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COVID-19 vaccination knowledge, attitudes and practices among the general population of Romania during the third wave of COVID-19 pandemic

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Abstract

Objective: Romania began its COVID-19 immunization programme with approved vaccinations in three stages, as follows: The first step of vaccination is for health and social professionals, the second stage is for high-risk persons and the third stage is for the remainder of the general public. This study aims at assessment of knowledge, attitude and practice towards COVID-19 and vaccination against COVID-19 in the Romanian population during the third wave of the pandemic.

Methods: This cross-sectional study was based on a Bosnian and Herzegovinian study on COVID-19 vaccination during the country's third wave of COVID-19 pandemic.

Results: Our study sample, dominantly female (629; 61.0%), with a bachelor's degree (734; 71.2%), either single (539; 52.3%) or in a relationship (363; 35.2%), engaged in intellectual labour (910; 88.3%) and living in an urban environment (874; 84.8%) with a mean age of 25.07 ± 8.21 years, 294 (28.5%) people with COVID-19 symptoms and 86 (8.3%) were tested COVID-19 positive, had a mean knowledge score of 16.38 ± 4.0 with correct answer rates on questions ranging from 30.1% to 88.2%. Being single (odds ratio = 3.92, $p = 0.029$) or in a relationship (odds ratio = 3.79, $p = 0.034$), having a bachelor's degree and higher (odds ratio = 1.61, $p = 0.006$) and being COVID-19 tested (odds ratio = 1.82, $p < 0.001$) were associated with higher knowledge test scores. Our sample had relatively optimistic attitudes towards final COVID-19 disease containment (712; 69.1%) and vaccination programmes (679; 65.9%). The majority of the sample followed socio-epidemiological measures and did not visit places of mass social gatherings (666; 64.1%) and wore masks (992; 95.7%) while being outside their home. In terms of vaccination rates, 382 (37.0%) of the individuals were presently immunized against COVID-19. Higher knowledge test scores (>15 points) (odds ratio = 1.66, $p = 0.002$) and positive attitudes of this study (odds ratio = 1.59, $p = 0.001$, odds ratio = 4.16, $p < 0.001$) were identified as independent predictors for vaccinating against COVID-19.

Conclusion: Romanian citizens have had good knowledge, optimistic attitudes and appropriate practices towards COVID-19 vaccination during the third wave of COVID-19 outbreak in the country. Higher knowledge regarding the disease and vaccination against it not only increased attitudes towards the end of the pandemic, but also increased the willingness to be vaccinated and to avoid infection risk factors.

Keywords

COVID-19, Romania, vaccination, healthcare, pandemic, infectious disease

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Introduction

The coronavirus disease 2019 (COVID-19) is a highly contagious respiratory disease that was initially found in December 2019 in Wuhan city,[1] caused by the new coronavirus, severe acute respiratory syndrome coronavirus 2,[2,3] which quickly spread globally leading to a global pandemic as of 11th March 2020, declared by WHO.[4]

Clinical presentation of COVID-19 depends on the severity of the disease, ranging from asymptomatic with no symptoms to mild cases with anosmia, dry cough, fever, sore throat, fatigue, diarrhoea, muscle or joint pain and loss of taste or appetite, dyspnoea, fever, confusion, chest pain or sense of pressure in the chest,[5] and to severe cases with acute respiratory disease syndrome, sepsis, shock, multiorgan failure or even death.[6]

As COVID-19 spread worldwide, various countries with the help of healthcare professionals attempted to establish measures to halt the spread of the disease, reduce the number of new cases and reduce the COVID-19-related mortality and morbidities through various medical entities. These measures were different in each country and varied from no restrictions at all to severe lockdowns across the entire country.[7] Despite these vast measures, it still remains as one of the main challenges in public health to cease the spread of the disease with vaccination against COVID-19 being one of the most potent ways to prevent further death toll and morbidity. One of the main concerns of public health experts worldwide is vaccine hesitancy and diminishing confidence in vaccines among the populations.[8]

The first COVID-19 case in Romania was confirmed on 25th February 2020 when a Romanian citizen came in contact with an Italian carrier 5 days earlier.[9] After the initial spread of COVID-19 in the country, Romania has entered a state of emergency as of 16th March 2020, with countrywide lockdown, restrictions of movement, curfew, social distancing, mandatory mask wearing and so on. Consequently, Romania started its vaccination programme with the authorized vaccines within the European Union.[10] The vaccination process in Romania consists of three stages: In the first stage, health and social workers were vaccinated; in the second stage, high-risk individuals were vaccinated and in the third stage, which is the current stage, the rest of the general population are being vaccinated.[11] Even though the country has introduced a vaccination programme, still there is some hesitancy among the population.

Therefore, this study aims at assessment of knowledge, attitude and practice (KAP) towards COVID-19 and vaccination against COVID-19 in the Romanian population. There have been various KAP studies regarding COVID-19 conducted in other geographical regions and among various populations, such as Northern Ethiopia,[12] Pakistan,[13] China,[14] Iran[15] and so on. The high number of participants, the time of conducting the survey which is 1 year after the start of the pandemic and a few months after the start of the vaccination programme and a thorough questionnaire covering an extended amount of information are the particularities of this study.

Methods

A cross-sectional observational study, approved by the ethics committee of Iului Hațieganu University of Medicine and Pharmacy in Cluj-Napoca (58/12.03.2021), was conducted between 15th March and 15th April 2021 using an online questionnaire-based survey among 1031 individuals from the general population across Romania including both rural and urban areas. The minimum sample size computed for our population of Cluj-Napoca using $n' = n/1 + ((z2xp(1-p))/e2N)$ ($z - z$ score; e – margin of error, N – population size, p – population proportion) was 384 subjects ($z = 384$, $e = 5\%$, $N = 308{,}164$). All subjects were informed about the study objectives, usage of the data obtained in the study, anonymity of the questionnaire, instructions to fill out the questionnaire as well as the online written informed consent.

Data collection and study questionnaire

Developed based on the Bosnian and Herzegovinian study,[16] the survey consists of three sections: The first section focuses on collecting the demographic data with 10 questions, the second part includes 21 questions regarding the knowledge towards COVID-19 and vaccination and the third section includes attitudes and practices towards the vaccination against COVID-19 with six questions (Supplemental Material 1).

The data collection was carried out through an anonymous online survey between 15th March and 15th April 2021 in respect of COVID-19 socio-epidemiological measures at the time which limited this study to the online setting. The questionnaire was distributed using Google® forms Administration App, which limited one response per e-mail, thus limiting multiple responses from one individual, via the internet, university, healthcare and other institutional emails; social media such as Facebook®, WhatsApp®, Instagram® faculty and Romanian community groups, as well as being directly sent to primary care physicians. The e-mail lists were obtained through university and healthcare information systems and were not included in the dataset as they were encrypted to ensure anonymity. Respondents IP address indicated place of questionnaire response and each subject indicated place of the residence. The estimated time required for filling out the survey, which includes multiple choice questions, was about 5 min. The questionnaire was in Romanian language and the respondents were provided with information regarding the aim of the study, their online written informed consent and their voluntary participation, anonymity of the questionnaire, and instructions to fill out the questionnaire. Inclusion criteria for our study setting included

respondents who were (i) residents of Romania, (ii) older than 18 years and (iii) who fully completed the study questionnaire, while respondents who were younger than 18 years and who were not Romanian residents were excluded from the study.

The following information has been collected in the demographic part: age, gender, education level, marital status, profession, living environment and history of COVID-19 including whether the individual has experienced the symptoms of COVID-19 since last year, has been ever tested or not for COVID-19, the test results were positive or negative and has experienced reinfection or not. The following information was acquired in the second section: KAP of the respondent towards the symptoms, means of transmission, available treatment and methods of prevention of COVID-19, as well as attitude towards the rumours regarding the COVID-19 and its vaccination. The third section obtains information regarding the KAP towards vaccination against COVID-19 including the preferred vaccine, whether vaccinated against COVID-19 or not, the intention of receiving a COVID-19 vaccine, accord to the necessity of worldwide vaccination against COVID-19, wearing a mask and attending crowded places. Cronbach's alpha coefficient of the study knowledge questionnaire score was 0.802 indicating good level of reliability.[16]

Statistical analysis

Descriptive statistics were applied to the collected data to assess the KAP towards the COVID-19 and vaccination against it. The Statistical Package for Social Sciences (SPSS) IBM Statistics v26.0 was employed to analyse the collected data and obtain simple frequencies and cross-tabulation. A simple student's t-test and ANOVA test were performed to compare the means of continuous variables. Binary regression was carried out to investigate independent predictors for various variables. In the analysis, the 95% confidence interval, odds ratio (OR) and beta coefficients (β) were obtained to evaluate the associations between various variables. In all the statistical analyses, the p value of less than 0.05 was considered statistically significant.

Results

The study questionnaire was distributed to around 8900 individuals with the response rate of 11.6%. In total, 1037 participants completed the study questionnaire, after which six cases have been excluded due to exclusion criteria, giving the final sample of 1031 participants. Our study sample was dominantly female (629; 61.0%), with a bachelor's degree (734; 71.2%), either single (539; 52.3%) or in a relationship (363; 35.2%), engaged in intellectual labour (910; 88.3%) and living in an urban environment (874; 84.8%). Mean age of the sample was 25.07 ± 8.21 with age ranging 18–80 years. In the previous 30 days, 294 (28.5%) people experienced COVID-19 symptoms such as fever, cough, dyspnoea, diarrhoea, abdominal pain and myalgia; 600 (58.2%) individuals have been COVID-19 tested and 86 (8.3%) were COVID-19 positive. Being COVID-19 reinfected was also reported among 443 (42.9%) subjects. Positive willingness to be vaccinated against COVID-19 was reported among 811 (78.6%) subjects preferably with Pfizer-BioNTech® (396; 48.8%), Oxford Uni-AstraZeneca® (161; 19.8%), Moderna® (145; 17.8%), Sputnik V® (97; 11.9%) or Sinovac® (12; 1.5%). Only 382 (37.0%) subjects were currently vaccinated against COVID-19. All demographic characteristics of the study sample are displayed in Table 1.

COVID-19 vaccination knowledge test scores

The mean knowledge score of our sample was 16.38 ± 4.0 with correct answer rates on questions ranging from 30.1% to 88.2% which are displayed in Table 2. Only 85 (8.2%) subjects scored maximum points (21 points) in the study questionnaire. Knowledge test scores differed across education levels, living environment, COVID-19 tested and vaccinated ($p < 0.001$) which are presented in Table 1. Binary logistic regression model showed that being single (OR = 3.92, 95% CI: 1.15–13.40, $p = 0.029$) or in a relationship (OR = 3.79, 95% CI: 1.10–13.02, $p = 0.034$), having a bachelor's degree and higher (OR = 1.61, 95% CI: 1.14–2.28. $p = 0.006$) and being COVID-19 tested (OR = 1.82, 95% CI: 1.39–2.38, $p < 0.001$) were associated with higher knowledge test scores (Table 3).

Attitudes towards COVID-19 vaccination

From the whole sample, 712 (69.1%) subjects agreed that COVID-19 vaccination programmes will prevail in a battle versus COVID-19, while 679 (65.9%) people agreed that everyone should be vaccinated against COVID-19. The vast majority (811; 78.6%) agreed to be vaccinated preferably with Pfizer-BioNTech® (396; 48.8%), Oxford Uni-AstraZeneca® (161; 19.8%), Moderna® (145; 17.8%), Sputnik V® (97; 11.9%) or Sinovac® (12; 1.5%). Binary logistic regression model showed that males (OR = 2.91, 95% CI: 2.16–3.92, $p < 0.001$), those who had higher knowledge test scores (>15 points) (OR = 3.42, 95% CI: 2.42–4.83, $p < 0.001$), who were COVID-19 positive (OR = 3.54, 95% CI: 2.04–6.14, $p < 0/001$), who had COVID-19 symptoms (OR = 2.33, 95% CI: 1.61–3.39, $p < 0.001$) and who were already COVID-19 vaccinated (OR = 2.04, 95% CI: 1.51–2.76, $p < 0.001$) were more likely to agree that vaccination programmes shall conquer COVID-19. Male sex (OR = 1.46, 95% CI: 1.07–1.99, $p = 0.016$), higher knowledge test scores (>15 points) (OR = 4.50, 95% CI: 3.17–6.40, $p < 0.001$), being single (OR = 5.43, 95% CI: 1.14–25.76, $p = 0.033$) and in a relationship (OR = 5.85, 95% CI: 1.22–27.97, $p = 0.027$) were positive independent predictors for agreeing that everyone should get the vaccine, while male sex (OR = 1.44, 95%

Table 1. Demographic characteristics of the sample in comparison with knowledge scores.

Characteristics		Number of participants *N* (%)	Knowledge score
Gender	Male	402 (49.0)	14.61 ± 4.30
	Female	629 (61.0)	13.73 ± 5.53
Age (years)	18–29	813 (78.8)	14.21 ± 4.48
	30–49	89 (8.6)	13.17 ± 4.57
	>50	129 (12.6)	13.64 ± 3.10
Marital status	Single	539 (52.3)	14.37 ± 4.26
	In a relationship	363 (35.2)	13.96 ± 4.69
	Married	111 (10.7)	13.15 ± 4.52
	Divorced	18 (1.8)	11.55 ± 3.53
Education*	High school or lower	172 (16.7)	12.53 ± 5.60
	Bachelor's degree	734 (71.2)	14.56 ± 4.16
	Master's degree	100 (9.7)	13.01 ± 3.89
	PhD	25 (2.4)	14.17 ± 3.63
Occupation	Unemployed	67 (6.4)	12.73 ± 3.61
	Physical labour	54 (5.3)	12.87 ± 3.54
	Intellectual labour	910 (88.3)	14.13 ± 4.10
Place of residence*	Rural environment	157 (15.2)	13.03 ± 5.53
	Urban environment	874 (84.8)	14.24 ± 4.24
COVID-19-related information	COVID-19 positive	86 (8.3)	8.73 ± 4.26
	COVID-19 tested*	600 (58.2)	10.00 ± 3.97
	COVID-19 symptoms	294 (28.5)	9.28 ± 4.22
	COVID-19 vaccinated*	382 (37.0)	12.58 ± 3.26

*$p < 0.001$.

CI: 1.01–2.05, $p = 0.041$) and higher knowledge scores (>15 points) (OR = 10.85, 95% CI: 7.64–15.39, $p < 0.001$) were also associated with a positive attitude to get vaccinated against COVID-19. All other independent predictors associated with various attitudes are presented in Table 3.

Practices towards COVID-19 vaccination

A substantial number of subjects (365; 35.2%) continue to visit places of huge social gatherings. The majority of the sample followed socio-epidemiological measures and did not visit places of mass social gatherings 666 (64.1%) and wore masks 992 (95.7%) while being outside their home. In terms of vaccination rates, 382 (37.0%) of the individuals were presently immunized against COVID-19. Higher knowledge test scores (>15 points) (OR = 1.66, 95% CI: 1.19–2.30, $p = 0.002$) and positive attitudes of this study (OR = 1.59, 95% CI: 1.20–2.12, $p = 0.001$, OR = 4.16, 95% CI: 2.93–5.89, $p < 0.001$) were identified as independent predictors for vaccinating against COVID-19. All other independent predictors associated with various practices towards COVID-19 are presented in Table 3.

Discussion

To the best of our knowledge, this is the first study in Romania that evaluates current COVID-19 immunization KAP and related demographic factors. It produced important information about the socio-demographic characteristics of the ongoing public healthcare crisis, as well as their influence on population behaviour during the COVID-19 pandemic. Our study sample was predominately female, young, either single or in a relationship, with a high level of education, engaged in intellectual labour and living in an urban environment. Study subjects were knowledgeable about COVID-19 vaccination with good knowledge regarding COVID-19, prevention, vaccination facts and vaccination outcomes. Being single or in a relationship, having a bachelor's degree and higher, and being COVID-19 tested were associated with higher knowledge test scores. Our sample had relatively optimistic attitudes towards final COVID-19 disease containment and vaccination programmes. Romanian residents showed good practices with a majority not visiting places of mass social gathering, wearing masks while being outside their home and vaccinating against COVID-19. Higher knowledge and positive attitudes were identified as independent predictors for vaccination against COVID-19.

When compared to the initial Bosnian and Herzegovinian study,[17] our study sample had a rather positive response rate regarding the willingness to vaccinate against COVID-19. This contrasting behaviour which was observed is associated probably with better clinical outcomes among the reinfected who were immunized against COVID-19, easier administrative procedures (passing border, entering various institutions and working areas), different governmental policies and measures and good social media presentation of

Table 2. KAP towards COVID-19 vaccination questionnaire.

Knowledge test	*N*	Questions	Answers	Correct answer rate (%)
	1.	The main COVID-19 symptoms are fever, fatigue, dry cough, muscle pain, loss of smell and taste, abdominal pain and diarrhoea	True, False, I don't know	71.2
	2.	Compared to the regular cold, stuffy nose, runny nose and sneezing are less common among COVID-19 infected	True, False, I don't know	48.8
	3.	Currently, there is no effective cure for COVID-19, but early symptomatic and supportive treatment can help most of the infected to recover	True, False, I don't know	66.0
	4.	Kids and children usually develop mild forms of the COVID-19	True, False, I don't know	30.1
	5.	Not all COVID-19 infected will develop severe forms of the disease	True, False, I don't know	82.4
	6.	COVID-19 is spread through the respiratory droplets from one person to the other	True, False, I don't know	59.1
	7.	A person infected with COVID-19 cannot spread the disease before the development of COVID-19 symptoms	True, False, I don't know	41.9
	8.	A regular citizen can wear a face mask to minimize the possibility to be infected	True, False, I don't know	88.2
	9.	In order to prevent being infected, public transportation and places of mass social gathering should be avoided	True, False, I don't know	77.5
	10.	Vaccination against COVID-19 is one of the effective ways to prevent getting infected	True, False, I don't know	81.8
	11.	Patients who currently have antibodies due to previous COVID-19 infection do not need to be vaccinated	True, False, I don't know	59.1
	12.	Patients who had COVID-19 infection do not need to be vaccinated	True, False, I don't know	82.7
	13.	My blood type is less susceptible to COVID-19, so I do not need to be vaccinated	True, False, I don't know	83.2
	14.	Patients who are not at risk for severe and critical forms of COVID-19 do not need to be vaccinated	True, False, I don't know	72.7
	15.	COVID-19 vaccine is not safe due to the fact that its development was so fast	True, False, I don't know	68.4
	16.	Getting the vaccine against COVID-19 makes people more prone for other infections and diseases	True, False, I don't know	61.2
	17.	COVID-19 vaccines cause infertility	True, False, I don't know	67.4
	18.	COVID-19 vaccines will harm my health	True, False, I don't know	52.0
	19.	You can get COVID-19 from the vaccine against COVID-19	True, False, I don't know	72.3
	20.	COVID-19 vaccines have tracking chips	True, False, I don't know	54.3
	21.	COVID-19 vaccines alter DNA	True, False, I don't know	79.3
Attitudes	1.	Do you agree that vaccination programmes will win the fight versus COVID-19?	Agree, Disagree, I don't know	69.1, 5.2, 25.7
	2.	Do you agree that everyone should be vaccinated against COVID-19?	Agree, Disagree, I don't know	65.9, 27.8, 6.3
	3.	Are you going to get vaccinated against COVID-19?	Agree, Disagree, I don't know	78.6, 20.7, 0.7
Practices	1.	In recent days, have you visited crowded places or were in contact with a lot of people?	Yes, No	20.5, 79.5
	2.	In recent days, have you worn a mask while leaving your home?	Yes, No	91.9, 8.1
	3.	Have you already been vaccinated against COVID-19?	Yes, No	6.3, 93.7

KAP: knowledge, attitude and practice.

the vaccination facts, outcomes and misconceptions. Furthermore, a comparable sample period eliminates the influence of COVID-19 pandemic advancement on these data and links them to the previously indicated criteria. While studies[18] have identified determinants of COVID-19 vaccine hesitation such as low educational attainment, a lack of a recent influenza vaccination and an estimated personal risk of infection, higher knowledge of COVID-19 vaccines, which was observed among those who held high academic education, who were either single or in a relationship and those who tested themselves for COVID-19, as well as males, have been determined to be predictors for

Table 3. Independent predictors associated with COVID-19 vaccination knowledge test scores, various attitudes towards COVID-19 vaccination and current COVID-19 vaccination practices.

K: Independent predictors for having high knowledge test scores (>15 points) regarding COVID-19 vaccination				P1: Independent predictors for visiting crowded places in last days			
Independent predictors	OR	95% CI	*p* Value	Independent predictors	OR	95% CI	*p* Value
Education (bachelor's degree and above versus other)	1.61	1.14–2.28	0.006	Higher knowledge test scores (>12)	1.98	1.50–2.61	<0.001
Marital status (single versus other)	3.92	1.15–13.40	0.029	Living environment (urban versus rural)	0.66	0.44–0.97	0.039
Marital status (in a relationship versus other)	3.79	1.10–13.02	0.034	Wearing a mask in public	2.53	1.26–5.62	0.009
COVID-19 tested	1.82	1.39–2.38	<0.001	The model was not statistically significant $X^2 = 6.008$, $p = 0.111$; it explained 4.8% (Nagelkerke R^2) and correctly classified 65.8% of cases			
The model was not statistically significant $X^2 = 5.87$, $p = 0.438$; it explained 5.4% (Nagelkerke R^2) and correctly classified 66.0% of cases							
A1: Independent predictors for agreeing that vaccination programmes are going to win against COVID-19				P2: Independent predictors for wearing a mask in crowded places			
Sex (male versus female)	2.91	2.16–3.92	<0.001	Higher knowledge test score (>15)	3.45	1.76–6.78	<0.001
Higher knowledge score (>15)	3.42	2.42–4.83	<0.001	Living environment (urban versus rural)	3.17	1.59–6.33	0.001
COVID-19 positive (yes versus no)	3.54	2.04–6.14	<0.001	The model was not statistically significant $X^2 = 0.321$, $p = 0.852$; it explained 8.9% (Nagelkerke R^2) and correctly classified 96.2% of cases			
COVID-19 symptoms (yes versus no)	2.33	1.61–3.39	<0.001				
COVID-19 vaccinated (yes versus no)	2.04	1.51–2.76	<0.001				
The model was not statistically significant $X^2 = 13.3$, $p = 0.064$; it explained 22.8% (Nagelkerke R^2) and correctly classified 69.2% of cases							
A2: Independent predictors for agreeing that everyone should get the vaccine				P3: Independent predictors for vaccination against COVID-19			
Sex (male versus female)	1.46	1.07–1.99	0.016	Higher knowledge test scores (>15)	1.66	1.19–2.30	0.002
Higher knowledge score (>15)	4.50	3.17–6.40	<0.001	Positive attitude for agreeing that vaccination programmes are going to win against COVID-19 (yes versus no)	1.59	1.20–2.12	0.001
Marital status (single versus other)	5.43	1.14–25.76	0.033	Positive attitude for agreeing that everyone should get the vaccine	4.16	2.93–5.89	<0.001
Marital status (in a relationship versus other)	5.85	1.22–27.97	0.027	The model was not statistically significant $X^2 = 11.53$, $p = 0.021$; it explained 18.4% (Nagelkerke R^2) and correctly classified 64.2% of cases			
Marital status (married versus other)	4.51	0.90–22.47	0.065				
The model was not statistically significant $X^2 = 11.01$, $p = 0.138$; it explained 30.9% (Nagelkerke R^2) and correctly classified 77.2% of cases							

vaccination against this disease which correlates with the U.S. study's findings.[18] These findings were also observed in other studies as well.[19–21] Furthermore, the results showed that subjects who tested for COVID-19 had better knowledge test scores and were more supportive of vaccination efforts and their involvement in ending the pandemic. Similar Chinese study[21] found that individuals who were aware of their increased risk of infection were more willing to get vaccinated as soon as the vaccine was created rather than postponing it. Gender and marital status difference regarding knowledge test scores and various attitudes towards COVID-19 vaccination correlate also with findings in other studies.[21]

Even though the correct answer rates differ in a range from 30.1% to 88.2% in our study, it still was higher than the initial study. Being knowledgeable not only increases the chance to have positive attitudes towards immunization against the disease, but increases positive practices and willingness to vaccinate against COVID-19. To achieve herd immunity, approximately 50% of the population should get vaccinated[22] which is currently reachable with only 37.0% of the population being vaccinated. Because of the aforementioned, vaccination hesitancy is a growing problem and is inevitably connected to insufficient knowledge about the novel coronavirus and the vaccine itself.

Our study had several limitations. For starters, the cross-sectional study design makes inferring causality problematic due to a lack of prospective follow up of the population, as well as assessing changes in specific COVID-19 behavioural patterns. In addition, our study was limited to the individuals who had internet access and computer skills, thus decreasing the response rate from various groups of population.

Conclusion

In conclusion, Romanian citizens have had good knowledge, optimistic attitudes and appropriate practices towards COVID-19 vaccination during the third wave of COVID-19 outbreak in the country. Higher knowledge regarding the disease and vaccination against it, not only increased attitudes towards the end of the pandemic, but also increased willingness to be vaccinated and to avoid infection risk factors. Results presented in this study imply that a more profound education must take place to achieve satisfying results and protect the population from the spread of COVID-19 in other countries.

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Authors contribution

Armin Šljivo: study design, article writing, statistical critical revision and final approval. Arian Abdulkhaliq: study design, obtaining ethical approval, critical revision and final approval. Nermir Granov: initial drafting, article writing, grammatical and vocabular review. Leopold Reiter: initial drafting, article writing, grammatical and vocabular review. Eljakim Mahendran: study sampling and administrative and technical support for the sampling. Ioannis Zeglis: study sampling and administrative and technical support for the sampling. Mohammed Abdulkadir Mohammed: study sampling, data coding, data review and exclusion and inclusion of the study respondents. Assy Yousef: study sampling, data coding, data review and exclusion and inclusion of the study respondents. Ilma Dadić: study sampling, statistical analysis, data interpretation and statistical critical revision. Katarina Ivanović: statistical analysis, data interpretation, statistical critical revision, initial data presentation and drafting. Amina Selimović: statistical analysis, critical revision and final approval. Ermina Mujičić: statistical analysis, critical revision and final approval. Florina Maria Gabor-Harosa: article drafting, critical revision, article organization, initial data presentation and drafting.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics approval

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Informed consent

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Supplemental material

Supplemental material for this article is available online.

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