

# Dynamics of the coronavirus disease 2019 outbreak in Poland: an epidemiological analysis of the first 2 months of the epidemic

Filip Raciborski<sup>1</sup>, Jarosław Pinkas<sup>2</sup>, Mateusz Jankowski<sup>2</sup>,  
Radosław Sierpiński<sup>3,4</sup>, Wojciech S. Zgliczyński<sup>2</sup>, Łukasz Szumowski<sup>3</sup>,  
Kamil Rakocy<sup>5</sup>, Waldemar Wierzbą<sup>6</sup>, Mariusz Gujski<sup>1</sup>

<sup>1</sup> Department of Prevention of Environmental Hazards and Allergology, Medical University of Warsaw, Warsaw, Poland

<sup>2</sup> School of Public Health, Centre of Postgraduate Medical Education, Warsaw, Poland

<sup>3</sup> Department of Cardiac Arrhythmia, National Institute of Cardiology, Warsaw, Poland

<sup>4</sup> Collegium Medicum, University of Cardinal Wyszyński in Warsaw, Warsaw, Poland

<sup>5</sup> KR Consulting, Warsaw, Poland

<sup>6</sup> Satellite Campus in Warsaw, University of Humanities and Economics in Łódź, Warsaw, Poland

## KEY WORDS

coronavirus  
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Poland, severe acute  
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## ABSTRACT

**INTRODUCTION** Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the novel severe acute respiratory syndrome coronavirus 2.

**OBJECTIVES** Our aim was to present an epidemiological analysis of the first 2 months (March and April 2020) of the COVID-19 epidemic in Poland.

**PATIENTS AND METHODS** This analysis was based on data from epidemiological reports collected between March 4 and April 30, 2020, by the Chief Sanitary Inspectorate. These epidemiological reports include data on sociodemographic characteristics of new laboratory-confirmed COVID-19 cases, the number of COVID-19-related deaths, the number of recovered COVID-19 patients as well as the number of laboratory tests performed.

**RESULTS** From March 4 to April 30, 2020, a total of 12 877 laboratory-confirmed COVID-19 cases were registered in Poland (55.7% women; mean [SD] age, 50.6 [20.5] years). The RT-PCR test was performed in 338 000 patients. The notification rate for COVID-19 was 33.2 per 100 000 inhabitants. One-third of laboratory-confirmed COVID-19 cases were among quarantined persons, 26.1% were related to the healthcare system (hospital or clinic), and 13.3% occurred in nursing homes. As of April 30, 2020, 644 COVID-19-related deaths were registered in Poland (46.5% women). The death rate for the whole country was 1.7 per 100 000 inhabitants.

**CONCLUSIONS** Our data showed higher notification rate for COVID-19 among women than men, but men were more likely to die from COVID-19. The notification rate for COVID-19 in Poland among women aged 45 to 54 years was 2-fold higher than among men.

**INTRODUCTION** Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged at the end of 2019 in Asia (Hubei province, China) and spread around the world.<sup>1</sup> The SARS-CoV-2 infection causes coronavirus disease 2019 (COVID-19). The most common symptoms at the onset of COVID-19 are fever, cough, fatigue, sore throat, shortness of breath, and myalgia.<sup>1-3</sup>

As of April 30, 2020, a total of 3 090 445 COVID-19 cases have been reported worldwide, including 217 769 deaths.<sup>4</sup> COVID-19 cases in Europe account for about half of those globally. The first country in Europe with a confirmed SARS-CoV-2 case was France (January 24, 2020).<sup>5</sup> On January 28, the first case was reported in Germany, and 3 days later in Italy, Spain, Sweden, and the United Kingdom.<sup>5</sup>

Correspondence to:  
Prof. Jarosław Pinkas, MD, PhD,  
School of Public Health, Centre  
of Postgraduate Medical  
Education, ul. Kleczewska  
61/63, 01-826 Warszawa,  
Poland, phone: +48 22 560 11 50,  
email: jpinkas@cmkp.edu.pl  
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## WHAT'S NEW?

This study presents findings from the analysis of the first 12 000 coronavirus disease 2019 (COVID-19) cases in Poland. The analysis of the notification rate for COVID-19 in different age groups allows the identification of groups at a higher probability of COVID-19 infection. The analysis of the structure of COVID-19–related deaths enables identification of groups requiring special medical care and preventive measures. The dynamics of the COVID-19 outbreak in Poland presented in this study indicate which administrative regions have increased notification rate for COVID-19 where healthcare professionals should pay special attention to the possibility of infection with severe acute respiratory syndrome coronavirus 2 in the population under their care.

By March 17, every country in Europe reported at least 1 case of COVID-19.<sup>6</sup> The highest number of cases of COVID-19 were observed in Spain, Italy, and the United Kingdom.<sup>7</sup>

In Poland, the first laboratory-confirmed case was reported on March 4, 2020. As of April 30, 12 877 laboratory-confirmed COVID-19 cases and 644 related deaths were reported in Poland. According to data from the European Centre for Disease Prevention and Control (ECDC), the number of reported cases per 100 000 population in Poland is one of the lowest in the European Union.<sup>8</sup> Within 2 weeks of the first laboratory-confirmed COVID-19 case, Poland had implemented numerous far-reaching public health interventions to mitigate the early spread of SARS-CoV-2, including closing borders, banning mass events, limiting trade, closing educational institutions, introducing childcare allowances.<sup>9</sup> The impact of these interventions on the dynamics of the COVID-19 epidemic in Poland has not been thoroughly investigated.

Our aim was to present an epidemiological analysis of the first 2 months (March and April, 2020) of the COVID-19 epidemic in Poland.

**PATIENTS AND METHODS** This analysis was based on data from epidemiological reports collected between March 4 and April 30, 2020, by the Chief Sanitary Inspectorate (Warsaw, Poland). Epidemiological reports are submitted daily to the Chief Sanitary Inspectorate by the State Sanitary Inspectorate territorial representatives within administrative regions (318 poviats and 16 provinces).<sup>10</sup>

The epidemiological report includes, among others, data on sociodemographic characteristics of new laboratory-confirmed COVID-19 cases (including sex, age, and place of residence), the number of COVID-19–related deaths, the number of recovered COVID-19 patients, as well as the number of laboratory tests performed.

The COVID-19 case definition for surveillance in Poland is in line with the definition proposed by the ECDC.<sup>11</sup> In Poland, laboratory testing for COVID-19 in suspected cases is based on the detection of unique sequences of SARS-CoV-2 virus RNA by real-time reverse-transcription polymerase chain reaction (RT-PCR).<sup>12</sup> Laboratory testing of

suspected COVID-19 cases is organized in line with the World Health Organization guidelines.<sup>12</sup>

Out of 12 877 laboratory-confirmed COVID-19 cases, 12 780 were registered in the analytical database (detailed information on 97 cases was not available). In the analytical database, missing data included sex of 4 patients and age of 47 patients (missing records resulted from reporting delay). Of 644 registered deaths, data regarding sex of 3 patients and age of 2 patients were missing.

Data on confirmed cases and deaths were analyzed on the national, regional (provinces), and local (poviats) level. The current state of the Polish population (as of June 30, 2019) was based on the Local Data Bank provided by the Central Statistical Office.<sup>13</sup>

**Statistical analysis** The data analysis was performed using the procedures available in the SPSS v25 package (IBM, Armonk, New York, United States). *P* values and confidence intervals were not determined since the study encompassed the entire population. Descriptive statistics were used to present quantitative data. The mean (SD) as well as minimum and maximum values were used. The maps were made using the QGIS 3.12.1 software (QGIS Geographic Information System. Open Source Geospatial Foundation Project. <http://qgis.org>).

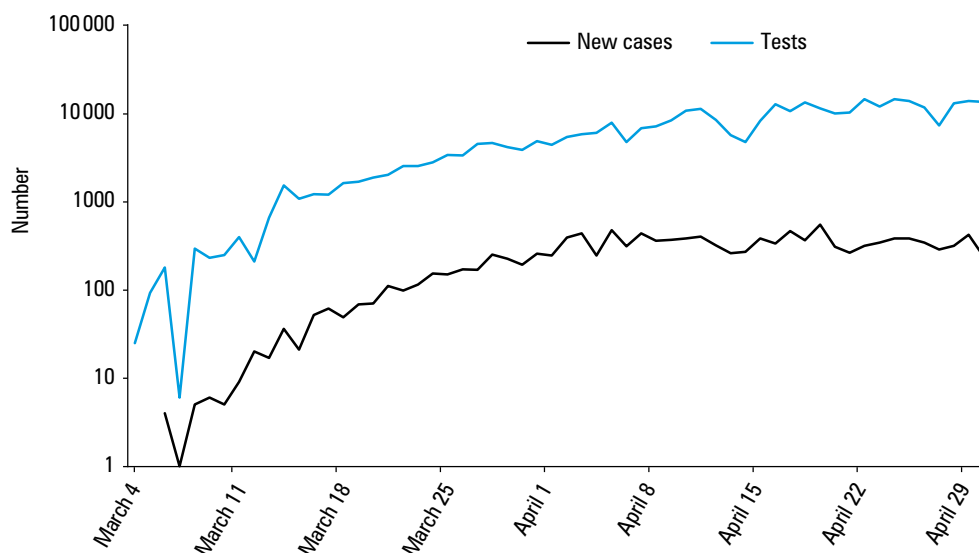
**Ethics** This study was carried out in accordance with the principles of the Declaration of Helsinki. Epidemiological reports are anonymous and prevented identification of any individual study subject by the research team at any stage of the study.

**RESULTS The number of laboratory-confirmed of coronavirus disease 2019 as of April 30, 2020** From March 4 to April 30, 2020, a total of 12 877 laboratory-confirmed COVID-19 cases were registered in Poland. Testing included 338 000 RT-PCR tests. The dynamics of epidemic development in the first 2 months in Poland is presented in **FIGURE 1**.

The notification rate for COVID-19 in Poland was 33.2 per 100 000 inhabitants (as of April 30, 2020). The highest rates were recorded in the Lower Silesia Province (52.6 out of 100 000), Silesia (49.4 out of 100 000), and Mazovia (46.6 out of 100 000), while the lowest were in the Lubuskie (8.6 out of 100 000) and Warmia-Masuria Provinces (10 out of 100 000). At the poviat level (**FIGURE 2**), the highest notification rates were recorded in the Białobrzegi Poviat in the Mazovia Province (514.8 per 100 000 inhabitants), the Lubeliniec Poviat in the Silesia Province (345.3 out of 100 000), and in the Krotoszyński Poviat in the Wielkopolska Province (337.8 out of 100 000). In all 3 poviats with the highest notification rates, the main setting of SARS-CoV-2 transmission was nursing homes (outbreaks of infection in long-term care facilities).

Among all confirmed cases, 55.7% were women. The mean (SD) age of patients with COVID-19

**FIGURE 1** The daily number of new laboratory-confirmed cases of coronavirus disease 2019 and the number of performed real-time reverse-transcription polymerase chain reaction tests (logarithmic scale)



was 50.6 (20.5) years; 52.2 (20.5) years in women and 48.6 (20.3) years in men. The youngest patient with confirmed disease in Poland was less than 1 year old and the oldest was 103 years. The youngest population of patients, on average, were 41 (14.1) years in the Lubuskie Province. The Opolskie Province included the oldest mean (SD) patient age, 56 (22) years.

The age distribution among COVID-19 cases differed between men and women (FIGURE 3). The youngest age groups were underrepresented compared with the general population. The highest number of COVID-19 cases was observed in the groups aged 45 to 59 years and significantly exceeded the share of this age group in the general population. Moreover, among women, the age groups of 45 to 59 years and 85 years and older were noticeably over-represented (FIGURE 3). Among men, the differences in the age structure of the infected in relation to the population were significantly lower (except for the youngest age groups).

The COVID-19 notification rate differed across age groups (FIGURE 4). In the youngest age groups (0–4 and 5–9 years), the notification rate was 6.5 and 8 per 100 000 inhabitants, respectively. In the groups aged 45 to 59 years, differences in the notification rate between men and women were observed, with the highest notification rate among women. The highest notification rate was in the oldest age group (85 years and over), with notification rates averaging 99 per 100 000 inhabitants. Of these patients, 102.4 per 100 000 inhabitants were women and 90.2 per 100 000 inhabitants were men. The details are presented in FIGURE 4.

#### Settings of severe acute respiratory syndrome coronavirus 2 transmission

Out of 12 534 laboratory-confirmed COVID-19 cases in Poland, one-third (33.1%) were quarantined persons (28.7% individuals who were a close contact of a probable or confirmed case and 4.4% who returned from abroad). Infections related to the healthcare system (visiting within previous 14 days a hospital or

clinic where the COVID-19 case was confirmed) accounted for 26.1% of cases. In total, 13.3% of all cases in Poland were identified in institutions related to nursing and care facilities (intended for dependent persons). Other nonspecific settings of SARS-CoV-2 transmission accounted for approximately 27% of COVID-19 cases.

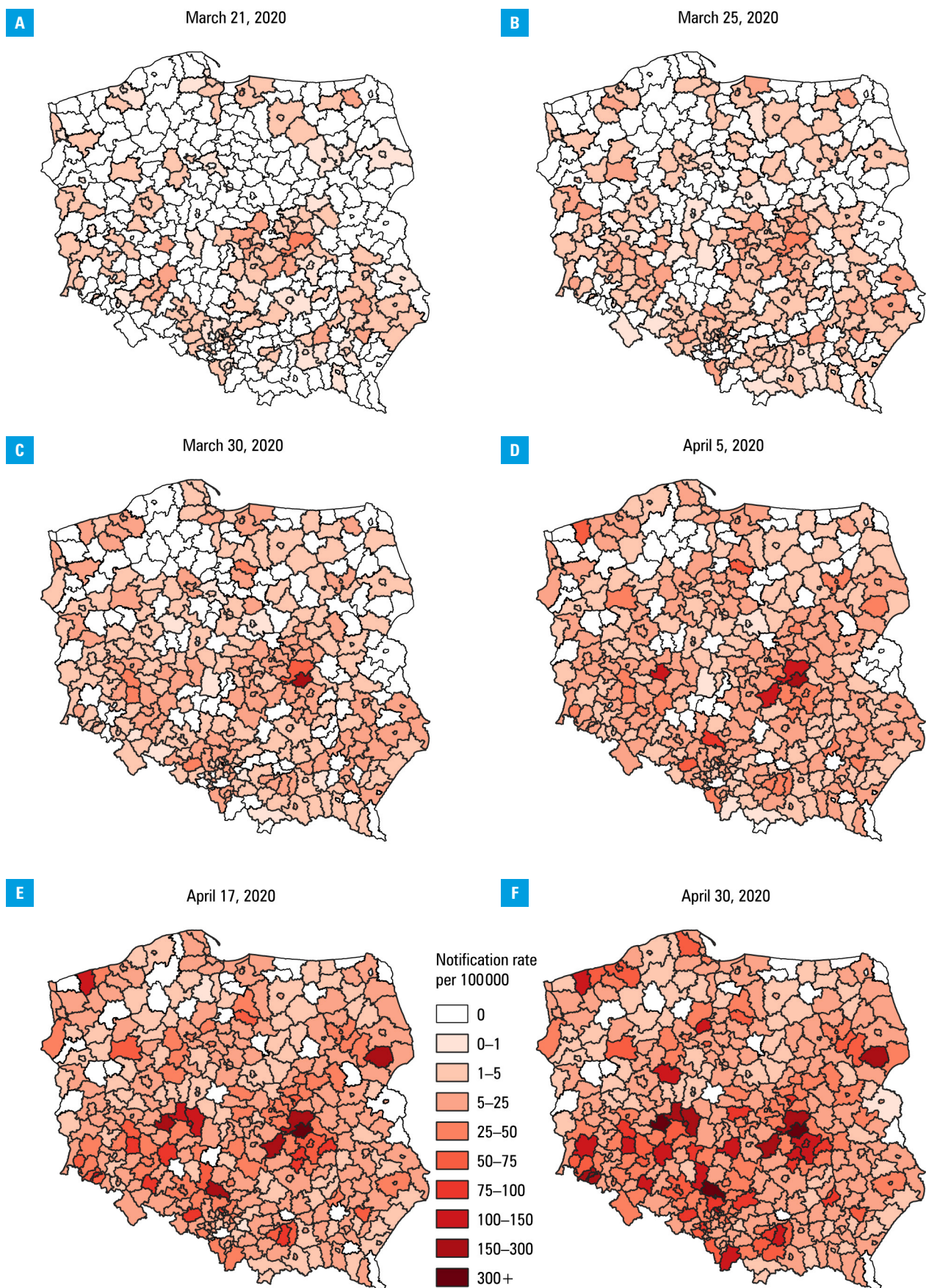
**Deaths due to coronavirus disease 2019** From March 4 to April 30, 2020, 644 COVID-19-related deaths were registered in Poland, of which women accounted for 46.5%. The death rate for the whole country was 1.7 per 100 000 inhabitants. The death rate varied from 0.1 per 100 000 inhabitants in the group aged 0 to 39 years to 15.9 per 100 000 in the group aged 80 years and older. The details are presented in FIGURE 5.

The mean (SD) age of fatal COVID-19 cases was 74.9 (12.7) years and ranged from 18 years to 98 years. Among women, it was 77.6 (13) years and among men, 72.6 (12.1) years. The youngest deceased male and female patient was 18 and 31 years, respectively and the oldest was 98 (with both sexes affected equally).

Among the total number of COVID-19-related deaths, the group aged up to 59 years constituted 10.5% (8.7% for women and 12% for men). Almost half of the COVID-19-related deaths (47.9%) were in the group aged 60 to 79 years (37.2% among women, 57.1% among men). The group aged 80 years and older accounted for 41.7% of COVID-19-related deaths in Poland (54% among women and 30.9% among men). Among the total number of COVID-19-related deaths, 31.7% were in the Mazovia Province, 18.5% were in the Silesia Province and 13.5% were in the Wielkopolska Province. Almost two-thirds of the total number of COVID-19-related deaths occurred in these 3 provinces.

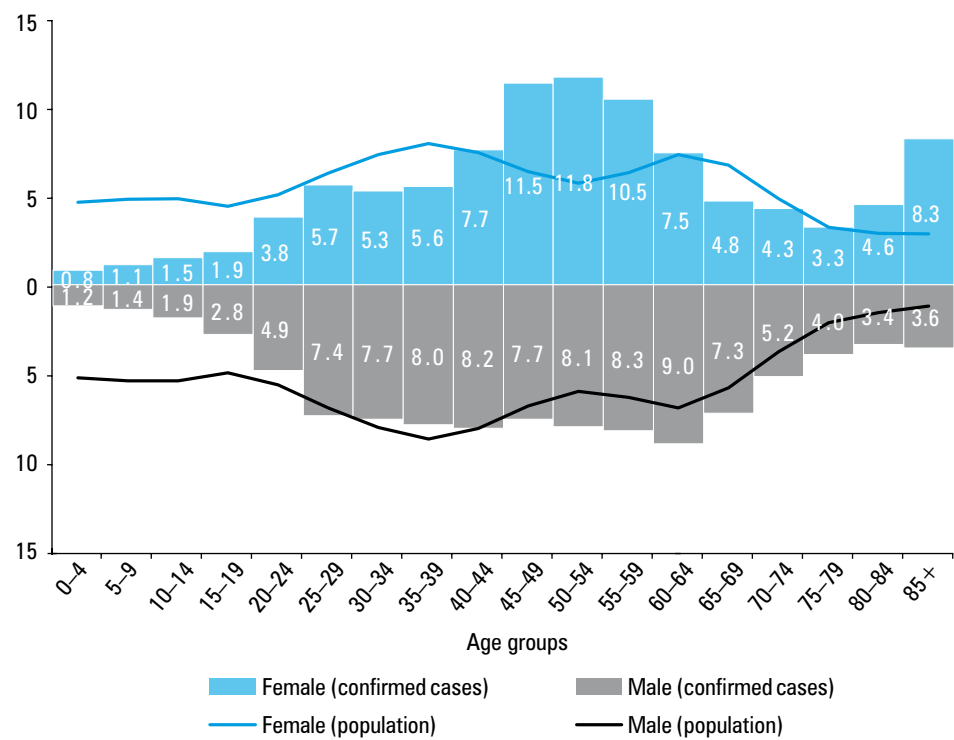
**DISCUSSION** To the best of our knowledge, this is the most comprehensive epidemiological analysis describing the COVID-19 outbreak in Poland. As of April 30, 2020, a total of 12 877 COVID-19 cases and 644 COVID-19-related deaths were



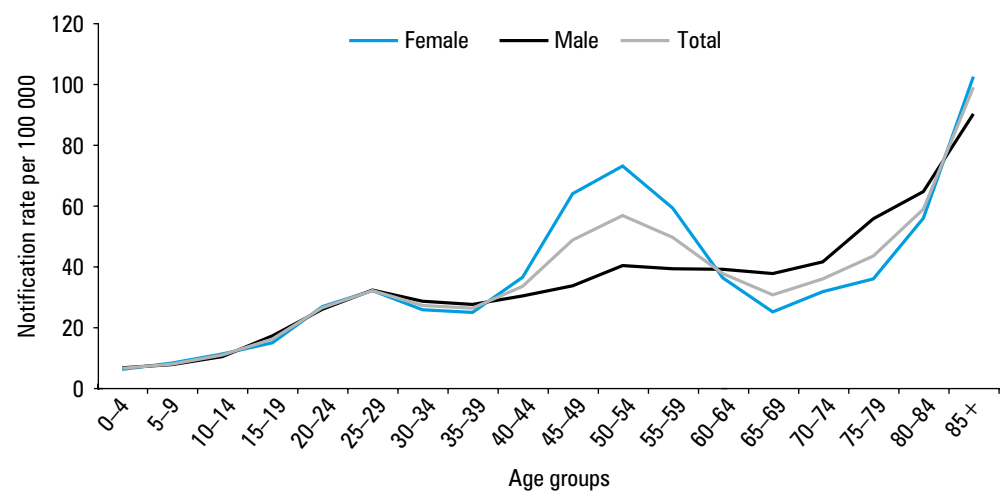


**FIGURE 2** Notification rate per 100 000 inhabitants in poviats at time points corresponding to exceeding **A** – 500, **B** – 1000, **C** – 2000, **D** – 4000, **E** – 8000 confirmed cases of severe acute respiratory syndrome coronavirus 2 infection, and **F** – current status (30 April, 2020).

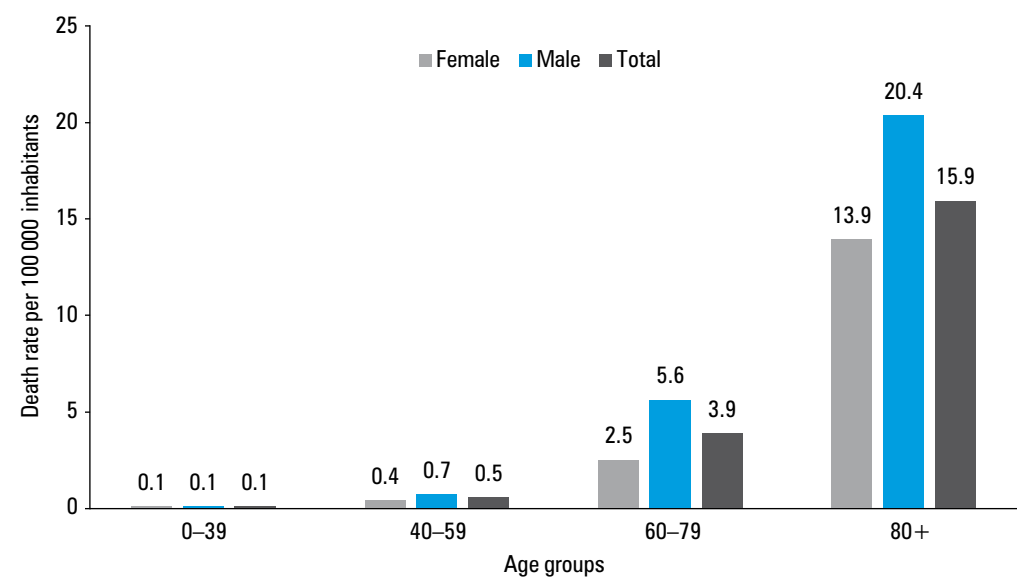
**FIGURE 3** Age distribution of laboratory-confirmed coronavirus disease 2019 cases (n = 12 729) compared with the structures of the Polish population



**FIGURE 4** Coronavirus disease 2019 notification rate per 100 000 inhabitants in different age groups (n = 12 729)



**FIGURE 5** Deaths from coronavirus disease 2019 per 100 000 inhabitants (n = 641)



registered in Poland. During the first 30 days, a systematic increase in the number of new COVID-19 cases per day was observed, followed by stabilization at around 300 to 400 cases per day. Among the confirmed cases, women constituted 55.7% and among the fatal cases 46.5%. The mean (SD) age for confirmed COVID-19 cases was 50.6 (20.5) years and 74.9 (12.7) years for deaths. Noticeably lower notification rates were observed in children and adolescents.

The lowest notification rates for COVID-19 cases were in the group aged 0 to 4 years (6.5 per 100 000) and 5 to 9 years (8 per 100 000). For comparison, the notification rate for the entire population was 33.2 per 100 000 inhabitants. The highest notification rates were in the oldest age group, 85 years and older (99 per 100 000 inhabitants). A significant increase in the notification rate was observed in the group of women aged 45 to 59 years (from 59.3 to 73.1 per 100 000). People aged 60 to 79 years constituted 47.9% and those aged 80 years or more, 41.7% of COVID-19-related deaths. The mortality rate in the oldest age group was 15.9 per 100 000 inhabitants. For comparison, in all people up to age 40 years, the mortality rate was 0.1 per 100 000 inhabitants. Most of the COVID-19 cases were confirmed among quarantined individuals.

The number of COVID-19 cases in Poland differs by the administrative regions. From the beginning of the epidemic, the highest rates of cases per 100 000 inhabitants were observed in central (Łódź and Mazovia Provinces) and southwest administrative regions (Lower Silesia and Silesia Provinces). All these regions have international airports. Moreover, southwest provinces border the Czech Republic, where the epidemic outbreak occurred a little earlier than in Poland and could be the source of infection for some cases in Poland. Furthermore, observed differences can be explained by demographic variations that include relatively high population density, urbanization rate, and number of healthcare facilities and nursing homes.

According to the ECDC data, the absolute number of COVID-19 cases and deaths in Poland is significantly lower than in western European countries.<sup>6-8</sup> Dynamics of the COVID-19 outbreak in Europe may vary between the countries due to sociodemographic as well as cultural factors.<sup>6</sup> In Poland, compared to other European countries, strict sanitary interventions (closing borders and limitations on everyday life and economy with particular emphasis on the service sector) were implemented relatively early to reduce the spread of SARS-CoV-2.<sup>9</sup>

Clinical characteristics of COVID-19 cases in different European countries showed that there are more women with COVID-19 than men.<sup>7,14</sup> However, men are more likely to die from COVID-19.<sup>15</sup> A similar phenomenon was observed in our study. In Poland, women accounted for 55.7% of all laboratory-confirmed COVID-19 cases and 46.5% of all COVID-19-related deaths.

Healthcare professionals are at increased risk for infection (from 10% in Italy<sup>16,17</sup> to 20% in Spain),<sup>7</sup> a factor which may explain the higher infection rate in women. The majority of healthcare workers are women, especially in the field of nursing. This assumption for Poland is somehow confirmed by a disproportionately high rate of infected women in the group aged 45 to 55 years.

We can hypothesize that a higher proportion of deaths among men could be associated with comorbidities, including cardiovascular disease, hypertension, and lung disease, which are generally more widespread in this group.<sup>7</sup> This observation is consistent with the present differences in average life expectancy between men (73.8 years) and women (81.7 years) in Poland.

The average age of COVID-19-related deaths as well as the age distribution of deaths with the largest proportion of deaths among older age groups in Poland are also comparable with other countries.<sup>7</sup> There were geographical differences in the number of COVID-19-related deaths between the provinces, wherein almost two-thirds of the total number of COVID-19 related deaths occurred in 3 voivodships

Compared with the epidemiological analysis of the first 1389 COVID-19 cases in Poland, the proportion of patients aged 20 to 29 years decreased,<sup>18</sup> which may suggest that at the beginning of the epidemic in Poland, most cases were imported and related to travel during the winter break at the universities.<sup>9,18</sup> The age structure of COVID-19 cases changes with the subsequent phase of the epidemic. At the end of the second month of the SARS-CoV-2 epidemic in Poland, the highest number of COVID-19 cases was observed in the groups aged 45 to 59 years.

At the same time, the number of COVID-19 cases in the oldest age groups increased, which may result from the SARS-CoV-2 infection among residents of nursing homes.

Among all laboratory-confirmed COVID-19 cases in Poland, the highest proportion was related to quarantined persons who have had close contact with a probable or confirmed COVID-19 case. Nosocomial transmission is the second most common setting of SARS-CoV-2 infections in Poland. Healthcare workers are at high risk of contracting SARS-CoV-2.<sup>17</sup> In Italy, more than 17 000 healthcare workers had been infected, which accounts for 10% of Italy's registered infections.<sup>16</sup> In Spain, 20% of confirmed COVID-19 cases are among healthcare workers.<sup>7</sup> In Poland, almost 30% of all COVID-19 cases are related to nosocomial transmission, which includes both healthcare workers and patients visiting hospitals or clinics before the infection.

In Europe, the highest number of COVID-19 cases related to long-term care facilities and nursing homes was observed in France (54 493 cases including 6517 deaths as of April 14), Spain (10 924 fatal cases as of April 16), and the United Kingdom (1043 fatal cases as of April 12).<sup>7</sup> Moreover, in those countries, a high number of



COVID-19–related fatal cases occurred in care homes. Compared with Western Europe, the proportion of COVID-19 cases related to nursing homes is relatively low.

This study has several limitations. First, the presented data were related only to laboratory-confirmed COVID-19 cases. It should be assumed that due to the asymptomatic course of infection in some patients, the presented statistics may be underestimated. Second, the number of laboratory-confirmed COVID-19 cases strongly correlates with the number of tests performed. Nevertheless, Poland uses only the RT-PCR test to confirm COVID-19 cases, which is the only recommended diagnostic method to confirm SARS-CoV-2 infection.<sup>12</sup> Third, since the epidemic remains on-going, further analysis will be needed to assess how effective the mitigation efforts have been in stopping the spread of SARS-CoV-2 in Poland. Nevertheless, this is the first comprehensive epidemiological analysis of the dynamics of the development of the COVID-19 epidemic in a country from central and eastern Europe.

In conclusion, our data show higher notification rates for COVID-19 among women than men but men are more likely to die from it. The youngest age groups (0–19 years) are underrepresented compared with the general population. The notification rate for COVID-19 in Poland among women aged 45 to 54 years is 2-fold higher than among men. Limiting nosocomial transmission is a key challenge in controlling the COVID-19 outbreak in Poland.

## ARTICLE INFORMATION

**NOTE** Digital identifiers were assigned to FR (ORCID iD, <https://orcid.org/0000-0003-0562-0260>), JP (ORCID iD, <https://orcid.org/0000-0002-1015-9643>), MJ (ORCID iD, <https://orcid.org/0000-0002-7142-5167>), RS (ORCID iD, <https://orcid.org/0000-0002-4731-1565>), WSZ (ORCID iD, <https://orcid.org/0000-0003-0054-4860>), KR (ORCID iD, <https://orcid.org/0000-0001-9722-637X>), WW (ORCID iD, <https://orcid.org/0000-0002-8134-2955>), MG (ORCID iD, <https://orcid.org/0000-0002-2938-4795>).

**CONTRIBUTION STATEMENT** FR, JP, MJ, KR, and MG conceived the concept of the study, its design, crude data collection and interpretation. JP, RS, LS, and MG are the authors of the conception of current research. FR, MJ, RS, WSZ, KR, WW, and KR were responsible for methodology of advanced data management and statistical analysis. FR, JP, MJ, WSZ, WW, and MG worked on the manuscript. RS and LS were responsible for linguistic correction and adjustment of the manuscript. All authors read and approved the final manuscript.

**CONFLICT OF INTEREST** None declared.

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