence and incidence of Covid-19 and associated deaths while using geocoded data to display their spatial distribution with geographic heat maps.

Results: The analysis included 193,197 Covid-19 cases and 7859 associated deaths. The point prevalence was highest in China (80,881), Italy (31,506), Iran (16,169), and Spain (11,312); no other country reported more than 10,000 cases. The incidence (per million population) was highest in San Marino (3389) followed by Iceland (645) and Italy (521); no other country had an incidence above 400 per million population.

Conclusion: Countries with a high Covid-19 prevalence may not have a high incidence, and vice versa. Public health agencies that provide real-time infection tracking tools should report country-specific Covid-19 incidence metrics, in addition to prevalence data.

Keywords: coronavirus, Covid-19, incidence, prevalence

Introduction

The first human transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus responsible for coronavirus disease 2019 (Covid-19), was reported to occur in Wuhan, China on November 17, 2019.¹ On March 11, 2020, following identification of 118,000 Covid-19 cases in 114 countries responsible for nearly 4300 deaths, the World Health Organization recognized Covid-19 as a pandemic.² A number of online tools have since become available to assist with tracking Covid-19 prevalence.³ Media reports regarding Covid-19 also tend to focus on infection prevalence. Yet we are unaware of resources that provide country-specific Covid-19 incidence data. This information may help to identify regions with a high Covid-19 infection burden that may otherwise be overlooked with current tracking tools.

Methods

We undertook a descriptive analysis of the global impact of Covid-19 using data reported 4 months after index case detection (March 17, 2020). The prevalence of Covid-19 cases, fatalities attributed to Covid-19, and the case fatality rate for each of the 238 countries

Correspondence: Larry E Miller
Miller Scientific, Johnson City, TN, USA
Tel +1 828-450-1895
Email larry@millerscientific.com

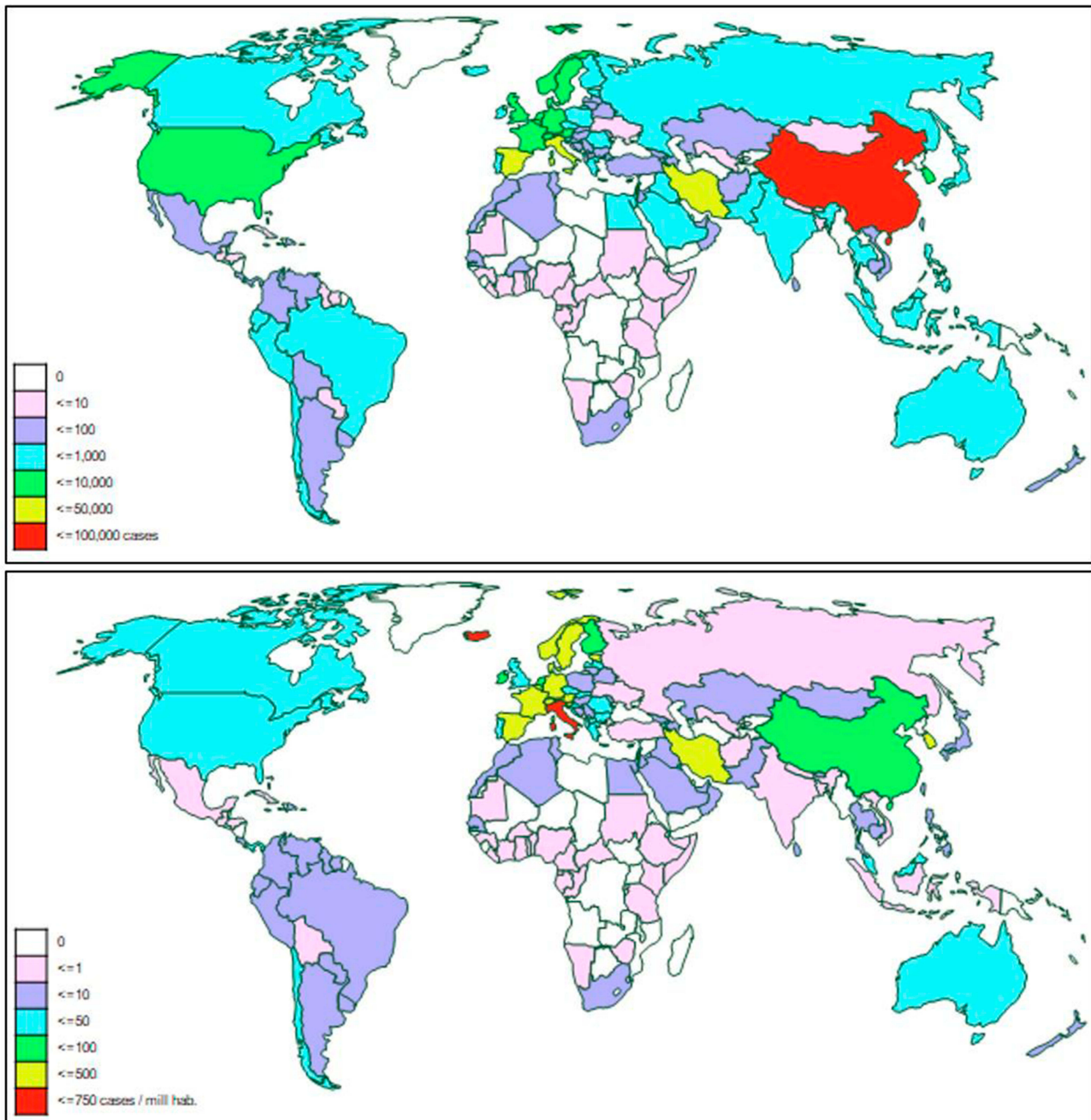


Figure 1 Global Covid-19 point prevalence (top) and incidence per million population (bottom). Data current as of March 17, 2020.

were accessed via the Centers for Disease Control and Prevention website that provides real-time tracking of Covid-19 cases reported by the World Health Organization.⁴ Country-specific population data were obtained from the United Nations Department of Economic and Social Affairs.⁵ We determined the country-specific point prevalence and incidence of Covid-19 and associated deaths. The Covid-19 incidence was calculated as the total number of confirmed Covid-19 cases divided by the population of the country, as

reported per million population. We used country-specific geocodes to transform each country to a location on a world map. We then displayed the worldwide Covid-19 spatial distribution with geographic heat maps, which illustrate country-specific rates by color-coding map areas.

Results

The analysis included 193,197 Covid-19 cases (7859 associated deaths), representing 99.6% of global confirmed cases

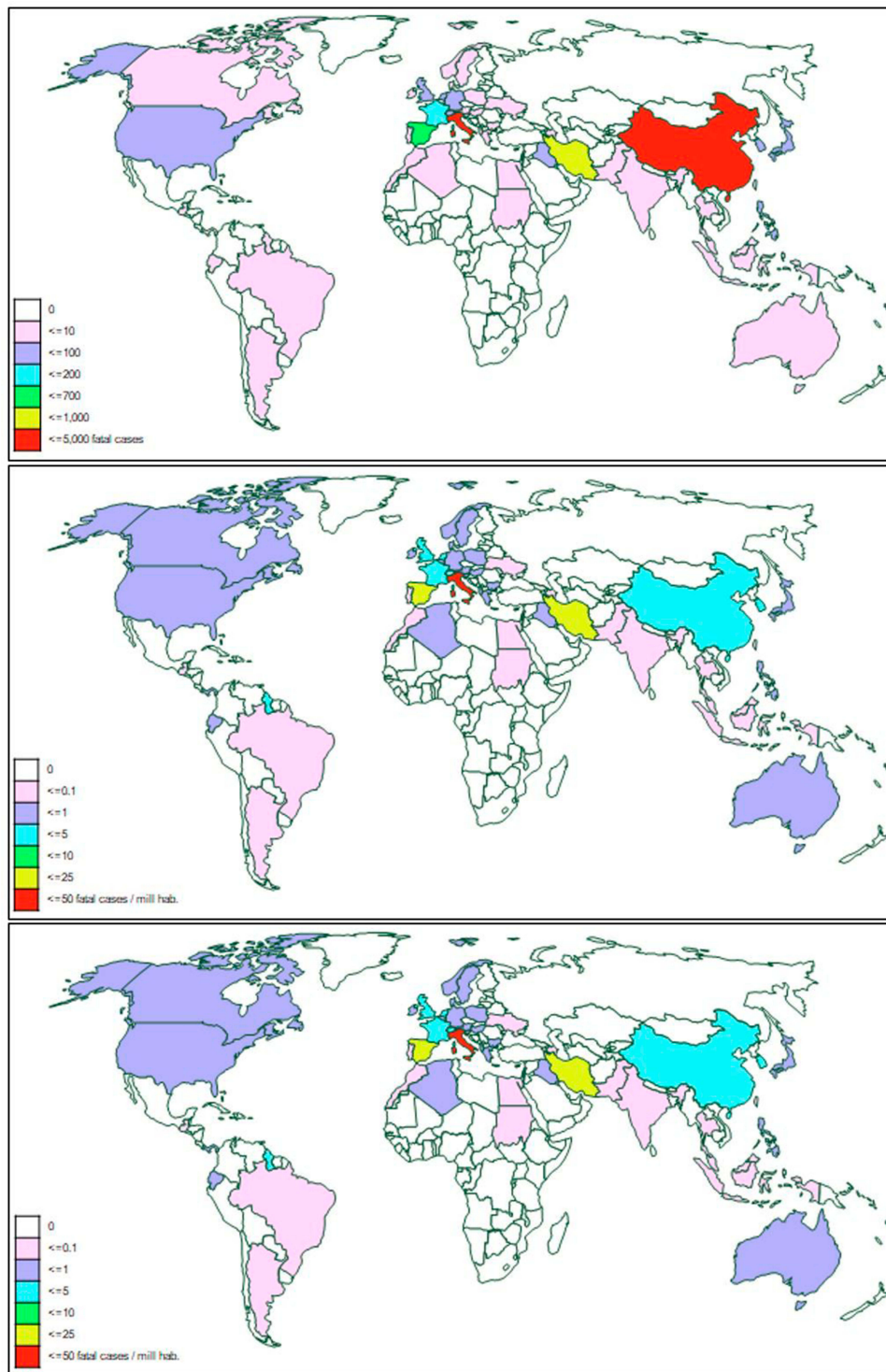


Figure 2 Global Covid-19 fatality point prevalence (top), incidence per million population (middle), and case fatality rate (bottom). Countries with less than 20 confirmed Covid-19 cases were excluded from the case fatality rate analysis due to poor estimate precision. Data current as of March 17, 2020.

(excluding 696 patients [7 deaths] aboard the Diamond Princess cruise ship for whom country of origin was unreported). Covid-19 cases were reported in 145 (60.9%) countries, with 52 (21.8%) countries reporting at least one related

death. The point prevalence was highest in China (80,881), Italy (31,506), Iran (16,169), and Spain (11,312); no other country reported more than 10,000 cases. The incidence (per million population) was highest in San Marino (3389)

followed by Iceland (645) and Italy (521); no other country had an incidence above 400 per million population. Similar results were found for Covid-19 fatalities with the highest point prevalence found in China (3226), Italy (2503), and Iran (988) and the highest incidence in San Marino (265), Italy (41), and Iran (12). The highest case fatality rates were reported in Algeria (8.3%), Italy (7.9%), and San Marino (7.8%). The spatial distribution of Covid-19 prevalence/incidence is provided in Figure 1 and the distribution of Covid-19 death prevalence/incidence and the case fatality rate is provided in Figure 2.

Discussion and Conclusion

This report provides, for the first time, a comparison of the spatial distribution of Covid-19 point prevalence and incidence. A key observation from this analysis was that European countries such as San Marino and Iceland were among those with the greatest Covid-19 burden. While the Covid-19 disease outbreak in Italy has been highlighted in peer-reviewed reports,^{6,7} the disproportionate burden of Covid-19 in this region may be easily overlooked with current tracking tools that provide only prevalence data. Our report is limited by data derived from confirmed Covid-19 cases as of March 17, 2020, yet the number of global cases continues to increase. Further, the reason for the disproportionate Covid-19 burden in countries like San Marino is unclear but certainly influenced by unmeasured factors such as population age, adherence to social distancing, surveillance capacity, access to healthcare resources, and the unknown prevalence of undocumented cases. Yet, the purpose of this report is not to provide real-time Covid-19 prevalence and incidence data nor to explain the discrepancies in these rates among countries. The key message of this report is that public health agencies that provide real-time infection tracking tools should report country-specific Covid-19 incidence metrics, in addition

to prevalence data. Such data may raise awareness of the high Covid-19 infection burden reported in less populated countries, inform and influence public health policy, and facilitate allocation of economic, social, and health resources to the most impacted regions.

Additional Contributions

The authors thank César Carvajal (Kannon & Saga Solutions, Maracaibo, Venezuela) for graphical assistance.

Funding

No funding was provided for this study.

Disclosure

The authors report no conflicts of interest.

References

1. South China Morning Post. Coronavirus: china's first confirmed Covid-19 case traced back to November 17; 2020. Available from: <https://www.scmp.com/news/china/society/article/3074991/coronavirus-chinas-first-confirmed-covid-19-case-traced-back>. Accessed March 19, 2020.
2. World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19-11 March 2020; 2020. Available from: <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-11-march-2020>. Accessed March 19, 2020.
3. Center for Infectious Disease Research and Policy. COVID-19 maps & visuals; 2020. Available from: <http://www.cidrap.umn.edu/covid-19/maps-visuals>. Accessed March 19, 2020.
4. Centers for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19): global map; 2020. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/world-map.html>. Accessed March 17, 2020.
5. United Nations Department of Economic and Social Affairs. World population prospects: the 2019 revision; 2020. Available from: <https://www.worldometers.info/world-population/population-by-country/>. Accessed March 17, 2020.
6. Abenavoli L, Cinaglia P, Luzzza F, et al. Epidemiology of coronavirus disease outbreak: the Italian trends. *Rev Recent Clin Trials*. 2020;15. doi:10.2174/1574887115999200407143449
7. Livingston E, Bucher K. Coronavirus disease 2019 (COVID-19) in Italy. *JAMA*. 2020;323(14):1335. doi:10.1001/jama.2020.4344

Risk Management and Healthcare Policy

Publish your work in this journal

Risk Management and Healthcare Policy is an international, peer-reviewed, open access journal focusing on all aspects of public health, policy, and preventative measures to promote good health and improve morbidity and mortality in the population. The journal welcomes submitted papers covering original research, basic science, clinical & epidemiological studies, reviews and evaluations,

guidelines, expert opinion and commentary, case reports and extended reports. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/risk-management-and-healthcare-policy-journal>

Dovepress