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Short Report

Risk of hospitalization and death for healthcare workers with COVID-19 in nine European countries, January 2020–January 2021

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SUMMARY

This article presents and compares coronavirus disease 2019 attack rates for infection, hospitalization, intensive care unit (ICU) admission and death in healthcare workers (HCWs) and non-HCWs in nine European countries from 31st January 2020 to 13th January 2021. Adjusted attack rate ratios in HCWs (compared with non-HCWs) were 3.0 [95% confidence interval (CI) 2.2–4.0] for infection, 1.8 (95% CI 1.2–2.7) for hospitalization, 1.9 (95% CI 1.1–3.2) for ICU admission and 0.9 (95% CI 0.4–2.0) for death. Among hospitalized cases, the case-fatality ratio was 1.8% in HCWs and 8.2% in non-HCWs. Differences may be due to better/earlier access to treatment, differential underascertainment and the healthy worker effect.

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Introduction

The impact of the ongoing coronavirus disease 2019 (COVID-19) pandemic on healthcare workers (HCWs) has been unprecedented. HCWs are exposed to infected patients, making them among the most affected professional groups [1–3], with nurses being infected most frequently [3]. In a meta-analysis of 97 studies that assessed infection among HCWs, 5% of COVID-19 cases in HCWs had severe complications and 0.5% of HCWs died [4]. Using surveillance data provided by countries in the European Union/European Economic Area (EU/EEA), this study investigated the risk of infection, hospitalization, intensive care unit (ICU) admission and death, and identified possible risk factors for death in hospitalized HCWs and non-HCWs (general population) with COVID-19.

Methods

COVID-19 surveillance in the World Health Organization (WHO) European Region is jointly coordinated by the European Centre for Disease Prevention and Control (ECDC) and the WHO Regional Office for Europe. Using case-based surveillance data reported to the European Surveillance System (TESSy), this study analysed the risk of infection, hospitalization, ICU admission and death among HCWs and non-HCWs using a case-to-case study design, and adjusted incidence rate ratios (IRRs) were calculated. Cases with unknown HCW status were assumed to be non-HCWs. All cases with unknown outcome status were recorded as ‘alive’ to avoid overestimating the number of deaths.

This study included all cases of COVID-19 in individuals aged 20–69 years (working age), reported to TESSy between 31st January 2020 and 13th January 2021 from countries that had: (i) consistent case-based reporting throughout the COVID-19 pandemic; (ii) at least 50% of cases reported as case-based data in TESSy; and (iii) at least 40% internal completeness of HCW status [5]. Crude and adjusted rates for infection, hospitalization, ICU admission and death were estimated by HCW status using negative binomial regression, accounting for country-reporting heterogeneity. The total number of HCWs in 2020 by country, from the latest HCW population statistics from Eurostat [6], were used for denominator values in Table I. The HCW population was subtracted from the 2020 population statistics from Eurostat [7] to calculate the non-HCW population. HCW professional categories included: (i) medical doctors; (ii) nurses and midwives; (iii) dentists; (iv) pharmaceutical personnel; (v) environmental and occupational health and hygiene personnel; (vi) medical and pathology laboratory personnel; (vii) physiotherapy personnel; (viii) traditional and complementary medicine personnel; and (ix) community HCWs.

As HCWs are tested more frequently than non-HCWs (risk of detection bias), IRRs and 95% confidence intervals (CIs) for death were estimated for hospitalized cases alone using negative binomial regression, adjusting for age group (20–29, 30–39, 40–49, 50–59 and 60–69 years), sex, preconditions (asthma, cancer, cardiac disease, diabetes, human immunodeficiency virus, hypertension, kidney disease, liver disease, lung disease excluding asthma, neuromuscular disease, obesity, pregnancy, smoking status, tuberculosis and other/unspecified), and three reporting periods (31st January–31st May 2020, 1st June–30th September 2020, 1st October 2020–13th January 2021).

### Table I

| Reporting period | Total | Hospitalized cases | Deaths | Cases admitted to ICU |
|------------------|-------|-------------------|--------|-----------------------|
| Overall (31st January 2020–13th January 2021) | 2,918,100 | 261,080 | 2,657,020 | 8169 |
| Attack rate (%) | 4.1 | 10.1 | 3.9 | 0.40 |
| 31st January–31st May 2020 | 209,993 | 58,734 | 151,259 | 4557 |
| Attack rate (%) | 0.3 | 2.3 | 0.2 | 0.22 |
| 1st June–30th September 2020 | 1,740,072 | 13,435 | 160,637 | 265 |
| Attack rate (%) | 0.2 | 0.5 | 0.2 | 0.01 |
| 1st October 2020–13th January 2021 | 2,534,035 | 188,911 | 160,637 | 2347 |
| Attack rate (%) | 3.6 | 7.3 | 3.5 | 0.13 |

HCW, healthcare worker; ICU, intensive care unit.

a Nine EU/EEA countries with consistent reporting case-based surveillance data reported to the European Surveillance System for cases aged 20–69 years: Austria, Finland, Ireland, Italy, Luxembourg, Malta, the Netherlands, Norway and Slovakia. Consistent reporting was defined as reporting case-based surveillance data throughout the entire study period (31st January–13th January 2021).

b One country (the Netherlands) was excluded as data on hospitalizations and ICU admissions were incomplete or not reported.

c Non-HCWs include cases with unknown HCW status.
May 2020, 1st June–30th September 2020 and 1st October 2020–13th January 2021). The time variable was included in the model to control for differences in testing, reporting and healthcare capacity during the pandemic. To account for country-reporting heterogeneity, adjusted IRRs were calculated using robust clustered standard errors with reporting country as a cluster effect in the negative binomial regression model. The level of statistical significance was $P < 0.05$, and the analyses were performed using Stata 16 and R 3.6.2.

Results

Nine countries met the inclusion criteria: Austria, Finland, Ireland, Italy, Luxembourg, Malta, the Netherlands, Norway and Slovakia. These countries (total 70 million population aged 20–69 years, 2.6 million HCWs) reported a total of 2.9 million cases from 31st January 2020 to 13th January 2021, corresponding to an overall attack rate of 4.1%. The proportion of HCW cases in the first reporting period (28%) differed greatly from reporting periods later in the pandemic (7.7–7.8%) (Table I). The attack rate in the population aged 20–69 years was 10.1% for HCWs and 3.9% for non-/unknown HCWs (Table I), corresponding to a crude IRR of 2.6 and an adjusted IRR of 3.0 (95% CI 2.2–4.0) for HCWs. The adjusted risk of COVID-19 requiring hospitalization or ICU admission was, respectively, 1.8 and 1.9 times higher in HCWs than in non-HCWs (95% CI 1.2–2.7 and 1.1–3.2, respectively), but the adjusted risk of death was not significantly different (adjusted IRR 0.9 [95% CI 0.4–2.0]).

Of 127,712 hospitalized cases aged 20–69 years, 8169 (6.4%) were HCWs and 119,543 (93.6%) were non-HCWs (Table I). Of hospitalized cases, 147 (1.8%) HCWs died, compared with 9773 (8.2%) non-HCWs (Table II).

Hospitalized HCWs had a lower risk of in-hospital death than non-HCWs [IRR 0.3 (95% CI 0.2–0.6)], but this effect was halved for HCWs admitted to an ICU [IRR 2.8 (95% CI 2.1–3.9) vs IRR 4.6 (95% CI 2.7–7.7) in non-HCWs; i.e. 0.6 (95% CI 0.4–0.9) when compared with non-HCWs admitted to an ICU (Table II).

ICU admission was found to be associated with increased risk of death after hospitalization, which likely reflects risk factors for severity of disease that were not included in the model (Table II). Being aged 60–69 years (compared with cases aged 20–29 years) [IRR 5.8 (95% CI 3.8–8.8)], having at least one precondition [IRR 2.0 (95% CI 1.8–2.3)] and being male [IRR 1.3 (95% CI 1.1–1.5)] were associated with increased risk of death among hospitalized cases (Table II). Being hospitalized between 1st June and 30th September 2020 and between 1st October 2020 and 13th January 2021 was associated with decreased risk of death [IRR 0.5 (95% CI 0.4–0.7) and 0.8 (95% CI 0.71–0.96), respectively] compared with the early phase of the pandemic. For hospitalized cases with at least one precondition (18.5% of HCWs, 20.1% of non-HCWs), there was no increased risk of death based on the

Table II
Number of hospitalized cases with coronavirus disease 2019 (COVID-19) and risk of death [incidence rate ratio (IRR)] by characteristics of cases, European Union and European Economic Area (EU/EEA) countries$, 31st January 2020–13th January 2021

| Characteristic | No. hospitalized cases (% within stratum) | Number of deaths (%) | IRR  | 95% CI |
|---------------|------------------------------------------|----------------------|------|-------|
|                | HCWs | Non-HCWs | HCWs | Non-HCWs |
| HCW and ICU admission | | | | |
| Non-HCW, not admitted to ICU | – | 102,597 (80.3) | – | 4823 (4.7) | Ref. | – |
| Non-HCW, admitted to ICU | – | 16,946 (13.3) | – | 4950 (29.2) | 4.6 | 2.7–7.7 |
| HCW, not admitted to ICU | 7453 (5.8) | – | 48 (0.6) | – | 0.30 | 0.2–0.6 |
| HCW, admitted to ICU | 716 (0.6) | – | 99 (13.8) | – | 2.83 | 2.1–3.9 |
| Sex | | | | |
| Female | 4786 (58.6) | 43,729 (36.6) | 34 (0.7) | 2,537 (5.8) | Ref. | – |
| Male | 3382 (41.4) | 75,808 (63.4) | 113 (3.3) | 7,236 (9.5) | 1.3 | 1.1–1.5 |
| Age group, years | | | | |
| 20–29 | 518 (6.3) | 6673 (5.6) | 0 (0.0) | 44 (0.7) | Ref. | – |
| 30–39 | 1099 (13.5) | 10,724 (9.0) | 2 (0.2) | 149 (1.4) | 1.6 | 1.0–2.6 |
| 40–49 | 1966 (24.1) | 18,918 (15.8) | 12 (0.6) | 561 (3.0) | 2.1 | 1.3–3.2 |
| 50–59 | 3027 (37.1) | 36,398 (30.4) | 42 (1.4) | 2,774 (6.2) | 3.0 | 2.0–4.6 |
| 60–69 | 1559 (19.1) | 46,830 (39.2) | 91 (5.8) | 6,745 (14.4) | 5.8 | 3.8–8.8 |
| Any precondition | | | | |
| No | 6654 (81.5) | 95,485 (79.9) | 89 (1.3) | 6,347 (6.6) | Ref. | – |
| Yesa | 1515 (18.5) | 24,058 (20.1) | 58 (3.8) | 3,426 (14.2) | 2.0 | 1.8–2.3 |
| Reporting period | | | | |
| 31st January–31st May 2020 | 4557 (55.8) | 40,139 (33.6) | 83 (1.8) | 4,520 (11.3) | Ref. | – |
| 1st June–30th September 2020 | 265 (3.2) | 7714 (6.5) | 4 (1.5) | 212 (2.7) | 0.53 | 0.42–0.67 |
| 1st October 2020–13th January 2021 | 3347 (41.0) | 71,690 (60.0) | 60 (1.8) | 5,041 (7.0) | 0.83 | 0.71–0.96 |

HCW, healthcare worker; ICU, intensive care unit; CI, confidence interval.

a Eight EU/EEA countries with consistent reporting case-based surveillance data reported to the European Surveillance System for hospitalized cases aged 20–69 years, including ICU admission: Austria, Finland, Ireland, Italy, Luxembourg, Malta, Norway and Slovakia. Consistent reporting was defined as reporting case-based surveillance data throughout the entire study period (31st January 2020–13th January 2021).

b Presence of at least one of the following: asthma, cancer, cardiac disease, diabetes, human immunodeficiency virus, hypertension, kidney disease, liver disease, lung disease, neuromuscular disease, obesity, pregnancy, smoking status, tuberculosis and other/unspecified.
number of preconditions for either hospitalized HCWs or hospitalized non-HCWs.

Discussion

In the analyses, HCWs in all countries were at increased risk of COVID-19 and hospitalization, suggesting increased risk of exposure to the virus. However, HCWs may seek and receive care earlier than non-HCWs, thereby impacting diagnosis, hospitalization and survival rates. By restricting analyses to cases requiring hospitalization, this limited the effect of differential underdiagnosis of cases in non-HCWs vs HCWs who are regularly tested in healthcare settings; this would lead to HCWs having increased likelihood of being diagnosed for the same severity of disease.

HCWs were less likely than non-HCWs to die following hospitalization. Risk factors for death such as sex, age and preconditions reflect what has been reported previously [8]. After 31st May 2020, there was a lower risk of dying in hospital for all COVID-19 cases than during the initial phase of the pandemic. Testing practices changed over time and the availability of better equipment, knowledge and treatment of cases most likely influenced health outcomes for all cases. During the second and third reporting periods, the decreased risk of death may be linked to improved management of severe cases [9].

In addition, it is plausible that HCWs, because they are close to the healthcare system, receive early treatment, including self-medication; are better able to identify symptoms that can lead to severe outcomes that affected their survival rates; and receive better care than non-HCWs. HCWs in these analyses may also have benefited from the healthy worker effect [10], or HCWs with high-risk preconditions may have stopped practicing during the pandemic. Attempts were made to address this effect by adjusting risk for age and number of preconditions, but unmeasured or residual confounding that could contribute to better survival of hospitalized HCWs than hospitalized non-HCWs may subsist (e.g. specific preconditions in each group that could not be compared in this study).

In addition, attempts were made to control for detection bias by restricting the multi-variable analysis to hospitalized cases, but it is possible that HCWs were hospitalized with less severe disease than non-HCWs, leading to an artificially increased likelihood of survival.

Country-specific definitions of HCWs vary and data on the professions of HCW cases were not available, so their distribution and data completeness in the surveillance dataset remain unknown. While misclassification of cases (either as non-HCWs or as alive) was possible, the adjusted IRRs did not change when the analysis was restricted to known HCWs and outcome statuses.

In conclusion, HCWs were at higher risk for COVID-19-related hospitalization than non-HCWs, which could possibly be explained by their proximity to healthcare services and prompt recognition of illness. This disparity should be addressed, either by increasing the general population’s awareness of the disease or by improving access to and quality of health care. Among hospitalized cases, the risk of death was lower for HCWs than for non-HCWs, likely due to the healthy worker effect, better or earlier access to treatment, and underascertainment. Still there remains a risk of severe outcome of COVID-19 in HCWs, which, together with increased risk of exposure, has made HCWs a priority group for vaccination with the aim of reducing the risk of hospitalization and death.

Caution should be exerted when drawing conclusions based on HCW data, especially for emerging pathogens. Further research is needed on exposure levels by HCW profession to fully explore the risk factors for COVID-19-related hospitalization and death among HCWs.

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Conflict of interest statement

None declared.

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