**Methods**

**Study design**

We designed a prospective cohort study of geopolitical areas with documented outbreaks of COVID-19 to determine the factors associated with the total deaths of this pandemic. Data, including daily new cases, daily new deaths, total deaths, and total cases, were collected from the WHO daily COVID-19 situation reports of 208 countries as of January 01 to May 31, 2020, for this analysis1.

**Outcome variable**

In this study, total deaths of COVID-19 per million were taken as an outcome variable. COVID-19 death is defined for surveillance purposes as a death resulting from a clinically compatible illness in a probable or confirmed COVID-19 case unless there is a clear alternative cause of death that cannot be related to COVID-19 disease (e.g. trauma). There should be no period of complete recovery between the illness and death2.

**Predictor variables**

Six variables were included in the model as predictors: total case per million3, population density4, population ages 65 and above of the national population5, Global Health Security Index (GHSI)6, Gross Domestic Product (GDP)7 and worldwide governance indicators (WGI)8.

Population density is midyear population divided by land area in square kilometres and the population ages 65 and above as a percentage of the total population. The population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin4,5. GHSI is the first comprehensive assessment of global health security capabilities to be employed in 195 countries; the 2019 GHSI report scored (out of 100) the country-level capacity for “early detection and reporting for epidemics of potential concern”6. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars7. Governance consists of the traditions and institutions by which authority in a country is exercised. This includes the process by which governments are selected, monitored and replaced; the capacity of the government to effectively formulate and implement sound policies; and the respect of citizens and the state for the institutions that govern economic and social interactions among them8.

**Statistical analysis**

We used negative binomial regression models to investigate the association between the number of total deaths of a country and other explanatory variable. We adopted a negative binomial model instead of a Poisson regression model because the dispersion ratio is larger than one, which indicates, the variances were greater than the means in outcome variables (p<0·001) and suggesting that overdispersion was present in the outcome variables (Table 2). The negative binomial model allows for overdispersion by assuming that the individual error terms come from a particular probability distribution (the γ distribution)9.

For the negative binomial regression analysis, we report incidence rate ratios (IRRs) adjusted for total cases per million, population density (per square kilometre), population ages 65 and above (% of the total population), global health security index, gross domestic product (per million), and worldwide governance indicators, with 95% confidence intervals (Cis). ). All analyses were done using the R (statistical package) and SPSS (IBM SPSS 25).

**Variable selection**

Variables were selected in two stages. In the first stage, we used the variance inflation factor (VIF) value to examine multicollinearity in the dataset with a cut-off value of 10.00. As a rule of thumb, a VIF value for predictors that exceed 10 in a dataset and 5 in a model indicates a problematic amount of collinearity10. In our data, the VIF score for the predictor variable human development index (HDI), social progress index, and social mobility index is very high (VIF >10) and we are not considered these variables in the final model (Table 1). In the second stage, again we used VIF value in a negative binomial regression model with a cut-off value of 5.00 and in this stage, the VIF score for all the predictor variables is less than the cut-off value (Table 3).

**References**

1. Max Roser, Hannah Ritchie, E. O.-O. and J. H. Coronavirus Pandemic (COVID-19) - Statistics and Research - Our World in Data. https://ourworldindata.org/coronavirus (2020).

2. WHO. *Coronavirus disease (COVID-19) Situation in numbers (by WHO Region)*. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200501-covid-19-sitrep.pdf?sfvrsn=742f4a18\_2 (2020).

3. WHO. Daily situation reports. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports (2020).

4. World Data Bank. Population density (people per sq. km of land area). *World Development Indecators* https://data.worldbank.org/indicator/EN.POP.DNST (2018).

5. The World Bank. Population ages 65 and above, total. *World Bank Data* https://data.worldbank.org/indicator/SP.POP.65UP.TO.ZS (2018).

6. Nuclear Threat Initiative (NTI) & Johns Hopkins Center for Health Security (JHU). GHS Index. https://www.ghsindex.org/ (2020).

7. The World Bank. GDP (current US$) | Data. *The World Bank* https://data.worldbank.org/indicator/NY.GDP.MKTP.CD (2018).

8. WGI. WGI 2019 Interactive. *WGI 2019* 1 http://info.worldbank.org/governance/wgi/ (2019).

9. Cameron, A. C. & Trivedi, P. K. *Regression analysis of count data*. (2014).

10. James, G., Witten, D., Hastie, T. & Tibshirani, R. *Springer Texts in Statistics An Introduction to Statistical Learning*. http://www.springer.com/series/417.