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Public Health

Letter to the Editor

Per capita death and infection rates should be avoided in international comparisons

In the search for the best strategy to control the novel coronavirus and stop vulnerable people from dying, politicians, influential news media and even scientists have used *per capita* rates of infection and death (usually reported in per million inhabitants) as a supposed correction for population size in comparisons between countries. These *per capita* infection and death rates have been commonly reported as indicators of the relative severity of the disease, with high rates indicating high severity. However, these numbers should be avoided in international comparisons.

The *per capita* death rate δ is calculated as the total number of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) deaths divided by the total population size. For example, if country X has 10 million inhabitants and the current death toll is 10 000, its *per capita* death rate is δ = 1000 deaths/1M (per million inhabitants). Similarly, if country Y has 100 million inhabitants and its death toll is also 10 000, its *per capita* death rate is δ = 100 deaths/1M. Clearly, both countries are experiencing exactly the same epidemiological process, so why should the epidemiological conditions be considered more severe in country X than in country Y? Well, the answer is, they shouldn't! Transmission and death are events that occur locally, generating clusters of infected and dead individuals. This heterogeneity in the distribution of cases can considerably bias the *per capita* rates in international comparisons because *per capita* rates dissolve the number of cases into the total population, whose size is arbitrary.

Assuming the *per capita* death rate is an effective indicator of the relative severity of SARS-CoV-2 can lead to bizarre conclusions. For example, at the time of writing, the epidemiological conditions of SARS-CoV-2 in Brazil were better than those in France or Italy because δ in Brazil was considerably lower than that in those countries (Fig. 1). Brazil would even need about 90 000 additional deaths for epidemiological conditions to be considered more severe than in the United Kingdom, whose death toll is 40 883 (Fig. 1). That is simply ridiculous! Furthermore, San Marino (not shown in the figure) has the highest SARS-CoV-2 *per capita* death rate in the world (δ = 1238 deaths/1M), corresponding to 42 deaths in total, while in the United States more than 100 000 people have already died and yet the *per capita* death rate (δ = 344 deaths/1M) remains significantly lower than that in San Marino. These bizarre and unreasonable conclusions clearly show why the *per capita* rates of death and infection should be avoided in international comparisons.

For the *per capita* death rate to be a valid indicator in comparisons between countries, the following numbers must have a spatial distribution that is homogeneously proportional to local population density: (i) number of infected individuals, (ii) quality of healthcare service and (iii) number of deaths caused by the disease. These homogeneity and proportionality assumptions are implicit in international comparisons. However, because these assumptions are clearly unrealistic, the conclusions resulting from such comparisons are not reliable. Although *per capita* rates are useful in many situations, they should not be used as relative severity indicators of communicable infectious diseases.

Governments should be judged by their ability to minimize local transmission and deaths, not by the effect of an arbitrary population size on *per capita* death and infection rates. Therefore, we need to stop using *per capita* rates as indicators of the relative severity of infectious diseases. When searching for the best strategy to control an infectious disease, the arbitrary population size (and political delimitations) should not be used as a determining factor. We must find the strategy that results in the least number of
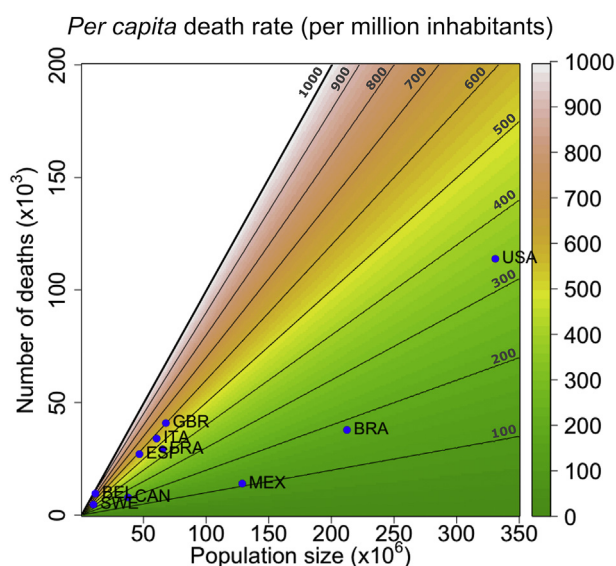

Fig. 1. Relationship between per capita death rate (per million inhabitants) of SARS-CoV-2, total number of deaths and population size. Data reported for Belgium (BEL), Brazil (BRA), Canada (CAN), Spain (ESP), France (FRA), Italy (ITA), Mexico (MEX), United Kingdom (GBR) and United States (USA) on June 10, 2020.

deaths, and to minimize the number of deaths, governments need to implement strategies based on national age distribution, household structure, public health conditions (e.g., sanitation and access to clean water), contact rates and social equality. Governments must adopt strategies that reflect those factors, rather than adopt whatever was implemented in countries with low *per capita* rates of infection and death.

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