European Review for Medical and Pharmacological Sciences 2021; 25: 6425-6430

SARS-CoV-2 infection prevalence in people experiencing homelessness

M. RALLI[1,2], F. DE-GIORGIO[2,3,4], F. PIMPINELLI[5], C. CEDOLA[2,6], N. SHKODINA[2,6], A. MORRONE[7], A. ARCANGELI[8], L. ERCOLI[2,6,9]

[1]Department of Sense Organs, Sapienza University of Rome, Rome, Italy
[2]Primary Care Services, Eleemosynaria Apostolica, Vatican City State
[3]Department of Health Care Surveillance and Bioethics, section of Legal Medicine, Università Cattolica del Sacro Cuore, Rome, Italy
[4]Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, Italy
[5]Department of Microbiology and Virology, IRCCS San Gallicano Dermatological Institute, Rome, Italy
[6]Istituto di Medicina Solidale Onlus, Rome, Italy
[7]Scientific Director, San Gallicano Dermatological Institute, IRCCS, Rome, Italy
[8]Department of Anaesthesiology and Intensive Care Medicine, Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, Italy
[9]Department of Biomedicine and Prevention, Tor Vergata University, Rome, Italy

Massimo Ralli and Fabio De Giorgio equally contributed to this work

Abstract. – OBJECTIVE: People experiencing homelessness have peculiar characteristics that make them more vulnerable to Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) transmission and to more serious forms of Coronavirus Disease 19 (COVID-19). The aim of this study was to evaluate the prevalence of SARS-CoV-2 infection in the homeless population assisted by the primary care services of the Eleemosynaria Apostolica, Vatican City.

PATIENTS AND METHODS: Persons experiencing homelessness and the volunteers assisting them were tested for COVID-19 through PCR and antigen rapid test between October 1st, 2020, and June 5th, 2021, in the clinical facilities of the Eleemosynaria Apostolica.

RESULTS: A total of 1665 subjects from 96 different countries in five continents were included in the study; age range was 1-90 years. Overall, 2315 COVID-19 tests through nasopharyngeal swab were performed; 1052 Polymerase Chain Reaction (PCR) tests and 1263 antigen rapid tests. Nearly 40% of the subjects underwent both tests (n=650, 39.04%), 402 were tested with PCR test only (24.14%) and 613 with antigen test only (36.8%). PCR tests were negative in 966 cases and positive in 86 (8.17%), while antigen tests were negative in 1205 cases and positive in 58 (4.59%). The number of positive cases varied over time, with a drastic increase during the winter months of 2020 and a progressive decrease over 2021. Among positive cases, 24.41% were symptomatic; symptoms included fever, breathing difficulties, anosmia/hyposmia, cough, headache, and diarrhea.

CONCLUSIONS: This study reported an overall prevalence of SARS-CoV-2 infection in our sample slightly above 8%. Additional data on viral genome through sequencing of SARS-CoV-2 in positive cases are of utmost importance to help identify variants and implement specific infection control measures.

Key Words:
COVID-19, SARS-CoV-2, Homeless, PCR test, Fragile populations.

Introduction

The Coronavirus Disease 19 (COVID-19) pandemic due to Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has affected all segments of the population[1-4], with a significantly worse impact on fragile subjects, such as persons experiencing homelessness[5-10].

This specific population has peculiar characteristics that make it more vulnerable to virus transmission and to more serious forms of COVID-19[6,9,11-14]. In fact, homeless persons live in settings that may favor contagion and infection

Corresponding Author: Massimo Ralli, MD; e-mail: massimo.ralli@uniroma1.it

spread due to physical proximity, elevate population density, limited use of face masks and difficult access to public healthcare assistance[6,14,15]. Furthermore, people experiencing homelessness have an increased incidence of chronic diseases, substance abuse and poor mental/physical conditions, that lead to an all-cause mortality higher than the general population[9,16].

During the pandemic, the primary care services of the Eleemosynaria Apostolica, Vatican City, offered a SARS-CoV-2 infection control service for persons experiencing homelessness in the surrounding areas of the State through Reverse Transcription Polymerase Chain Reaction (PCR) and antigen rapid tests. Furthermore, prevention measures were implemented; they included distribution of face masks and hand-sanitizing gel, education on best practices to avoid contagion, and daily temperature and symptom check[17,18]. Last, COVID-19 vaccines have been administered to vulnerable populations starting January 2021[19,20].

The aim of this study was to evaluate through PCR and antigen rapid tests the prevalence of SARS-CoV-2 infection in people experiencing homelessness assisted by the primary care services of the Eleemosynaria Apostolica, Vatican City.

Patients and Methods

The study was performed between October 1st, 2020, and June 5th, 2021, in the clinical facilities of the primary care services of the Eleemosynaria Apostolica, Vatican City, and included 1665 subjects.

At admission, a medical doctor compiled for each person a clinical-anamnestic record investigating current or recent (previous 14 days) symptoms suggestive of COVID-19, such as fever > 37.5°C, cough, tiredness, hyposmia/anosmia, sore throat and breathing difficulties. Interview was followed by a basic health assessment with medical examination and measurement of body temperature, blood pressure, and oxygen saturation. Then, a nasopharyngeal swab for SARS-CoV-2 was performed. Subjects underwent PCR test, antigen rapid test, or both. In case of a positive antigen test, a PCR test was always performed the same day.

PCR analysis was performed within 4 hours from collection as follows: Bosphore® Novel Coronavirus (2019-nCoV) Detection Kit v3 was used to detect and characterize 2019-nCoV in human respiratory samples. Fluorescence detection was accomplished using FAM, HEX, Texas RED and Cy5 filters. SARS-CoV-2 was detected in three regions of the virus in a single reaction: E gene was used for screening purpose, where SARS-CoV-2 and the closely related coronaviruses are detected, and the orf1ab target region and N gene region were used to discriminate SARS-CoV-2 specifically. Before amplification, a fast extraction was performed. Real-time PCR was performed using Montania 4896® thermal cycler. Antigen rapid tests were performed using NADAL® COVID-19 Antigen Rapid Test, a chromatographic lateral flow immunoassay that checks for protein fragments from the virus and thus for its direct, physical presence in the body.

Repeated tests at different timepoints in the same subject were not included in the total count of tests (only the first test was included).

The study was conducted in accordance with the Declaration of Helsinki; all subjects signed a written informed consent.

Statistical Analysis

Descriptive analysis was used for the main demographic characteristics of the patients and results of SARS-CoV-2 tests. To assess the adequacy of the sample size in relation to the testing methodology used, the formula [n = z2 P (1 - P) / d2] was used[21]. Based on this formula, a minimum sample size of 753 subjects was considered adequate to provide a precise estimate of the prevalence. Prism Software version 8.3.1 (GraphPad Software LLC, La Jolla, CA, USA) was used to perform statistical analysis and prepare figures.

Results

A total of 1665 individuals were tested for COVID-19 through PCR, antigen or both tests. The sample included 1245 males (74.77%) and 420 females (25.22%); average age was 48.53 years (age range: 1-90 years). Most of the participants (n=1482, 89.01%) were experiencing homelessness living in the street or in congregate settings such as shelters or encampments, while 183 (10.99%) were volunteers that assisted the homeless.

Subjects came from 96 different countries in five continents; the most represented countries were Italy (n=644, 38.67%), Romania (n=138, 8.28%), Poland (n=131, 7.86%) and Egypt (n=65,

3.9%). Continent of origin was Europe for 1041 subjects (62.52%), followed by Africa (431 subjects, 25.88%), North and South America (112 subjects, 6.72%), Asia (80 subjects, 4.8%), and Australia (1 subject, 0.06%).

A total of 2315 nasopharyngeal swabs were performed: 1052 PCR tests and 1263 antigen tests. Nearly 40% of the subjects underwent both tests at the same time (n=650, 39.04%), 613 were tested with antigen test only (36.81%) and 402 with PCR test only (24.14%).

PCR tests were negative in 966 cases and positive in 86 (8.17%), while antigen tests were negative in 1205 cases and positive in 58 (4.59%) (Figure 1). For individuals undergoing both tests at the same time, 53 (8.15%) were positive to both tests, 27 (4.15%) had a positive PCR and a negative antigen test (false negative antigen test), and 5 (0.76%) a negative PCR and a positive antigen test (false positive antigen test). Five hundred sixty-five subjects (86.92%) resulted negative to both tests.

Overall positivity rate at PCR test was 8.17%; 8.54% (82/960) for people experiencing homelessness and 4.34% (4/92) for volunteers. When sorting PCR tests for country of origin, Africa had a 9.83% positivity rate (17/173), Asia a 34.55% (19/55), Europe 5.81% (47/809) and America a 20% (3/15) rate (Figure 2). Specific PCR positivity rates sorted per country of origin are shown in Table I.

The number of positive cases varied over time, with a drastic increase during the winter months of 2020 (Nov-Jan) and a progressive decrease over 2021 (Figure 3).

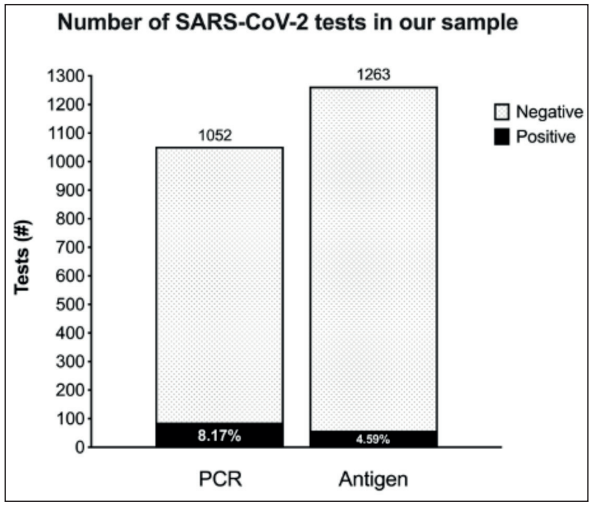

Figure 1. Number of SARS-CoV-2 tests in our sample.

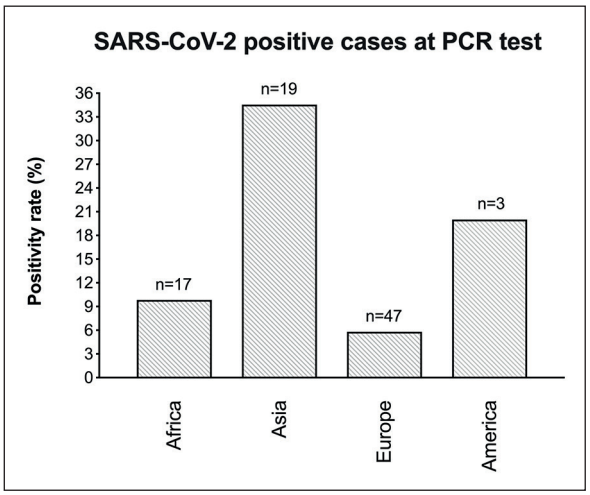

Figure 2. SARS-CoV-2 positive cases at Polymerase Chain Reaction (PCR) test sorted by continent of origin.

Among positive cases at PCR test, 21 (24.41%) were symptomatic; symptoms included fever, breathing difficulties, anosmia/hyposmia, cough, headache, and diarrhea.

Discussion

In this study, we reported the prevalence of SARS-CoV-2 infection in a fragile population consisting of people experiencing homelessness assisted by the primary care services of the Elemosynaria Apostolica, Vatican City, and in volunteers providing them assistance.

We found an overall positivity rate slightly above 8% in a sample of 1665 subjects; there were differences between the homeless and the volunteers, as well as when sorting per country of origin. The prevalence found in our study among homeless individuals is similar to that found in the general population over the same period in Italy[2,22,23]. However, it should be considered that fragile populations are more at risk of outbreaks with significantly higher contagion rates[24-28], as they have specific peculiarities regarding virus transmission compared to the general population. They include living in settings that favor infection spread, such as shelters, encampments or abandoned buildings, and limited access to basic hygiene supplies and prevention measures[5]. In addition, homeless people often present several comorbidities and have limited access to health care structures[29,30], thus worsening the impact of COVID-19 and leading to a higher mortality[5,31,32].

Table I. Positivity rate at PCR nasopharyngeal swab test in our sample sorted by country of origin.

Country	Tested subjects (#)	Positive cases (#)	Positivity rate (%)
Algeria	5	1	20%
Bangladesh	19	1	5.26%
Belarus	3	1	33.33%
Colombia	21	5	23.81%
Congo	18	3	16.67%
Egypt	44	4	9.09%
Eritrea	11	1	9.09%
Gabon	6	1	16.67%
Guinea	6	1	16.67%
Italy	543	34	6.26%
Mali	8	1	12.5%
Morocco	35	2	5.71%
Pakistan	4	2	50%
Poland	106	2	1.89%
Romania	102	7	6.86%
Russia	12	1	8.33%
Somalia	19	1	5.26%
Spain	12	1	8.33%
Sri Lanka	31	14	45.16%
Tanzania	3	1	33.33%
Tunisia	17	1	5.88%
Ucraine	27	1	3.7%

The SARS-CoV-2 prevalence found in our study is comparable to that found by other authors in similar fragile populations[25,25,33-35]. In our sample, most of the positive cases were reported during the winter months of 2020, with a progressive decrease over 2021. This can be explained by seasonal changes and by the beginning – in January 2021 – of a COVID-19 vaccination campaign in the Vatican City for people experiencing homelessness[19].

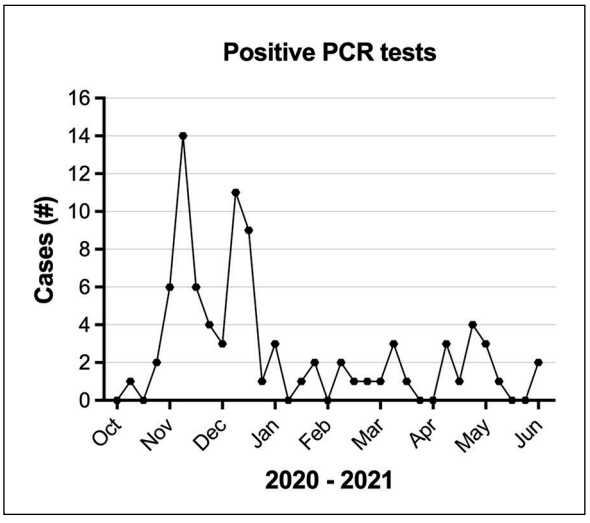

Figure 3. Timeline of positive SARS-CoV-2 cases in our sample between October 2020 and June 2021. Positive cases varied over time, with a drastic increase during the winter months of 2020 (Nov-Jan) and a progressive decrease over 2021.

In our sample, most subjects were asymptomatic; this is consistent with rates reported by other studies that showed an elevate number of cases without symptoms[27,36-38]. This also confirms that symptom screening and temperature monitoring alone in COVID-19 prevention are insufficient measures to reduce virus transmission, and routine surveillance with PCR, antigen and serological tests for SARS-CoV-2 should be implemented to identify and isolate asymptomatic cases.

The large number of countries of origin of subjects included in the study provided a near-complete geographical representation of the homeless population, and allowed an analysis also sorted by country. Infection prevalence rate ranged from 1.89% of Poland (106 subjects) to 45.16% of Sri Lanka (31 subjects). The elevate rate found for some countries may be explained by the low number of subjects and potential outbreaks in their living communities (such as the case of Sri Lanka); similar data have been reported in outbreaks in homeless shelters by other authors[24,26].

Limits of the Study

The main limit of this study is the absence of serological data for anti-SARS-CoV-2 antibodies in enrolled subjects that could have provided ad-

ditional details on infection spread. In addition, we did not report the rate of vaccinated subjects among positive and negative cases.

Conclusions

This study reported an overall prevalence of SARS-CoV-2 infection in our sample slightly above 8%. A large number of homeless individuals over a wide time span were included in the study, providing a comprehensive overview of infection spread and control in this population. Collection of additional data on viral genome through sequencing of SARS-CoV-2 in positive cases is of utmost importance to help identify variants and implement specific infection control measures.

Conflict of Interest

The Authors declare that they have no conflict of interests.

Acknowledgements

The authors wish to thank His Holiness Pope Francis for providing directions, structures, and equipment to make healthcare available for vulnerable populations through the Offices of Papal Charities (Eleemosynaria Apostolica), and Cardinal Konrad Krajewski, Apostolic Almoner, for the extraordinary efforts in the realization of this mission. The authors would also like to thank the Istituto di Medicina Solidale, Sr. Annalisa Maggiolini, Mr. Mario Mareri and Mr. Giancarlo Trobbiani.

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