



OCCUPATIONAL RISKS FOR SARS-CoV-2 INFECTION: THE POLISH EXPERIENCE

RADOSŁAW SIERPIŃSKI^{1,2}, JAROSŁAW PINKAS³, MATEUSZ JANKOWSKI³, GRZEGORZ JUSZCZYK⁴,
ROMAN TOPÓR-MĄDRY^{5,6}, and ŁUKASZ SZUMOWSKI^{1,7}

¹ Cardinal Stefan Wyszyński University, Warsaw, Poland
Collegium Medicum

² Medical Research Agency, Warsaw, Poland

³ Centre of Postgraduate Medical Education, Warsaw, Poland
School of Public Health

⁴ Medical University of Warsaw, Warsaw, Poland
Department of Public Health

⁵ Agency for Health Technology Assessment and Tariff System, Warsaw, Poland

⁶ Jagiellonian University, Kraków, Poland
Collegium Medicum, Faculty of Health Sciences

⁷ National Institute of Cardiology, Warsaw, Poland
Department of Cardiac Arrhythmia

Abstract

Objectives: The disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), termed COVID-19, is asymptomatic or mild in most cases. These patients do not need treatment in hospital and can be isolated at home. To date, most studies have been conducted among inpatients with severe COVID-19. In this study, the authors surveyed patients with mild COVID-19 who remained in home isolation, and analyzed the sources and occupational risk factors for SARS-CoV-2 infections. **Material and Methods:** This cross-sectional study was carried out on April 17–18, 2020, among patients infected with SARS-CoV-2 who remained in home isolation in Poland. Data were acquired through a structured interview that included questions about the isolation course, symptoms, comorbidities, infection source, household characteristics, occupation, and workplace. Data were presented with descriptive statistics. **Results:** Of the 4878 patients in home isolation, the authors were able to contact 3313. Of them, 1191 patients declined their invitation, and 2122 agreed to take part. The median age of the patients included in the study was 50 years; 59% were female. Most patients (92%) had not been abroad before the infection. More than half (55%) knew how they became infected; of them, 75% became infected at work. Of all patients, 70% were occupationally active. Nearly half of the occupationally active patients (48%) worked in healthcare, 3% worked in public administration or defense, 3% worked in transportation, and 2% worked in education. Sixty-five percent of the occupationally active patients worked in companies with >100 employees. **Conclusions:** Most of the patients with COVID-19 in home isolation in Poland were occupationally active, wherein the majority of people who were aware of the source of SARS-CoV-2 infection worked in healthcare. As most of the infected patients worked in companies with >100 employees, which is not a Polish employment pattern, the authors expect that smaller companies may have a lower risk of SARS-CoV-2 infections. *Int J Occup Med Environ Health.* 2020;33(6):781–9

Key words:

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Corresponding author: Jarosław Pinkas, Centre of Postgraduate Medical Education, School of Public Health, Kleczewska 61/63, 01-826 Warsaw, Poland (e-mail: jaroslaw.pinkas@cmkp.edu.pl).

INTRODUCTION

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has spread throughout the world at an unprecedented rate. The epidemic started at the end of 2019 in China, and, as of May 7, 2020, there were >3 million confirmed cases worldwide [1]. Moreover, the high degree of asymptomatic infections and a lack of universal testing suggest that the true prevalence of SARS-CoV-2 infections is likely much greater [1,2].

Generally, SARS-CoV-2 causes a disease termed COVID-19, which presents mainly with fever and respiratory symptoms, but other symptoms, such as loss of smell or diarrhea, may also occur [3]. The virus spreads primarily through respiratory droplets among people in close contact or through contact with the immediate environment of the infected person [4]. It is highly transmittable, with an estimated reproductive number twice as high as that of the influenza virus [5].

Due to the immense scale of the SARS-CoV-2 epidemic, healthcare systems worldwide are struggling to provide adequate patient care. As neither a vaccine nor effective treatments for COVID-19 are available, it is essential to limit public exposure to the virus [6–8]. In particular, it is important to isolate people with confirmed SARS-CoV-2 infections. Although about 80% of COVID-19 cases are asymptomatic or mild and do not need treatment in hospital [9,10], these patients can still spread the disease and should be isolated at home [11]. In Poland, home isolation lasts for 14 days and is completed when nasopharyngeal swabs, taken on days 10–12, are negative for SARS-CoV-2 [12].

To date, most published studies on COVID-19 have been conducted among inpatients with a severe disease form, whereas data for patients in home isolation are scarce. In this study, the authors surveyed people infected with SARS-CoV-2 who were in home isolation, with the aim of identifying the sources and occupational risk factors for the infection.

MATERIAL AND METHODS

Study design and participants

This cross-sectional study was carried out on April 17–18, 2020, among non-hospitalized patients with the SARS-CoV-2 infection confirmed by reverse-transcription polymerase chain reaction (RT-PCR) of nasopharyngeal swabs. In Poland, patients who do not need treatment in hospital are isolated either in isolation centers or at home. The authors invited all patients who were in home isolation on April 17–18, 2020 to participate in this study; participation was voluntary. All procedures followed the ethical standards of the national research committee and the 1964 Helsinki Declaration (and its subsequent amendments). Laboratory testing for COVID-19 followed the European Centre for Disease Prevention and Control (ECDC) guidelines [13].

Study procedures

Data were acquired through a structured interview. The authors called the participants by phone and asked them about their isolation course, symptoms, comorbidities, infection source, household characteristics, occupation, and workplace. Table 1 shows the interview form with all questions. The obtained data were anonymized before the analysis. The Classification of Occupations and Specialties was based on the classification provided by Statistics Poland [14].

Statistical analysis

The authors used descriptive statistics to present data: medians and percentages. Due to the descriptive nature of the study, no inferential statistics were done.

RESULTS

Participants

As of April 17, 2020, contact details were available for 4878 patients in home isolation, but telephone numbers were available for 4516. Of them, 1203 patients could not be contacted, 1191 patients declined the invitation, and

Table 1. Structured interview questions for patients infected with COVID-19 who remained in home isolation on April 17–18, 2020 (Warsaw, Poland)

Question	Answer
1. Are you now in isolation?	Yes/No
2. Has your sanitary-epidemiological station informed you not to leave your home?	Yes/No
3. Are you in quarantine? Since when?	Yes/No
4. Have people from your household been tested for coronavirus? When?	Yes/No; date
5. Do the police check on you? How often?	Yes/No; frequency
6. Do you know when your quarantine ends?	Yes/No
7. Since your positive coronavirus test, have you been in contact with other people?	Yes/No
8. Were you occupationally active at the time of the infection? If not, are you unemployed, retired, on a pension?	Yes/No
9. What is your profession? (a list of professions from Statistics Poland)	
10. Where do you work?	
11. What is the type of your work? (Polish Classification of Activities codes)	
12. Do you know how you got infected?	Yes/No
13. If so, was the infection related to your work?	Yes/No
14. Does the infection with coronavirus make it impossible for you to work?	Yes/No
15. During the last 14 days, have you worked outside your home?	Yes/No
16. Do you know of any infections among other employees of your company?	Yes/No
17. Were you abroad up to 14 days before the infection?	Yes/No
18. During 14 days before the infection, did you have contact with anyone who had come back from abroad?	Yes/No
19. During 14 days before the infection, did you have contact with anyone in quarantine?	Yes/No
20. Are there any cases of COVID-19 among people you are close to (same household or direct contact for ≥ 15 min every day)?	Yes/No
21. Would you get vaccinated if there were a vaccine?	Yes/No
22. Do you smoke?	Yes, often/Rarely/No
23. How many people are there in your household? Give the total number, and the numbers of children and people aged ≥ 65 years.	Total ____ Children ____ People aged ≥ 65 years ____
24. In which country do you work?	Poland/Other country
25. How many people are employed in your company?	<10, 10–100, >100
26. How many people at work do you have contact with during a usual day?	
27. Before you got infected, did you use personal protective equipment at work (masks, visors, gloves, hand rub)?	Yes, always/Nearly always/ Sometimes/Nearly never/Never
28. What was the date when the symptoms first appeared?	__/__/__
29. What was the date of the test result confirming COVID-19?	__/__/__
30. Have you observed the following symptoms:	
30.1 loss of appetite	Yes/No
30.2 loss of smell	Yes/No

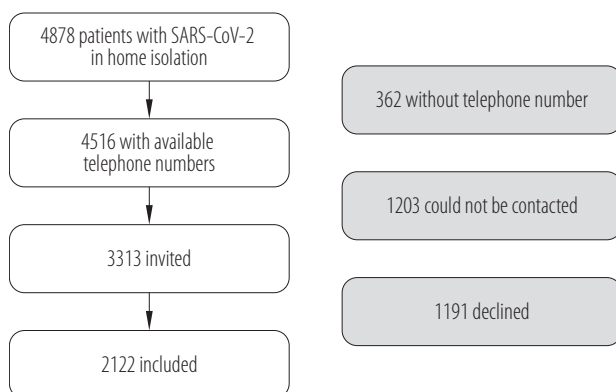
Table 1. Structured interview questions for patients infected with COVID-19 who remained in home isolation on April 17–18, 2020 (Warsaw, Poland) – cont.

Question	Answer
30.3 loss of taste	Yes/No
30.4 diarrhea	Yes/No
31. Do you have any of the following conditions:	
31.1 hypertension	Yes/No
31.2 diabetes	Yes/No
31.3 heart disease (coronary heart disease, myocardial infarction, heart failure)	Yes/No
31.4 chronic kidney disease	Yes/No
31.5 chronic lung disease	Yes/No

2122 agreed to take part (Figure 1). The response rate was 43.5% (41.8% among males and 43.8% among females). The median age of the patients included in the study was 50 years (range: 18–99 years); 59% were female. The median time from the symptom onset to the confirmation of the disease by RT-PCR was 2 days. About 1 in 10 people (9% of all patients) in the study admitted that they had contact with other people since confirmation of a positive result on the laboratory test for COVID-19.

Source of infection

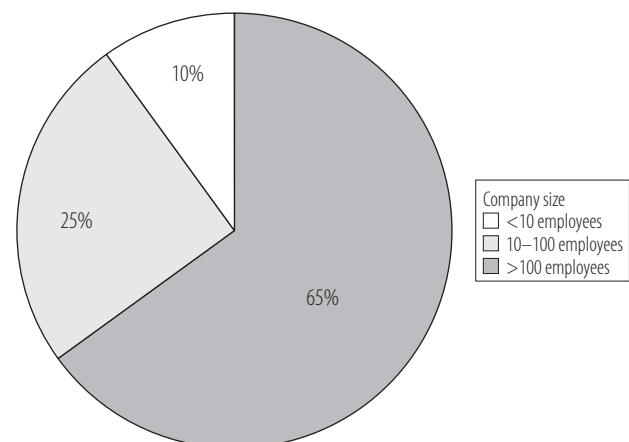
Most patients (92%) had not been abroad before the infection, and 87% did not have contact with people who

**Figure 1.** Flow diagram showing the inclusion process for the study cohort of patients infected with SARS-CoV-2 who remained in home isolation on April 17–18, 2020, Poland

had returned from abroad. More than half (55%) knew how they became infected (self-reported awareness of the settings of SARS-CoV-2 transmission). Among the patients who declared awareness of the source of infection, 75% became infected at work. Sixty-five percent of all occupationally active patients worked in companies with >100 employees (<10 employees – 10%; 10–100 employees – 25%) (Figure 2).

Occupational status

Of all patients, 70% were occupationally active (in line with the Classification of Occupations and Specialties by

**Figure 2.** Company size among the occupationally active people infected with SARS-CoV-2 who remained in home isolation on April 17–18, 2020, Poland

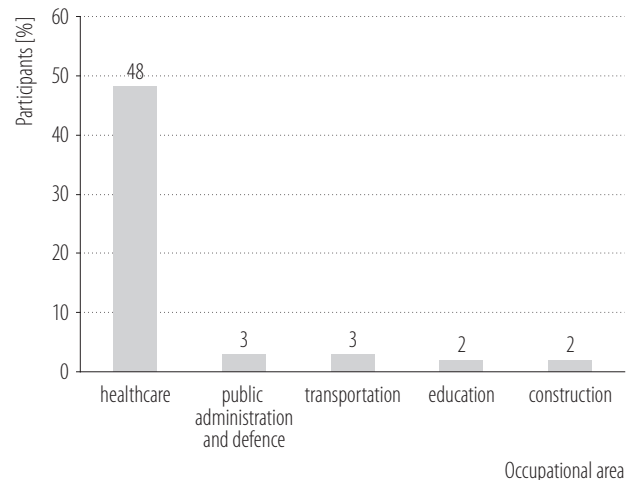
Statistics Poland); 97% worked in Poland. Almost half of the occupationally active patients (48%) worked in healthcare, 3% worked in public administration or defense, 3% worked in transportation, and 2% worked in education (Figure 3). The remaining occupational areas accounted for $\leq 1\%$ of all cases each; 24% of the respondents had an unclassified occupational area.

In terms of their profession, 25% of the occupationally active patients were nurses, 9% were physicians, 3% were medical caretakers, 3% were cleaners in hospitals, 2% were policemen, and 2% were drivers (Figure 4). The remaining professions accounted for $\leq 1\%$ of all cases each; 40% of occupations were unclassified. Personal protective equipment (PPE) for COVID-19 (in line with the WHO guidance [15]) at work was always used by 60% of the occupationally active patients, nearly always used by 16%, sometimes used by 9%, and nearly never or never used by 16%.

DISCUSSION

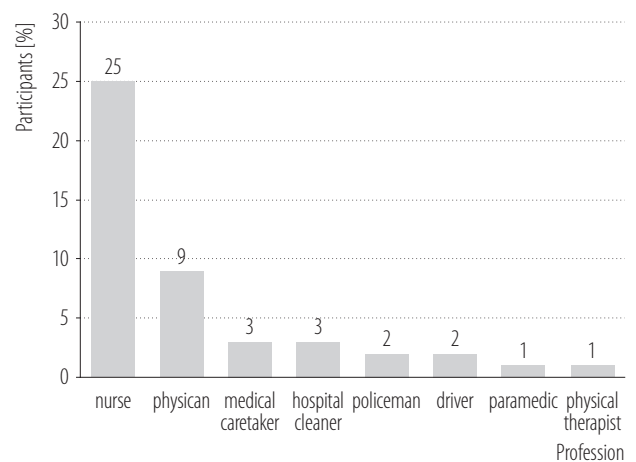
This study found that about 90% of the patients with SARS-CoV-2 who remained in home isolation had not gone abroad or had no contact with people from abroad. Only half of the patients knew how they became infected (self-reported knowledge of the source of infection). Of them, three-quarters were infected at work, primarily in healthcare facilities. Workplace-related infections occurred even though most patients declared regular use of PPE at work.

These data confirm that the transmission of SARS-CoV-2 in Poland is local, with a vast majority of infections occurring within the country's borders. As expected, the patients involved in the study, who all had asymptomatic or mild forms of the disease, were, on average, younger and healthier than patients with COVID-19 who require treatment in hospital. The median age in the sample was 50 years, whereas severe COVID-19 is considerably more common in people aged ≥ 65 years [16]. Similarly,



The remaining areas accounted for $\leq 1\%$ of all cases and are not shown.

Figure 3. Most common occupational areas among the occupationally active people infected with SARS-CoV-2 who remained in home isolation on April 17–18, 2020, Poland



The remaining professions accounted for $\leq 1\%$ of all cases and are not shown.

Figure 4. Most common professions among the occupationally active people infected with SARS-CoV-2 who remained in home isolation on April 17–18, 2020, Poland

the prevalence of chronic diseases that increase the risk of severe COVID-19, such as cardiovascular or respiratory diseases, was low in this cohort (data submitted for publication) [17].

As of April 17, 2020, there were 8379 laboratory-confirmed COVID-19 cases reported in Poland (including 332 deaths

and 866 recovered) [18]. An epidemiological analysis of the first 1157 confirmed COVID-19 cases showed that women represented 50.5% of these [19]. More than one-third of the confirmed cases (33.9%) were people aged 30–49 years [19]. According to the Chief Sanitary Inspectorate, as of April 11, 2020, women represented 55.5% of the COVID-19 cases in Poland (median age: 50 years) [20]. A demographic characteristic of the examined group in this study is comparable to those reported by the Chief Sanitary Inspectorate in the total group of COVID-19 cases in Poland.

An important observation of this study is that three-quarters of infections with a known source occurred at the workplace, and nearly half of all patients were healthcare professionals. This finding is understandable, as healthcare professionals are exposed to the virus more often. Indeed, these data are in line with previous reports that healthcare-related SARS-CoV-2 infections represent a substantial proportion of all SARS-CoV-2 infections [21–23]. Importantly, although most patients in this study declared that they had used PPE, they still acquired the infection. Although the authors did not gather data on the types of PPE used, it seems to be insufficient in the cohort. Unfortunately, shortages of appropriate PPE for healthcare workers are problematic worldwide because of the unprecedented scale of the SARS-CoV-2 epidemic [24]. Providing PPE for healthcare workers in adequate quantities seems essential to maintain the workforce throughout the epidemic; however, other ways of improving the safety of healthcare professionals, such as routine testing at the workplace, should also be considered [25].

According to the ECDC rapid risk assessment report (as of April 23, 2020), nosocomial transmission is the prevalent setting of SARS-CoV-2 infections in Europe. In Italy, >17 000 healthcare professionals had been infected (10% of all registered infections in Italy) [26]. In Spain, 20% of COVID-19 cases were among healthcare work-

ers [26]. In Poland, similarly as in other European countries, healthcare-related SARS-CoV-2 infections represent a substantial proportion of all infections.

The frequency of SARS-CoV-2 infections among other professions was much lower than that observed in the healthcare industry. Indeed, only 3% of these cases worked in public administration or defense, and 3% worked in transportation. These are the key professions whose members continued to work despite the lockdown measures introduced in Poland.

Most patients with COVID-19 worked in companies that employed >100 people. It is conceivable that in larger companies the virus can spread to more people before it is detected. Moreover, infections among healthcare professionals, who usually work in facilities employing >100 people, may have contributed to this finding. The observation that the risk of acquiring a SARS-CoV-2 infection at work seems to be lower in small companies may be important from an economic standpoint. It is reasonable to suggest that the reopening of the economy should begin with small companies. To further reduce the infection risk at work, WHO has put forward a document suggesting several preventive actions, including disinfection of surfaces, hand hygiene, and respiratory hygiene, among others [27].

About 1 in 10 people in this study admitted that they had breached isolation rules by contacting other people. Such non-compliance reduces the effectiveness of home isolation, which could be why home isolation is less effective than institutional isolation [28,29]. Self-isolation is difficult, and observing all self-isolation rules may be challenging for many people. Therefore, it is essential to look for measures that can improve compliance with home isolation. A study from Israel found that compliance with a self-isolation regimen was 94% when financial compensation was given, but it decreased to 57% when the compensation was removed [30]. The psychological impact of self-isolation may be lowered by providing basic supplies

and clear information on the aims and protocols of isolation [31]. One group suggested that compliance with home isolation might be increased through public strategies to foster moral obligation and trust in public authorities [32]. In the present study, nearly half of the patients with COVID-19 in home isolation transmitted the disease to another person. In an earlier study, secondary transmission in household contacts was only 16% [33]. Although it would be preferable to isolate patients infected with SARS-CoV-2 outside of their home, to reduce the transmission risk within the same household, this strategy seems unfeasible because of the large scale of the epidemic.

Certain limitations of this study need to be mentioned. First, the data gathered in this study came from subjective declarations. This approach seems to be less reliable than using official reports. For example, the contacts between patients and their local sanitary-epidemiological stations could be verified through official reports. However, this seems unfeasible in such a large study sample. Similarly, when asked directly, people may tend to overestimate their compliance with isolation measures or not to disclose any breaches of the isolation rules. Second, the study included patients with confirmed infections only; therefore, the results may not be representative of the wider Polish population. For example, there may be a bias towards testing some professional groups more often than others. The strengths of this study include a large cohort, which was recruited by contacting all patients in home isolation during the study period.

CONCLUSIONS

Most of the patients with COVID-19 in home isolation in Poland are occupationally active, wherein the majority of people who were aware of the source of SARS-CoV-2 infection worked in healthcare. As most of the infected patients worked in companies with >100 workers, which is not a Polish employment pattern, the authors expect

that smaller companies may have a lower risk of SARS-CoV-2 infections. This finding should be considered when planning strategies for liberating economic restrictions as it indicates industries that require particularly stringent sanitary guidelines.

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