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Characteristics of COVID-19 pandemic and public health consequences

On April 20 (10:46 h), 2020, the Johns Hopkins University estimated 2,406,745 million confirmed cases worldwide and 165,273 deaths from Corona virus disease 2019 (COVID-19). The highest numbers of confirmed cases were observed in the United States (759,766), Spain (198,674), Italy (178,972), France (154,098), and Germany (145,742). Official statistics of the epidemic in Germany are reported by the Robert Koch Institute. On April 20, 2020, a cumulative number of 141,672 confirmed cases and 4404 deaths were reported with a case fatality (CF) of 3.1% in Germany (https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Fallzahlen.html; accessed April 20, 2020). The infection rate is substantially underestimated because a significant proportion of COVID-19 patients have not been confirmed by polymerase chain reaction (PCR) since many patients, especially younger ones, have only few symptoms if any, and many patients with symptoms are not tested at all. It has been speculated that the total number of COVID-infected people is about five times higher than the official statistics. This bias must be taken into account when interpreting any COVID-19 statistics.

The median age at COVID-19 diagnosis is 50 years in Germany. Corona infections can present as completely asymptomatic but also with very severe courses requiring intensive care unit (ICU) treatment. Due to the changing availability of corona testing and the changing conditions that must be met in order to test a suspected case of corona in Germany, the evaluation of the development of the daily number of newly confirmed corona infections is complicated. By the 10th calendar week of 2020, 3.1% of 87,863 corona tests were positive. In calendar weeks 11, 12, and 13, these numbers were 5.9% of 127,457, 6.8% of 348,619, and 8.7% of 354,521, respectively [1].

By April 19, 2020, a cumulative number of 6619 treatments in ICUs had been completed according to the registry of the German Interdisciplinary Association for Intensive and Emergency Medicine (DIVI). Of these, 1979 patients (30%) died. A cross-sectional analysis of the number of ICU patients on April 19, 2020, revealed that overall 2889 patients were currently ICU patients with 2113 (73%) undergoing artificial ventilation. It should be noted that the DIVI registry expanded the coverage of ICU cases by connecting more and more ICUs to the registry over time. Given the overall 9508 ICU patients and the total of 139,897 confirmed COVID cases, the proportion of COVID-19 patients requiring ICU treatment is about 6.8% [2].

The CF is most likely overestimated because many nations, including Germany, have limited testing capacity and therefore preferentially more severely symptomatic patients are tested. However, more severely symptomatic patients have a higher CF than less symptomatic patients. If one assumes that this bias is similar across all age groups, the age-dependency of the CF is still interpretable. **Fig. 1a** shows the age dependency of the CF for Italy, Spain, and the United States [3]. Until the age of 60 years, there is barely any CF. However, thereafter, the CF increases greatly by age. As the available data have not been simultaneously stratified by age and comorbidity, it is not yet possible to answer whether it is age per se or comorbidity associated with age that is responsible for this sharp increase in mortality from the age of 60.

A review of 355 COVID-19 deaths in Italy showed that the mean age at diagnosis was 79.5 years (SD: 8.1) and 70% were male. Most patients suffered from comorbidities including ischemic heart disease (30%), diabetes (36%), cancer (20%), atrial fibrillation (25%), dementia (6.8%), and a history of stroke (9.6%). The mean number of pre-existing diseases was 2.7 (SD: 1.6). Only 0.8% had no pre-existing comorbidities, showing that comorbidities most likely play an important role [4]. Data from China show that the CF is highest among people with cardiovascular disease (13.2%), diabetes (9.2%), chronic respiratory disease (8.0%), hypertension (8.4%), and cancer (7.6%). Patients without comorbidities had a CF of 0.9%. However, neither of these percentages were age-standardized, and confounding bias by age is likely to be present [5].

At the beginning of a pandemic with a new pathogen, when there are few reliable data available on the rate of new cases and CF, it is understandable that very strict interventions such as the current nationwide lockdown are necessary. However, as soon as the daily number of newly infected people decreases ("flattening of the curve") as is currently the case in Germany (**Fig. 1b, c**), age-, sex-, comorbidity-, region-, and setting-specific data on the infection rate and CF should help

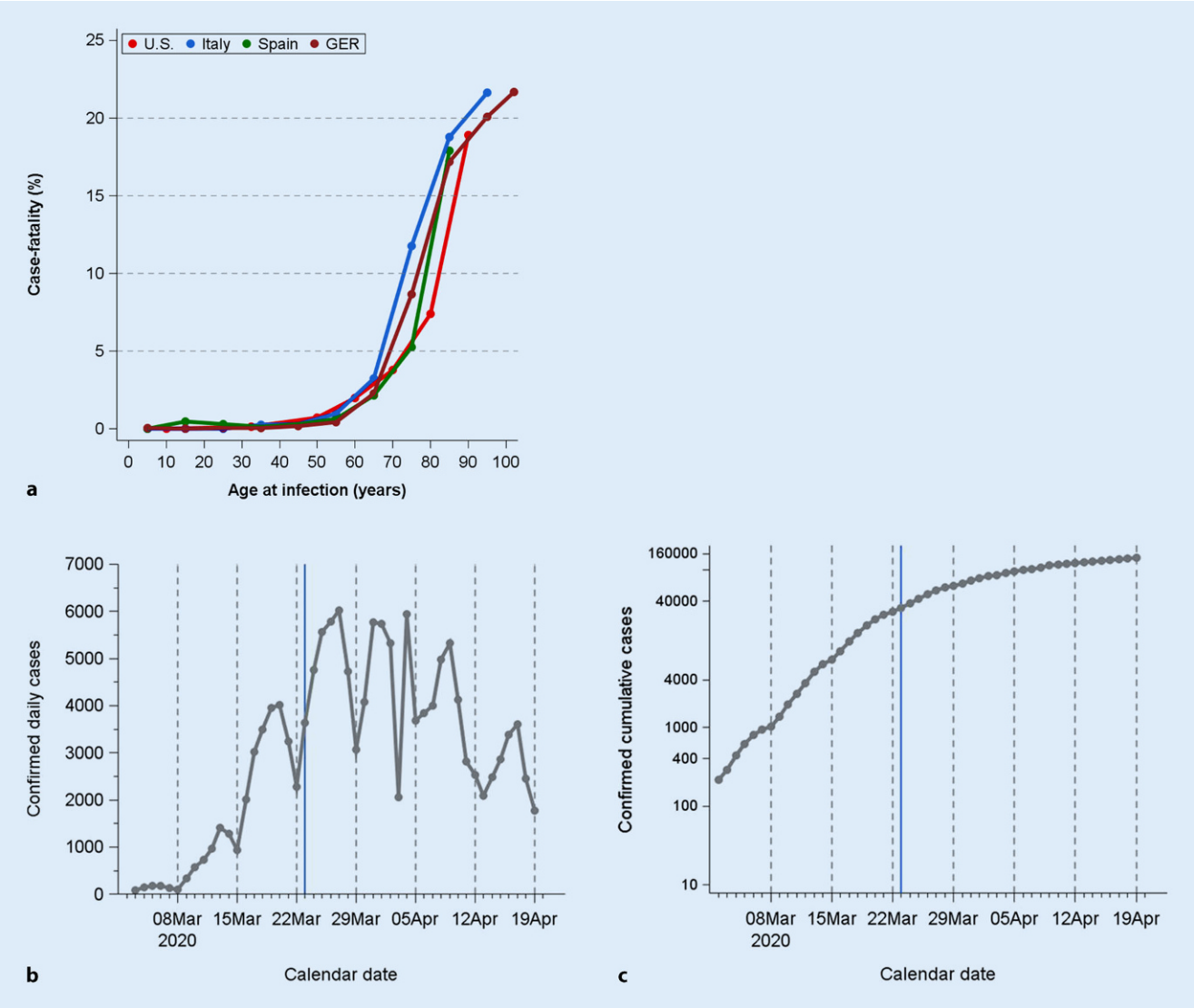

Fig. 1 ▲ **a** Association between age at diagnosis of COVID-19 and case fatality in Italy (up to March 16, 2020), Spain (up to March 22, 2020), the United States (up to March 16, 2020), and Germany (up to April 17, 2020). **b**, **c** Reported daily number of new corona cases and cumulative number of new corona cases until April 20, 2019 in Germany (*vertical dotted lines:* Sundays; *vertical blue line:* start of the lockdown in Germany; the cut-off in the number of new cases reported on Sundays is due to the fact that not all health authorities report new cases to the Robert Koch Institute on Sundays and therefore is an artifact)

to set up targeted, that is, risk-adapted measures to contain the pandemic without severely restricting the entire economy and social life [3].

The risk analysis for civil protection in 2012 by the Federal Ministry of the Interior predicted that statistically a pandemic like the current COVID pandemic occurs once in a period of 100–1000 years. This risk analysis used epidemiologic features that were very similar to the current pandemic, with some exceptions. For example, the CF was assumed to be 10% and each age group had the same infection risk (https://www.bbk.bund.de/SharedDocs/Downloads/BBK/DE/Downloads/Krisenmanagement/BT-Bericht_Risikoanalyse_im_BevSch_2012.pdf?__blob=publicationFile; accessed April 9, 2020).

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