Original Research / Orijinal Araştırma

Prevalence of COVID-19 During 2021 in Prishtina, Kosovo: A Population-Based Cross-Sectional Study

2021 Yılında Kosova, Priştine'de COVID-19 Prevalansı: Popülasyona Dayalı Kesitsel Bir Çalışma

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Abstract

Background: The global crisis of COVID-19 (Coronavirus disease 2019) has prompted comprehensive research into its impact, with studies uncovering varied occurrence and mortality rates. This study seeks to determine the prevalence of COVID-19 amongst the overall population based on self-reported symptoms and testing while also examining the association of prevalence with demographic, health, and epidemiological factors.

Methods: A cross-sectional survey was carried out with citizens of Prishtina, the capital city of Kosovo from May to June 2021. We calculated the prevalence of self-reported COVID-19 symptoms and positive tests among the citizens, as well as crude and adjusted ORs examining the association of COVID-19 infection with explanatory factors, including the protection and exposure coefficient.

Results: A total of 654 (52.1%) out of 1255 respondents reported having experienced COVID-19 symptoms. Six hundred (47.8%) households reported having an infected family member and 44 (7.3%) households reported having a dead family member due to COVID-19. In addition, 47.2% of 3,068 household members were infected with COVID-19, and 1.5% died due to COVID-19. A total of 689 respondents underwent testing for COVID-19 and 184 (26.7%) reported positive results. For individuals who reported COVID-19 symptoms, higher odds for infection were found among urban residents (adjusted OR, 1.53; 95%CI, 1.13-2.07; p=0.006), individuals with infected household members (adjusted OR, 2.53; 95%CI, 2.00-3.20; p<0.001), higher exposure coefficient (adjusted OR, 2.20; 95%CI, 1.42-3.41; p<0.001), and existing health conditions (adjusted OR, 2.22; 95%CI, 1.50-3.27; p<0.001). For individuals who underwent COVID-19 testing, higher odds for infection were found among individuals with infected household members (adjusted OR, 3.51; 95% CI, 2.29-5.39; p<0.001).

Conclusion: This study highlights the prevalence of COVID-19 in Prishtina and the significance of factors like existing health conditions, household size, epidemiologic behaviour, and the number of infected members as important determinants of COVID-19 incidence.

Keywords: COVID-19; pandemic; prevalence; symptoms; testing.

Özet

Giriş: Koronavirüs hastalığının (Coronavirus disease 2019-COVID-19) küresel krizi, etkilerine yönelik kapsamlı araştırmaları teşvik etmiş ve çalışmalar, farklı görülme ve ölüm oranlarını ortaya çıkarmıştır. Bu çalışma, kendi kendine bildirilen semptomlar ve testlere dayanarak genel nüfus arasında COVID-19 prevalansını belirlemeyi, ayrıca prevalansın demografik, sağlık ve epidemiyolojik faktörlerle olan ilişkisini incelemeyi amaçlamaktadır.

Yöntemler: Mayıs-Haziran 2021 tarihleri arasında Kosova'nın başkenti Priştine'deki vatandaşlarla kesitsel bir anket gerçekleştirdik. Vatandaşlar arasında kendi kendine bildirilen COVID-19 semptomları ve pozitif testlerin prevalansını, ayrıca COVID-19 enfeksiyonunun koruma ve maruziyet katsayısı gibi açıklayıcı faktörlerle ilişkisini inceleyen ham ve düzeltilmiş odds oranlarını hesapladık.

Sonuçlar: Ankete katılan 1255 kişiden 654'ü (%52.1) COVID-19 semptomları yaşadığını bildirdi. Altı yüz (%47.8) hane, bir aile üyesinin enfekte olduğunu ve 44 (%7.3) hane, bir aile üyesinin COVID-19 nedeniyle öldüğünü bildirdi. Ek olarak, 3064 hane üyesinin %47.2'si COVID-19 ile enfekte olmuş ve %1.5'i COVID-19 nedeniyle hayatını kaybetmiştir. Toplam 689 katılımcı COVID-19 testi yaptırmış olup, 184'ü (%26.7) pozitif sonuç bildirmiştir. COVID-19 semptomlarını bildiren bireyler arasında, enfeksiyon açısından daha yüksek olasılıklar; kentsel bölgede yaşayanlar (aOR, 1.53; 95%CI, 1.13-2.07; p=0.006), enfekte hane üyeleri olanlar (aOR, 2.53; 95%CI, 2.00-3.20; p<0.001), daha yüksek maruziyet katsayısı (aOR, 2.20; 95%CI, 1.42-3.41; p<0.001) ve mevcut sağlık sorunları olanlar (aOR, 2.22; 95%CI, 1.50-3.27; p<0.001) arasında bulunmuştur. COVID-19 testi yaptıran bireyler arasında, enfekte hane üyeleri olanlarda enfeksiyon açısından daha yüksek olasılıklar (aOR, 3.51; 95% CI, 2.29-5.39; p<0.001) bulunmuştur.

Sonuç: Bu çalışma, Priştine'deki COVID-19 prevalansını ve mevcut sağlık sorunları, hane büyüklüğü, epidemiyolojik davranış ve enfekte üye sayısı gibi faktörlerin COVID-19 insidansının önemli belirleyicileri olduğunu vurgulamaktadır.

Anahtar Kelimeler: COVID-19; pandemi; prevalans; semptomlar; test

Geliş tarihi / Received: 08.10.2024 Kabul tarihi / Accepted: 19.12.2024

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DOI: 10.21763/tjfmpc.1557681

Introduction

COVID-19 (Coronavirus disease 2019), caused by the novel coronavirus SARS-CoV-2, appeared as a global health emergency in late 2019 and has since affected millions of individuals worldwide.[1] Its prevalence is approaching 770 million cases globally, with more than 7 million deaths, while at least 67% of the total world population is already vaccinated with a primary dose of a COVID-19 vaccine,[2] although with significant variability between countries.[3] The rapid spread of the virus has led to significant morbidity and mortality, and a comprehensive strategy is crucial for addressing these challenges.[1]

COVID-19 manifests with diverse symptoms and clinical presentations, primarily affecting the respiratory system.[4] The virus's tropism for angiotensin-converting enzyme 2 (ACE2) receptors underpins the involvement of multiple organs, as reflected by gastrointestinal symptoms like nausea, vomiting, and diarrhea.[5] Additionally, an estimated 10% of individuals with SARS-CoV-2 infection experience long-term COVID-19, marked by the persistence of symptoms or the emergence of new symptoms after recovery from the acute phase of the illness.[6]

The identification of COVID-19 relies on various diagnostic tests designed to detect the presence of the SARS-CoV-2 virus or the antibodies produced in the response to the infection.[1] The polymerase chain reaction (PCR) tests, currently accepted as the "reference standard", amplify and analyse the viral genetic material to confirm the presence of the virus with high accuracy.[7] Conversely, antigen tests serve as a rapid alternative in detecting specific viral proteins and providing quicker results, although with a lower sensitivity.[8] They are also essential for monitoring seroconversion and seroreversion in individuals and communities.[8]

Based on the World Health Organization data, as of November 2024, there are 274,279 reported cases of COVID-19, and 46% of the total population was vaccinated with a complete primary series of a COVID-19 vaccine.[2] Kosovo has reported 3,212 deaths, and Europe reported more than two million deaths due to COVID-19.[2] The COVID-19 pandemic reached Kosovo relatively late compared to other countries in the region and Europe, with the initial confirmed cases reported on March 13, 2020.[9] With the extensive movement of people between Kosovo and many countries in the West, there were growing fears of rapid distribution of the virus from these countries[9]. Indeed, some of the first cases were in people who recently had been in Italy, which had a significant surge of COVID-19 cases during that time.[9] As of May 2021, there were 106,803 new cases of COVID-19 and 2,220 reported deaths due to COVID-19 in Kosovo.[2] Vaccination for the general population was unavailable until June 2021, although the first doses were administered in March 2021 to the high-risk groups.[2] There was a substantial worsening of the main COVID-19 pandemic indicators, new cases, and deaths after June 2021.[2] The identification of COVID-19 and its prevalence in Prishtina and elsewhere in Kosovo relied on PCR and antigen tests.[9]

During the COVID-19 pandemic, the Municipality of Prishtina took the initiative to perform several studies examining the prevalence among the population, municipality workers,[10] and healthcare workers.[11] A cross-sectional study of municipal administration workers with data collected between October and December 2020 showed that 21.1% of municipal workers tested positive for SARS-CoV-2 antibodies (IgG or IgM).[10] Another cross-sectional survey conducted in the same time frame among primary healthcare workers in Prishtina revealed that 17.47% tested positive for SARS-CoV-2 antibodies (IgG or IgM).[11] Additionally, 48.63% of these workers either had antibodies or reported a previous positive PCR test.[11] Both studies showed that the population under the study were abiding well by protective measures.[10,11] A nationwide study conducted from May to June 2021 by the National Institute of Public Health found that 37.0% of Kosovo's general population had detectable SARS-CoV-2 antibodies.[12] The highest seroprevalence (48.7%) was observed in the 60–69 age group.[12] While this study encompassed the entire country, Prishtina, the most populous city in the country, likely had a comparable or higher seroprevalence rate. This study's objective is to assess the prevalence of COVID-19 in the city of Prishtina in 2021 and investigate its correlation with various demographic, epidemiological, and health factors.

Methods

Study design and setting

We used a cross-sectional survey and collected data from a sample of residents of the municipality of Prishtina to determine the prevalence of COVID-19 among residents. The data were collected from May to June 2021. Ethical approval for the study was obtained from the Ethics Committee of the Kosovo Doctors Chamber (12-08-2020, ref. no. 8/2020), and informed consent was given by every participant of the study. The study was carried out by the guidelines of the Helsinki Declaration for human participant data.

2.2. Survey instrument

We developed a specific survey instrument for the study to collect data on population prevalence and other data. This survey collected various information on demographics, socioeconomic status, educational background, residence, body mass index, smoking status, alcohol consumption, existing conditions, self-reported COVID-19 test results, self-reported COVID-19 symptoms, number of infected and deceased family members from COVID-19

per household. Our survey questions were developed based on a comprehensive literature review and were subsequently reviewed by public health experts for relevance and clarity. We conducted a pilot test to identify and resolve issues, ensuring the questions were clear and effective. The survey instrument underwent rigorous validation processes, including content and construct validation and reliability testing, to confirm that it accurately measured the intended concepts and provided reliable data. The internal consistency of the scale was assessed using Cronbach's alpha. The scale, which consisted of 27 items, demonstrated good reliability with a Cronbach's alpha coefficient of 0.797. A local company collected the data. All interviewers underwent training on the study's methodology, survey administration, confidentiality, and ethical conduct.

Sample selection

The survey's method was multi-staged random probability sampling. We targeted a sample of over 1200, which is known as representative of residents of Prishtina. The sample frame targeted all residents of Prishtina municipality aged 18 years of age and older. Respondents were selected through the simple random sampling of individuals from a database of panel providers in Kosovo. Out of 3,097 contacts reached, we received responses from 1,255 respondents, i.e. 40.52% response rate. The power calculation for the sample was performed for a total population size of Prishtina (N=219,017), a final sample size of the study (n=1,255), an expected proportion or effect size of 5%, a significance level of 0.05, and a desired power of 0.8. The calculations suggest an effective sample size of approximately 1,248, which indicates that our study's sample size is more than sufficient to detect the expected proportion with the given significance level and desired power.

Data collection and participant involvement

All interviews were conducted via telephone. Interviewers thoroughly communicated and discussed the informed consent, outlining the study's purpose and procedures to ensure participants' comprehension. The consent process involved informing participants about the voluntary nature of their participation, granting them the option to refuse to answer any questions or retreat from the interview at any point. Following confirmation of understanding, participants were invited to engage in the research voluntarily. Informed consent was obtained verbally over the phone before starting the interview. Interviewers provided respondents with a contact number, and if a respondent could not answer the questions during the initial testing, a convenient appointment was scheduled. The interview data were manually recorded on a paper survey. The interview data were later entered into the database manually, posing a risk of bias due to errors or digitization errors. To address the risk of information bias, we implemented measures such as double data entry, validation checks, rigorous training, quality assurance protocols, and standardized forms to enhance accuracy and reliability.

Outcome measures

The primary pre-specified outcomes were COVID-19 prevalence and mortality, including (i) proportion of individuals with self-reported positive COVID-19 test as compared to the total sample of respondents, (ii) proportion of individuals with self-reported positive COVID-19 symptoms as compared to the total sample of respondents, (iii) proportion of households reporting an infection of a family member with COVID-19 as compared to total sample size of respondents, (iv) proportion of COVID-19 infected individuals among households compared to the total household members as reported by respondents, (v) proportion of households reporting deceased family members from COVID-19 as compared to total size of respondents, and, (vi) proportion of COVID-19 deaths compared to total household members as reported by respondents.

Additional outcome measures were the crude and adjusted OR of COVID-19 prevalence measures concerning different characteristics such as the level of education, gender, residence, exposure, and protective behaviours towards COVID-19, etc. The sample was weighted for age, gender, and residence. The exposure index was a self-calculated index of the average of nineteen different variables measuring different exposure behaviours, such as going out to shop in the markets, visiting indoor shopping centres, cafes and restaurants, attending weddings, funerals, or religious ceremonies, playing indoor sports, hospital visits, home visits, and travelling both within Prishtina and Kosovo and beyond within 30 days before participating in the study. Each of these different variables was measured with a 5-point Likert scale. The protective index was calculated as the average of seven variables measuring protection measures such as regular hand washing, routine use of hand sanitisers, avoiding touching the face with unwashed hands, ensuring physical distancing, and disinfecting surfaces and the phone. The individual variables creating composite protection measures were also measured with 5-point Likert scales.

Statistical analysis

Firstly, we estimated the prevalence and mortality from COVID-19 using self-reported measures. Then, we performed a descriptive analysis of COVID-19 prevalence measures against several categories of variables. All variables were tested for normality using a histogram, and summary measures (median and mean) were examined. Crude univariable logistic regression was conducted to test the unadjusted associations of variables with odds for prevalence. Then, all the variables with a p-value < 0.10 representing differences that could potentially influence the seroprevalence were included in multiple logistic regression. In both regression analyses, we used the weights

of the sample. All statistical analyses were conducted using Stata 18 BE (StataCorp LLC, College Station, TX, USA).

Results

Study sample and COVID-19 prevalence and mortality

A total of 1275 respondents refused to participate in the study, 108 respondents withdrew, and 38 were younger than 18 years old at the time of the interview. Additionally, 2,476 telephone numbers were unavailable, 546 were non-existent, 669 contacts had wrong residence information, 216 were already vaccinated, 567 could not complete the survey due to time-related issues, and three interviews were cancelled. This left us with a total sample of 1,255 participants living in Prishtina municipality. Table 1 summarises prevalence rates and sample characteristics.

A total of 184 (26.7%) out of 689 respondents who had performed the test, reported a positive COVID-19 test. Six hundred and fifty-four respondents (52.1%) reported positive COVID-19 symptoms. In addition, 47.8% of respondents reported having COVID-19-infected family members within the household. Respondents reported 1447 (47.2%) of COVID-19 infected individuals compared to a total of 3068 household members. Additionally, 7.3% of respondents reported dead family members from COVID-19. There were 47 (1.5%) COVID-19-related deaths compared to a total of 3068 household members. The average age of participants was 41.99 (±14.46) years. A larger portion of the respondents were males (59.6%) and resided in urban settings (86.1%). The household size was around five members.

Table 1. *Self-reported COVID-19 prevalences and characteristics of the sample*

	Events	Total	%
Prevalences			
Self-reported positive COVID-19 test	184	689	26.7
Self-reported positive COVID-19 symptoms	654	1255	52.1
Households reporting infected with COVID-19 family members	600	1255	47.8
Number of COVID-19-infected individuals compared to total household members	1447	3068	47.2
Households reporting dead family members from COVID-19	44	1255	7.3
Number of COVID-19 deaths compared to total household members	47	3068	1.5
Sample characteristics			
Age*	41.997	14.461	
Gender (Male)	748	1255	59.6
Urban residence	1,081	1255	86.1
Education			
Up to 9 years	111	1255	8.8
Up to 12 years	521	1255	41.5
More than 12 years	608	1255	48.4
Don't know/Refuses	15	1255	1.2
Employment status			
Employed	727	1255	57.9
Unemployed	437	1255	34.8
Retired/Disabled	91	1255	7.3
Household size (members)*	4.952	2.000	
Exposure coefficient*	0.6753617	0.275	
Protection coefficient*	4.294024	0.738	
Body-mass index*	25.94954	4.252	
Smoking status	458	1255	36.5
Alcohol consumption	148	1255	11.8
Existing conditions	158	1255	12.6

** Mean and Standard deviation*

Analyses of individuals with self-reported COVID-19 test

For individuals who reported undergoing a COVID-19 test (Table 2), we found a lower likelihood of COVID-19 infection for urban residents (aOR, 0.56; 95%CI, 0.35-0.89; p=0.014), individuals with up to 12 years of education (aOR, 0.44; 95%CI, 0.22-1.88; p=0.20), higher protection coefficient (aOR, 0.75; 95%CI, 0.58-0.98; p=0.037), and individuals who were smokers (aOR, 0.64; 95%CI, 0.43-0.96; p=0.029). Higher odds for infection were found among individuals with infected household members (aOR, 3.51; 95% CI, 2.29-5.39; p<0.001). No significant effect was observed with the exposure coefficient.

Table 2. Multiple logistic regression of individuals with self-reported COVID-19 test

	Positive (n = 184)		**Negative/Don't know (n = 505)**		**Crude Odds Ratio and 95%CI**				**Adjusted** Odds Ratio and 95%CI**			
	n	%	n	%	OR	Lower	Upper	P value	OR	Lower	Upper	P value
Age (years)*	40.603	14.449	42.713	14.050	0.99	0.98	1.01	0.257				
Gender (Male)	104	56.5	279	55.3	1.12	0.80	1.57	0.511				
Urban residence	157	85.3	451	89.3	0.65	0.42	1.00	0.051	0.56	0.35	0.89	0.014
Education												
Up to 9 years	16	8.7	34	6.7	Reference	.	.	.	Reference			
Up to 12 years	54	29.4	195	38.6	0.52	0.27	1.00	0.049	0.44	0.22	0.88	0.020
More than 12 years	111	60.3	272	53.9	0.83	0.45	1.53	0.544	0.74	0.38	1.45	0.384
Don't know/Refuses	3	1.6	4	0.8	1.28	0.31	5.31	0.732	0.95	0.22	4.19	0.949
Employment status												
Employed	122	66.3	318	63.0	Reference	.	.	.				
Unemployed	53	28.8	158	31.3	0.87	0.60	1.26	0.446				
Retired/Disabled	9	4.9	29	5.7	0.81	0.43	1.55	0.531				
Household size (members)*	5.060	1.885	4.863	1.927	1.04	0.96	1.14	0.329				
Infected household members	156	84.8	296	58.6	3.40	2.24	5.15	<0.001	3.51	2.29	5.39	<0.001
Exposure coefficient*	0.690	0.279	0.682	0.268	1.03	0.56	1.89	0.916				
Protection coefficient*	4.280	0.678	4.413	0.643	0.80	0.62	1.02	0.073	0.75	0.58	0.98	0.037
Body-mass index*	26.251	4.232	26.077	4.497	1.01	0.97	1.05	0.642				
Smoking status	51	27.7	188	37.2	0.60	0.41	0.87	0.008	0.64	0.43	0.96	0.029
Alcohol consumption	25	13.6	67	13.3	1.00	0.61	1.64	0.990				
Existing conditions	22	12.0	76	15.1	0.70	0.41	1.21	0.202				

** Mean and Standard deviation. ** Adjusted for variables listed in the calculation of adjusted estimates. The Hosmer-Lemeshow goodness-of-fit test indicated an adequate model fit ($\chi^2 = 9.43$, $p = 0.307$).*

Analyses of individuals with self-reported COVID-19 symptoms

For individuals who reported experiencing COVID-19 symptoms (Table 3), we found a lower likelihood of COVID-19-reported infection for males (aOR, 0.66; 95%CI, 0.52-0.84; p=0.001). Higher odds for infection were also found among urban residents (aOR, 1.53; 95%CI, 1.13-2.07; p=0.006), individuals with infected household members (aOR, 2.53; 95%CI, 2.00-3.20; p<0.001), higher exposure coefficient (aOR, 2.20; 95%CI, 1.42-3.41; p<0.001), and existing health conditions (aOR, 2.22; 95%CI, 1.50-3.27; p<0.001). No significant effect was observed with the protection coefficient.

Table 3. *Multiple logistic regression of individuals with self-reported COVID-19 symptoms*

	Positive (n = 654)		**Negative/Don't know (n = 601)**		**Crude Odds Ratio and 95%CI**				**Adjusted** Odds Ratio and 95%CI**			
	n	%	n	%	OR	Lower	Upper	P value	OR	Lower	Upper	P value
Age (years)*	41.726	14.663	42.291	14.245	1.00	0.99	1.00	0.288				
Gender (Male)	357	54.6	391	65.1	0.65	0.52	0.81	<0.001	0.66	0.52	0.84	0.001
Urban residence	586	89.6	495	82.4	1.78	1.34	2.37	<0.001	1.53	1.13	2.07	0.006
Education												
Up to 9 years	59	9.0	52	8.7	Reference	.	.	.	Reference			
Up to 12 years	252	38.5	269	44.8	0.84	0.56	1.25	0.385				
More than 12 years	336	51.4	272	45.3	1.12	0.75	1.67	0.577				
Don't know/Refuses	7	1.1	8	1.3	0.76	0.28	2.06	0.584				
Employment status												
Employed	375	57.3	352	58.6	Reference	.	.	.				
Unemployed	236	36.1	201	33.4	1.08	0.85	1.37	0.531				
Retired/Disabled	43	6.6	48	8.0	0.90	0.62	1.32	0.586				
Household size (members)*	4.924	2.039	4.983	1.958	1.00	0.95	1.05	0.838				
Infected household members	388	59.3	212	35.3	2.60	2.06	3.26	<0.001	2.53	2.00	3.20	<0.001
Exposure coefficient*	0.689	0.285	0.660	0.264	1.75	1.17	2.62	0.006	2.20	1.42	3.41	<0.001
Protection coefficient*	4.322	0.700	4.263	0.778	1.08	0.93	1.26	0.328				
Body-mass index*	25.898	4.428	26.006	4.052	0.99	0.96	1.02	0.479				
Smoking status	208	31.8	250	41.6	0.67	0.53	0.85	0.001	0.79	0.61	1.01	0.059
Alcohol consumption	78	11.9	70	11.7	1.07	0.76	1.52	0.689				
Existing conditions	102	15.6	56	9.3	1.88	1.31	2.70	0.001	2.22	1.50	3.27	<0.001

* Mean and Standard deviation. ** Adjusted for variables listed in the calculation of adjusted estimates. The Hosmer-Lemeshow goodness-of-fit test indicated an adequate model fit ($\chi^2 = 13.13$, $p = 0.217$).

Analyses of households with COVID-19-infected members

For individuals who reported a household with COVID-19-infected members (Table 4), we found a higher likelihood of COVID-19 reported for urban residents (aOR, 1.38; 95%CI, 1.03-1.83; p=0.03) and households with a higher number of family members (aOR, 1.07; 95%CI, 1.01-1.13; p=0.015).

Table 4. *Multiple logistic regression of households with COVID-19-infected members*

	Positive (n = 600)			**Negative/Don't know (n = 655)**			**Crude Odds Ratio and 95%CI**				**Adjusted** Odds Ratio and 95%CI**			
	n	%		n	%		OR	Lower	Upper	P value	OR	Lower	Upper	P value
Urban residence	530	88.3		551	84.1		1.34	1.01	1.78	0.046	1.38	1.03	1.83	0.030
Household size (members)*	5.113	2.008		4.805	1.982		1.06	1.01	1.12	0.022	1.07	1.01	1.13	0.015

* Mean and Standard deviation. ** Adjusted for variables listed in the calculation of adjusted estimates. The Hosmer-Lemeshow goodness-of-fit test indicated an adequate model fit ($\chi^2 = 2.69$, $p = 0.747$).

Discussion

In our study, we found that 26.7% of respondents who underwent testing were COVID-19 positive. Moreover, 52.1% of the total sample size reported experiencing symptoms indicative of COVID-19, and 47.8% of respondents disclosed having family members within their households who tested positive for COVID-19. Additionally, 47.2% of the total household members were described to have been infected with COVID-19, and 7.3% of respondents have lost family members to COVID-19, accounting for 47 deaths (1.5%) of the total household members. Higher protection of the population via preventive measures showed lower odds of COVID-19 infection in the group reporting testing. In contrast, higher exposure in public spaces indicated higher odds for COVID-19 infection in the group reporting COVID-19 symptoms.

Context

Our study found that 26.7% of respondents who underwent COVID-19 testing were positive. The results are comparable with findings from other studies performed in Kosovo, i.e. 21.1% of Prishtina municipal workers tested positive for SARS-CoV-2 antibodies (IgG or IgM),[10] 17.47% of healthcare workers tested positive for SARS-CoV-2 antibodies (IgG or IgM) and 48.63% either had antibodies or reported a previous positive PCR test,[11] or 37.0% of Kosovo's general population had detectable SARS-CoV-2 antibodies.[12]

By the end of November 2022, Europe had the most cases of COVID-19, the most deaths, and the most tests performed, even though it accounts for 9.4% of the world's population.[13] The prevalence of COVID-19 in countries across Europe has varied, with some nations experiencing higher positive case rates than others.[14] The lower incidence and mortality rates in Eastern European countries have been associated with various factors, including differences in healthcare systems, population density, and median age.[15] Kosovo's healthcare infrastructure and socio-economic landscape play a significant role in shaping the observed prevalence of COVID-19.[9] Compared to many European countries, Kosovo faced challenges such as limited healthcare resources, fewer testing facilities, and delayed access to vaccination during the pandemic.[9] Additionally, socio-economic disparities, including variations in education, income levels, relatively young population, and urban-rural healthcare accessibility, may have influenced testing rates and the detection of cases.[12]

Our study revealed that urban residents had higher odds of manifesting COVID-19 symptoms. For individuals who reported undergoing a COVID-19 test, Abu-Hammad et al. highlighted that the prevalence of COVID-19 in different cities and countries is influenced by numerous factors, including social, economic, demographic, environmental, and climatic factors.[16] Additionally, worse clinical outcomes and mortality were higher among men, and no single factor offers a strong explanation.[16]

Population density and size have been considered to influence COVID-19 transmission in cities. Still, the rate of spread was not proportional in some of the world's heavily populated countries, such as Egypt, the Gaza Strip, Indonesia, Bangladesh, and India.[17] Gonzalez-Val et al. investigated the determinants of the diffusion and intensity of COVID-19 at the country level, focusing on three urban variables: percentage of the urban population, population density, and primacy.[18] Major urban centres with a greater concentration of regions tightly connected through economic, social, and commuting ties face increased susceptibility to pandemic outbreaks.[17] Upon considering various economic and social variables, examining the relationship between urban density and COVID-19 morbidity and mortality rates revealed that the geographic distribution pattern of confirmed cases and deaths could not be solely attributed to density.[17] The study's findings utilising data from Japanese prefectures indicated a statistically significant inverse relationship between social capital and infection rates, particularly when adjusting for population density.[19] Compelling evidence was discovered, affirming that social capital indices serve as robust and significant predictors of COVID-19 spread rates, revealing that communities characterised by stronger bonding social capital experience diminished rates of COVID-19 transmission across counties.[20] Our study found higher odds of infection among individuals with infected household members. Numerous studies have underscored the significant impact of household size and the presence of infected household members on the prevalence of COVID-19.[21] Wang et al. observed that the rate of transmission among household members of a patient with SARS-CoV-2 infection was 30%.[22] Moreover, a study by Buchholz et al. on over 50,000 households concluded intense exposure to household contacts likely occurs before the symptom onset of the primary case (presymptomatic exposure), resulting in many secondary cases with a symptom onset shortly after the symptom onset of the primary case.[23] Understanding these dynamics has been crucial in shaping public health recommendations, emphasising the importance of isolation and quarantine measures within households to mitigate the virus's spread and protect vulnerable individuals.

According to our study, smokers were less likely to manifest symptoms or have a positive result if undergoing a COVID-19 test. A meta-analysis of observational studies reported that ever, current and former smoking was associated with 28%, 29%, and 25% increases in the relative risk of death in patients with COVID-19.[24] Additionally, our study did not detect a significant association between alcohol consumption or body mass index and COVID-19 prevalence or the likelihood of developing severe conditions related to COVID-19, despite

previous reports suggesting it as a notable risk factor. The mechanisms linking smoking to a reduced risk of infection remain uncertain and require further investigation. Therefore, the findings should be interpreted with caution, particularly given the well-established adverse health effects of smoking.

Study strengths and limitations

The strength of our study relies on the survey developed in consultation with published research and healthcare professionals. This study also provided insights into individuals' risk levels compared to the household size and the number of infected members within a household while measuring the exposure and protection coefficient. Our findings can help in long-term public health planning, assessing community immunity levels, and informing resource allocation in healthcare systems that may be less resilient. Additionally, it can guide public health policies tailored to local contexts, fill significant regional knowledge gaps, and monitor new variants that could disproportionately impact developing countries.

However, the study's main limitation stemmed from its small sample and average response rate. Regrettably, the lack of similar studies in Kosovo made it challenging to grasp Prishtina's citizens' risk profile and compare it to the prevalence of COVID-19 in Kosovo. Furthermore, there was a discrepancy between self-reported symptoms and self-reported positive COVID-19 tests. Several factors can be responsible, such as false negatives due to testing sensitivity, previous infections resulting in negative tests, symptoms caused by other illnesses, and the mildness of symptoms that might lead individuals to avoid seeking medical assistance. This highlights the limitations of self-reported data and the effect of disregarding untested cases concerning interpreting prevalence.

Additionally, limited access to healthcare, fear of stigma, and the cost or inconvenience of medical visits may further explain why symptomatic individuals did not seek medical help despite experiencing symptoms.

Implications for research and policymaking

Residents of the capital city may face a higher risk of COVID-19 due to the greater population density, as evidenced by the higher proportion of positive cases compared to the rest of Kosovo. This highlights the need for policymakers in Kosovo and other regions to continuously monitor and integrate emerging evidence and strategies worldwide. Such vigilance is crucial for developing effective policies that guide the implementation of protective measures. Our findings indicate the necessity for further studies to evaluate the spread of COVID-19 across different environments and populations. Public health strategies should focus on increasing testing capacity, targeted awareness, and contact tracing in densely populated areas . The associations with smoking, alcohol use, and BMI suggest complex biological and behavioural factors which require further study. These findings emphasise the need for tailored interventions, including promoting healthy lifestyles and improving outreach to at-risk groups.

Conclusions

In conclusion, this comprehensive study shed light on the prevalence of COVID-19 in Prishtina, drawing from self-reported symptoms and self-reported positive test data while simultaneously examining various influential factors. Notably, existing health conditions, household size, protective and exposing behaviour, and the number of infected members within households emerged as pivotal determinants of COVID-19 prevalence. This underscores the importance of tailored public health strategies considering specific vulnerabilities within different population segments. Moving forward, these insights provide a valuable foundation for refining mitigation measures and resource allocation in Prishtina and offering a template for similar studies in other urban settings grappling with the pandemic's impact.

Funding

The study was funded by the Municipality of Prishtina.

Conflict of Interest Statement

The authors declare no conflicts of interest related to this study.

Artificial Intelligence Statement

No artificial intelligence or automated tools were used in the design, analysis, or writing of this manuscript.

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