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<https://doi.org/10.2298/MPNS2204089U>**PREDICTORS OF VACCINATION AGAINST CORONAVIRUS DISEASE 2019 IN SERBIA***PREDIKTORI VAKCINACIJE PROTIV COVID-19 U SRBIJI***Snežana UKROPINA^{1,2}, Mioljub RISTIĆ^{3,4}, Vesna MIJATOVIĆ JOVANOVIĆ^{1,5},
Sonja ŠUŠNJEVIĆ^{1,5}, Vladimir VUKOVIĆ^{3,4} and Miloš MARKOVIĆ⁶****Summary**

Introduction. The main goal of vaccination against coronavirus disease 2019 is to significantly reduce the morbidity and mortality caused by severe acute respiratory syndrome coronavirus 2 infection. The free-of-charge recommended vaccination against coronavirus disease 2019 in Serbia started in December, 2020, and it is still ongoing. The aim of this study was to determine the main socio-demographic characteristics associated with the acceptance of vaccination against coronavirus disease 2019 among the Serbian population. **Material and Methods.** A cross-sectional survey was conducted among the participants aged ≥ 15 years in the general population of Serbia during September and October, 2021. Data were collected using an electronic questionnaire. **Results.** During the study period, a total of 1,418 participants were included in the survey. In general, vaccination against coronavirus disease 2019 was significantly ($p < 0.05$) more often accepted with increasing age of the participants, among females, those who were married and with higher education, among the university faculty members/health workers, employees in the government sector, those who had one child, and those with unspecified income. satisfaction compared to comparison groups. **Conclusion.** Taking into account all identified predictors, the main predictors of vaccination against coronavirus disease 2019 among our participants were family members/close friends or others who died from coronavirus disease 2019 and intention to get vaccinated against influenza in the future. There is an urgent need to conduct further studies that assess intentions, beliefs, and attitudes towards vaccines against coronavirus disease 2019 among the population throughout the Republic of Serbia.

Key words: Immunization; COVID-19 Vaccines; Serbia; Sociodemographic Factors; Health Knowledge, Attitudes, Practice; Surveys and Questionnaires; Vaccination Coverage

Sažetak

Uvod. Osnovni cilj vakcinacije protiv COVID-19 je značajno smanjenje morbiditeta i mortaliteta uzrokovanih infekcijom SARS-CoV-2. Preporučena, besplatna vakcinacija protiv COVID-19 u Republici Srbiji započeta je u decembru 2020. godine i još uvek traje. Cilj ove studije bio je da se utvrde glavne sociodemografske karakteristike u vezi sa prihvatanjem vakcinacije protiv COVID-19 među stanovništvom Republike Srbije. **Materijal i metode.** Sprovedena je studija preseka među učesnicima uzrasta ≥ 15 godina u opštoj populaciji Srbije tokom septembra i oktobra 2021. Podaci su prikupljeni korišćenjem elektronskog upitnika. **Rezultati.** Tokom posmatranog perioda, uključeno je ukupno 1.418 ispitanika. Uopšte posmatrano, vakcinacija protiv COVID-19 bila je značajno češće prihvaćena ($p < 0,05$) sa porastom uzrasta učesnika među ženama, onima koji su bili u braku i sa visokim obrazovanjem, kod nastavnika fakulteta/zdravstvenih radnika, onih koji su bili zaposleni u državnom sektoru, onih koji su imali jedno dete i ispitanika sa neodređenim zadovoljstvom u prihodima u poređenju sa poredbenim grupama. **Zaključak.** Uzimajući u obzir sve utvrđene prediktore, glavni prediktori vakcinacije protiv COVID-19 među našim učesnicima bili su podaci o postojanju članova porodice/bliskih prijatelja ili drugih koji su umrli od COVID-19 i namera da se ubuduće vakcinišu protiv gripa. Neodložno je potrebno sprovesti dalja istraživanja kojima se procenjuju namere, uverenja i stavovi prema vakcinama protiv COVID-19 među stanovništvom širom Republike Srbije.

Glavne reči: imunizacija; vakcine protiv COVID-19; Srbija; socio-demografski faktori; znanje o zdravlju, stavovi, praksa; ankete i upitnici; obuhvat vakcinacijom

Introduction

The global pandemic of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was declared by the World Health Organization (WHO) on March 11, 2020 [1]. The SARS-CoV-2 has

emerged as a major global concern, affecting not only the healthcare systems but also the economy, which sparked fear of a new worldwide economic downturn [2–4].

Elderly people and those with underlying medical conditions (e.g. cardiovascular disease, diabetes, chronic respiratory disease, or cancer) are at in-

Abbreviations

COVID-19	– coronavirus disease 2019
SARS-CoV-2	– severe acute respiratory syndrome coronavirus 2
WHO	– World Health Organization
OR	– odds ratio
CI	– confidence interval
IQR	– interquartile range

creased risk of developing severe infection caused by SARS-CoV-2. However, people at any age, regardless of their medical conditions, may get COVID-19 and become seriously ill or die [5].

The main goal of COVID-19 vaccination is to significantly reduce the morbidity and mortality caused by SARS-CoV-2 [3, 6].

The success of vaccination campaign can be undermined by vaccine hesitancy worldwide [2, 6]. Even before COVID-19 pandemic, WHO declared vaccine hesitancy as one of the ten challenges to global health [7], and this problem has grown throughout the ongoing COVID-19 pandemic [3, 8, 9].

In Serbia, the COVID-19 vaccination campaign using Pfizer-BioNTech BNT162b2 (Comirnaty®) started on December 24, 2020. The recommended immunization program was implemented (and it is still ongoing), and all COVID-19 vaccines were offered free of charge. Until the end of the study period, the Medicines and Medical Devices Agency of Serbia approved four vaccines for countrywide vaccination, namely Pfizer-BioNTech BNT162b2 (Comirnaty®), Gamaleya Research Institute Gam-COVID-Vac (Sputnik V®), Sinopharm BBIBP-CorV (Vero Cell®), and Oxford/AstraZeneca ChAdOx1-S/nCoV-19 AZD1222 (Vaxzevria®) [10], and everyone has the possibility to choose a vaccine among those four available. These vaccines are based on different platforms and have diverse mechanisms of action, which were previously described elsewhere [11–14]. According to available data (report of the Institute of Public Health of Serbia), during the first 10 months of 2021, a total of 6.172.015 doses of COVID-19 vaccines were given in Serbia (one dose was received by 2.870.046, two doses by 2.749.410, and three doses by 552.559 persons). Coverage of at least one dose of COVID-19 vaccine in adult population (over 18 years of age) of Serbia until October 31, 2021 was 49.8% [15]. The majority of citizens of Serbia (3.861.745 or 62.6%) were vaccinated with Sinopharm BBIBP-CorV.

The aim of our study was to evaluate the main socio-demographic characteristics as well as certain vulnerability factors for the acceptance of COVID-19 vaccines among Serbian population.

This study was public health surveillance and no clearance by Ethics Committee for this response is required in Serbia. Personal and confidential information were removed, except for demographic, socioeconomic, and vulnerability factors, as well as participants' COVID-19 vaccination status, and the data were anonymized before the authors could access them.

Material and Methods

The survey recruitment was performed from September 1 to October 31, 2021. Study participants were recruited from different parts of Serbia, including major cities, namely Belgrade, the capital city with approximately 1.7 million inhabitants, and Novi Sad, the main administrative Center of Vojvodina with a population of 362.675 citizens, as well as a number of smaller cities across Serbia. Data were collected using an electronic questionnaire. This cross-sectional survey was designed using Google forms® platform and used a snowball sampling strategy. At the beginning of the research, the study investigators shared the survey link in social media (Twitter, Instagram, Facebook), on the website of the Institute of Public Health of Vojvodina, Novi Sad) and through emails to their primary social contacts (aged ≥ 15 years). In the primary communication, respondents were requested to share the link of the survey.

On receiving and clicking the link, participants were auto-directed to the informed consent page, followed by the survey questionnaire. Once they filled out the questionnaire, the system would not allow them to sign up again. The inclusion criteria were as follows: (1) age of 15 years and over; (2) ability to read and complete the self-administered questionnaire independently; (3) voluntary agreement to participate in this study; and (4) knowledge of Serbian language. People who fulfilled these criteria and answered the questionnaire within the specified period were included in the study.

We used an anonymous, population-based, structured questionnaire in Serbian language. The questionnaire was developed based on relevant research on this topic after a thorough literature review [16–20]. We designed a questionnaire which consisted of several sections that covered demographic, socioeconomic, as well as various vulnerability factors. A history of vaccination against COVID-19 (vaccinated with at least one dose of COVID-19 vaccine or unvaccinated) was also included in the questionnaire. Detailed instructions to participants were also provided in order to inform them to select one or more given options from the list of answers, depending on the question they were referring to. A small survey that preceded the investigation was performed with the aim to further improve the quality of the questionnaire. The draft questionnaire was pilot tested in 200 participants. Based on these data and a feedback from these participants, a refined version of the questionnaire was prepared and included in the final study.

The primary group of the survey included those who were “vaccinated with at least one dose of COVID-19 vaccines” (we presumed that this classification potentially means that these participants intended to complete immunization against COVID-19 in the near future), and they were compared with those that did not receive any vaccine and were assigned to the “unvaccinated group”. Categorical

variables were compared using chi-square or Fisher's exact test. Fisher's exact test was used to determine whether or not there is a significant association between two categorical variables. Multivariable logistic regressions were used to assess the association between selected vulnerabilities of participants and COVID-19 vaccination status. The multivariable model was adjusted for potential confounders, including age, gender, marital status, having children, employment, and income satisfaction. Logistic regression models were employed using a priori hypothesis to tabulate odds ratios (OR) and their 95% confidence interval (CI). All analyses were performed using SPSS software tool (version 22) MedCalc for Windows, version 12.3.0 (MedCalc Software, Mariakerke, Belgium). A two-tailed p -value < 0.05 was considered statistically significant.

Results

General socio-demographic characteristics

During the study period, a total of 1,418 participants were enrolled. The mean age of the participants was 44 years (median age 44 years; interquartile range (IQR) 37 - 53). Out of the total number of respondents, 1,065 (75.1%) were vaccinated with at least one dose of COVID-19 vaccine, and 353 (24.9%) subjects were not vaccinated against COVID-19. The mean age of vaccinated and unvaccinated persons was 46 years (median age 45 years; IQR 39 - 53) and 39.3 years (median age 40 years; IQR 30 - 48), respectively.

Most of the study participants were aged 40 - 49 years (496/1,418; 35.0%), females (854/1,418; 60.2%), married (909/1,418; 64.1%), graduate award holders (644/1,418; 45.4%), service holders (649/1,418; 45.8%), employed in the government sector (641/1,418; 45.2%), without children (531/1,418; 37.4%), and with undefined income satisfaction (800/1,418; 56.4%). Out of all participants, there were respondents from the City of Novi Sad, other cities in Vojvodina, City of Belgrade, and other cities of Serbia, 918 (64.7%), 316 (22.3%), 113 (8%), and 71 (5%), respectively.

Socio-demographic characteristics

In general, vaccination against COVID-19 significantly ($p < 0.05$) increased with the age of participants, among females, among married participants, those with higher education level, among the university faculty members/health workers, those who were employed in the government sector, those who had one child, and those with undefined income satisfaction compared to comparison groups. Similar results were obtained when these characteristics were compared with the uptake of COVID-19 vaccines in four different settlement areas covered in our research separately, although few exceptions have been observed as follows: vaccination against COVID-19 was not significantly associated with the age of participants in other cities in Serbia ($p = 0.4698$), with gender in other cities in

Vojvodina ($p = 0.1320$) and other regions in Serbia ($p = 0.9128$), with marital status in Novi Sad ($p = 0.2207$), in Belgrade ($p = 0.3474$) and other regions in Serbia ($p = 0.0985$), with education level in Belgrade ($p = 0.1930$) and other regions in Serbia ($p = 0.0914$), with the number of children in other regions in Serbia ($p = 0.8576$), and income satisfaction in Belgrade ($p = 0.2958$) and other regions in Serbia ($p = 0.4143$) (**Table 1**).

Vulnerabilities of the participants

The **Table 2** shows the associations between certain vulnerabilities of the participants and COVID-19 vaccination status. Thus, multiple logistic regression models revealed that those who previously had laboratory-confirmed COVID-19, those who had family members affected by COVID-19, those who had family members/close friends or others who died due to COVID-19, those who were previously vaccinated against influenza, those who were planning to get the seasonal flu vaccine in the future, and respondents who received all childhood vaccines, were more likely ($p < 0.05$) to receive a vaccine against COVID-19. Surprisingly, presumably an important vulnerability factor of participants, namely "having any chronic disease" was not significantly associated (OR (95% CI): 1.24 (0.92 - 1.67)) with vaccination against COVID-19.

Discussion

To the best of our knowledge, this study is the first one to examine the association of certain demographic, socioeconomic and vulnerability factors of participants and their decision to receive COVID-19 vaccine after their implementation in the national immunization programme, using an online self-reported questionnaire.

This study was conducted in different locations of Serbia during the largest (fifth) wave of COVID-19 outbreak.

Public attitudes towards COVID-19 vaccination vary around the world [3, 21-26].

In our survey, as many as $\frac{3}{4}$ out of the total number of respondents were vaccinated with at least one dose of COVID-19 vaccine, and such a high uptake could be ascribed to a specific method design of our study (self-selected online voluntary survey), which may predominantly recruit persons that are more prone to be vaccinated. Indeed, the proportion of vaccinated individuals in our study was considerably higher compared to COVID-19 vaccine coverage in Serbia that was below 50% at the time when the study was carried out [15]. However, vaccination status of COVID-19 was different in four settlement areas where our participants lived. Namely, participants from the City of Novi Sad, other cities of Vojvodina, City of Belgrade, and other cities in Serbia received at least one dose of COVID-19 (80.5%, 70.3%, 61.1%, and 49.3%, respectively). A similar example of different prevalence of COVID-19 vaccine acceptance in different

Table 1. Demographic and socioeconomic factors and attitudes in relation to vaccination status against COVID-19 and respondents' place of residence**Tabela 1.** Demografski i socioekonomski faktori i stavovi u odnosu na vakcinalni status protiv COVID-19 i mestu prebivališta ispitanika

Variables/ <i>Varijable</i>	City of Novi Sad <i>Grad Novi Sad</i> (N/B=918)					p/p	Other cities in Vojvodina/ <i>Ostali gradovi u Autonomnoj Pokrajini Vojvodina</i> (N/B=316)					
	Total <i>Ukupno</i>	Vaccinated <i>Vakcinisani</i>	Unvaccinated <i>Nevakcinisani</i>	p/p	Total <i>Ukupno</i>		Vaccinated <i>Vakcinisani</i>	Unvaccinated <i>Nevakcinisani</i>	p/p			
	(N/B=739)		(N/B=179)		(N/B=222)		(N/B=94)					
	n	n %	n %		n		n %	n %				
Did you previously have laboratory-confirmed COVID-19?/ <i>Da li ste prethodno imali potvrđen COVID-19?</i>												
No/ <i>Ne</i>	667	565	84.71	102	15.29	<0.001	202	155	76.73	47	23.27	0.0008
Yes/ <i>Da</i>	251	174	69.32	77	30.68		114	67	58.77	47	41.23	
Were any of your family members affected by COVID-19?/ <i>Da li je bilo ko od članova Vaše porodice obolelo od COVID-19?</i>												
No/ <i>Ne</i>	537	452	84.17	85	15.83	0.0010	161	120	74.53	41	25.47	0.0898
Yes/ <i>Da</i>	381	287	75.33	94	24.67		155	102	65.81	53	34.19	
Did any of your family members/close friends or others die due to COVID-19? <i>Da li je bilo ko od članova Vaše porodice/bliskih prijatelja imao fatalni ishod zbog COVID-19?</i>												
No/ <i>Ne</i>	185	101	54.59	84	45.41	<0.001	59	27	45.76	32	54.24	<0.001
Yes, family member/close friend	223	197	88.34	26	11.66		49	37	75.51	12	24.49	
Yes, other/ <i>Da, drugi</i>	510	441	86.47	69	13.53		208	158	75.96	50	24.04	
Do you have any chronic disease (e.g. Diabetes mellitus, hypertension, chronic cardiovascular disease, chronic kidney disease, chronic obstructive pulmonary disease, malignancy or any other chronic diseases)?/ <i>Da li imate neko hronično oboljenje (dijabetes melitus, arterijsku hipertenziju, hronično kardiovaskularno oboljenje, bubrežno oboljenje, hroničnu opstruktivnu bolest pluća, malignitet ili dr.)?</i>												
No/ <i>Ne</i>	621	492	79.23	129	20.77	0.1589	217	140	64.52	77	35.48	0.0010
Yes/ <i>Da</i>	297	247	83.16	50	16.84		99	82	82.83	17	17.17	
Did you ever get the seasonal flu vaccine?/ <i>Da li ste ikada vakcinisani sezonskom vakcinom protiv gripa?</i>												
No/ <i>Ne</i>	630	478	75.87	152	24.13	<0.001	209	133	63.64	76	36.36	0.0003
Yes/ <i>Da</i>	288	261	90.63	27	9.38		107	89	83.18	18	16.82	
Do you plan to get seasonal flu vaccine in the future?/ <i>Da li planirate da se vakcinišete protiv gripa u budućnosti?</i>												
No/ <i>Ne</i>	336	203	60.42	133	39.58	<0.001	130	69	53.08	61	46.92	<0.001
Yes/ <i>Da</i>	299	276	92.31	23	7.69		99	89	89.90	10	10.10	
Unsure/ <i>Nisam siguran</i>	283	260	91.87	23	8.13		87	64	73.56	23	26.44	
Did you get all vaccines in a childhood?/ <i>Da li ste vakcinisani svim vakcinama u dečjem uzrastu?</i>												
No/ <i>Ne</i>	15	9	60.00	6	40.00	0.0433	6	1	16.67	5	83.33	0.0099
Yes/ <i>Da</i>	903	730	80.84	173	19.16		310	221	71.29	89	28.71	
Vaccines against COVID-19 available in Serbia are safe/ <i>Vakcine protiv COVID-19 u Srbiji su bezbedne</i>												
No/ <i>Ne</i>	117	23	19.66	94	80.34	<0.001	50	4	8.00	46	92.00	<0.001
Yes/ <i>Da</i>	697	650	93.26	47	6.74		205	186	90.73	19	9.27	
Don't Know/ <i>Ne znam</i>	104	66	63.46	38	36.54		61	32	52.46	29	47.54	
It is true that in our country there were not registered life-threatening reactions after immunization against COVID-19? <i>Da li je istina da u našoj državi nisu registrovane ozbiljne neželjene reakcije nakon vakcinacije protiv COVID-19?</i>												
No/ <i>Ne</i>	258	147	56.98	111	43.02	<0.001	108	50	46.30	58	53.70	<0.001
Yes/ <i>Da</i>	471	433	91.93	38	8.07		99	91	91.92	8	8.08	
Don't Know/ <i>Ne znam</i>	189	159	84.13	30	15.87		109	81	74.31	28	25.69	
Do you think that vaccines against COVID-19 can provoke autoimmune disease? <i>Da li mislite da vakcine protiv COVID-19 izazivaju autoimune bolesti?</i>												
No/ <i>Ne</i>	236	140	59.32	96	40.68	<0.001	70	29	41.43	41	58.57	<0.001
Yes/ <i>Da</i>	476	434	91.18	42	8.82		123	104	84.55	19	15.45	
Don't Know/ <i>Ne znam</i>	206	165	80.10	41	19.90		123	89	72.36	34	27.64	
Do you think that vaccines against COVID-19 can provoke infertility? <i>Da li mislite da vakcine protiv COVID-19 izazivaju sterilitet?</i>												
No/ <i>Ne</i>	594	539	90.74	55	9.26	<0.001	141	130	92.20	11	7.80	<0.001
Yes/ <i>Da</i>	159	84	52.83	75	47.17		78	30	38.46	48	61.54	
Don't Know/ <i>Ne znam</i>	165	116	70.30	49	29.70		97	62	63.92	35	36.08	
Adverse events after vaccination against COVID-19 are most commonly local (i.e. pain, swelling, redness) <i>Neželjene reakcije nakon vakcinacije protiv COVID-19 su najčešće lokalne (npr. bol, otok, crvenilo)</i>												
No/ <i>Ne</i>	69	23	33.33	46	66.67	<0.001	26	6	23.08	20	76.92	<0.001
Yes/ <i>Da</i>	796	690	86.68	106	13.32		241	192	79.67	49	20.33	
Don't Know/ <i>Ne znam</i>	53	26	49.06	27	50.94		49	24	48.98	25	51.02	
Do you think that vaccines against COVID-19 can protect you against severe clinical forms of disease and lethal outcome? <i>Da li mislite da vakcine protiv COVID-19 štite protiv teških formi oboljenja i smrtnog ishoda?</i>												
No/ <i>Ne</i>	141	38	26.95	103	73.05	<0.001	63	9	14.29	54	85.71	<0.001
Yes/ <i>Da</i>	711	661	92.97	50	7.03		201	183	91.04	19	9.45	
Don't Know/ <i>Ne znam</i>	66	40	60.61	26	39.39		52	30	57.69	22	42.31	

Variables Varijable	Belgrade/Beograd					Other regions of Serbia/Ostali regioni u Srbiji						
	(N/B=113)					(N/B=71)						
	Total Ukupno	Vaccinated Vakcinisani	Unvaccinated Nevakcinisani			p/p	Total Ukupno	Vaccinated Vakcinisani	Unvaccinated Nevakcinisani			p/p
	(N/B=69)	(N/B=44)				(N/B=35)	(N/B=36)					
	n	n %	n %				n	n %	n %			
Did you previously have laboratory-confirmed COVID-19?/Da li ste prethodno imali potvrđen COVID-19?												
No/Ne	80	54 67.50	26 32.50			0.0289	48	22 45.83	26 54.17			0.3991
Yes/Da	33	15 45.45	18 54.55				23	13 56.52	10 43.48			
Were any of your family members affected by COVID-19?/Da li je bilo ko od članova Vaše porodice oboleo od COVID-19?												
No/Ne	63	45 71.43	18 28.57			0.0112	37	18 48.65	19 51.35			0.9092
Yes/Da	50	24 48.00	26 52.00				34	17 50.00	17 50.00			
Did any of your family members/close friends or others die due to COVID-19? Da li je bilo ko od članova Vaše porodice/bliskih prijatelja imao fatalni ishod zbog COVID-19?												
No/Ne	27	6 22.22	21 77.78				25	4 16.00	21 84.00			
Yes, family member/close friend Da, član porodice/blizak prijatelj	29	20 68.97	9 31.03	<0.001			13	8 61.54	5 38.46	<0.001		
Yes, other/Da, drugi	57	43 75.44	14 24.56				33	23 69.70	10 30.30			
Do you have any chronic disease (e.g. Diabetes mellitus, hypertension, chronic cardiovascular disease, chronic kidney disease, chronic obstructive pulmonary disease, malignancy or any other chronic diseases)?/Da li imate neko hronično oboljenje (dijabetes melitus, arterijsku hipertenziju, hronično kardiovaskularno oboljenje, bubrežno oboljenje, hroničnu opstruktivnu bolest pluća, malignitet ili dr.)?												
No/Ne	79	45 56.96	34 43.04			0.1731	55	25 45.45	30 54.55			0.2300
Yes/Da	34	24 70.59	10 29.41				16	10 62.50	6 37.50			
Did you ever get the seasonal flu vaccine?/Da li ste ikada vakcinisani sezonskom vakcinom protiv gripa?												
No/Ne	71	32 45.07	39 54.93			<0.001	56	24 42.86	32 57.14			0.0451
Yes/Da	42	37 88.10	5 11.90				15	11 73.33	4 26.67			
Do you plan to get seasonal flu vaccine in the future?/Da li planirate da se vakcinišete protiv gripa u budućnosti?												
No/Ne	58	20 34.48	38 65.52				49	15 30.61	34 69.39			
Yes/Da	35	34 97.14	1 2.86	<0.001			9	9 100.00	0 0.00	<0.001		
Unsure/Nisam siguran	20	15 75.00	5 25.00				13	11 84.62	2 15.38			
Did you get all vaccines in a childhood?/Da li ste vakcinisani svim vakcinama u dečjem uzrastu?												
No/Ne	4	0 0.00	4 100.00			0.0211	3	0 0.00	3 100.00			0.2394
Yes/Da	109	69 63.30	40 36.70				68	35 51.47	33 48.53			
Vaccines against COVID-19 available in Serbia are safe/Vakcine protiv COVID-19 u Srbiji su bezbedne												
No/Ne	40	4 10.00	36 90.00				37	5 13.51	32 86.49			
Yes/Da	63	59 93.65	4 6.35	<0.001			28	26 92.86	2 7.14	<0.001		
Don't Know/Ne znam	10	6 60.00	4 40.00				6	4 66.67	2 33.33			
It is true that in our country there were not registered life-threatening reactions after immunization against COVID-19? Da li je istina da u našoj državi nisu registrovane ozbiljne neželjene reakcije nakon vakcinacije protiv COVID-19?												
No/Ne	53	13 24.53	40 75.47				41	9 21.95	32 78.05			
Yes/Da	39	37 94.87	2 5.13	<0.001			19	17 89.47	2 10.53	<0.001		
Don't Know/Ne znam	21	19 90.48	2 9.52				11	9 81.82	2 18.18			
Do you think that vaccines against COVID-19 can provoke autoimmune disease? Da li mislite da vakcine protiv COVID-19 izazivaju autoimune bolesti?												
No/Ne	48	13 27.08	35 72.92				38	7 18.42	31 81.58			
Yes/Da	49	43 87.76	6 12.24	<0.001			20	19 95.00	1 5.00	<0.001		
Don't Know/Ne znam	16	13 81.25	3 18.75				13	9 69.23	4 30.77			
Do you think that vaccines against COVID-19 can provoke infertility? Da li mislite da vakcine protiv COVID-19 izazivaju sterilitet?												
No/Ne	60	52 86.67	8 13.33				28	23 82.14	5 17.86			
Yes/Da	37	5 13.51	32 86.49	<0.001			34	6 17.65	28 82.35	<0.001		
Don't Know/Ne znam	16	12 75.00	4 25.00				9	6 66.67	3 33.33			
Adverse events after vaccination against COVID-19 are most commonly local (i.e. pain, swelling, redness) Neželjene reakcije nakon vakcinacije protiv COVID-19 su najčešće lokalne (npr. bol, otok, crvenilo)												
No/Ne	21	1 4.76	20 95.24				27	6 22.22	21 77.78			
Yes/Da	86	65 75.58	21 24.42	<0.001			41	29 70.73	12 29.27	<0.001		
Don't Know/Ne znam	6	3 50.00	3 50.00				3	0 0.00	3 100.00			
Do you think that vaccines against COVID-19 can protect you against severe clinical forms of disease and lethal outcome? Da li mislite da vakcine protiv COVID-19 štite protiv teških formi oboljenja i smrtnog ishoda?												
No/Ne	42	4 9.52	38 90.48				36	4 11.11	32 88.89			
Yes/Da	65	62 95.38	3 4.62	<0.001			28	27 96.43	1 3.57	<0.001		
Don't Know/Ne znam	6	3 50.00	3 50.00				7	4 57.14	3 42.86			

Table 2. Predictors of vaccination against COVID-19 according to certain characteristics of respondents – multivariate logistic regression model**Tabela 2.** Prediktori vakcinacije protiv COVID-19 prema određenim karakteristikama ispitanika – multivarijantni logistički regresioni model

Logistic regression variables <i>Varijable logističke regresije</i>	OR ^a (95% CI/Inter- val poverenja)	p/p
Previously having laboratory-confirmed COVID-19/ <i>Prethodna laboratorijska potvrda COVID-19</i>	2.15 1.64 – 2.80	< 0.001
Having family members affected by COVID-19/ <i>Postojanje obolelih od COVID-19 u porodici</i>	1.60 1.24 – 2.07	0.0003
Having family members/close friends or others who died due to COVID-19 <i>Postojanje smrtnog ishoda među članovima porodice/bliskim prijateljima</i>	4.75 3.56 – 6.34	< 0.001
Having any chronic disease (e.g. Diabetes mellitus, hypertension, chronic cardiovascular disease, chronic kidney disease, chronic obstructive pulmonary disease, malignancy or any other chronic diseases)/ <i>Postojanje bilo kog hroničnog oboljenja (dijabetes melitus, hipertenzija, hronično kardiovaskularno oboljenje, bubrežno oboljenje, hroničnu opstruktivnu bolest pluća, malignitet ili dr.)</i>	1.24 0.92 – 1.67	0.1605
Previous vaccination against influenza/ <i>Vakcinisan sezonskom vakcinom protiv gripa ranije</i>	2.98 2.14 – 4.13	< 0.001
Planning to get vaccinated against seasonal flu in the future <i>U planu vakcinacija protiv sezonskog gripa u budućnosti</i>	8.06 6.00 – 10.83	< 0.001
Received all vaccines in a childhood/ <i>Dobijene sve vakcine u dečjem uzrastu</i>	5.17 2.29 – 11.67	0.0001

^a Adjusted for the following variables: age, gender, marital status, having children, employment, and income satisfaction.

^a *Prilagođeno za sledeće varijable: godine, pol, bračni status, broj dece, zaposlenje i zadovoljstvo prihodima.* Numbers in bold indicate statistical significance/*Boldovani brojevi su statistički značajni.*

countries within the same region of South Asia has previously been published [6].

Regarding the age distribution and vaccine acceptance in our study, except for other regions of Serbia with no significant difference of received COVID-19 vaccine in terms of age groups, in all other three locations a higher incidence of vaccination was found among older compared to younger participants. This phenomenon may result from the fact that the older adults are at a higher risk of morbidity, hospitalization and mortality than the young ones [3].

Males are more willing to accept the vaccine against COVID-19 than females, and reasons for this gender inequality are not clearly defined [3]. One of the possible reasons for willingness to accept COVID-19 vaccines may lie in the higher fatality rate of COVID-19 among males [27]. However, at least based on our study, since vaccination was more frequent among females than males (79.3% vs. 68.8%, respectively), but only in two biggest cities in Serbia (Novi Sad and Belgrade), it is possible that the female population can be more easily convinced than males to get vaccinated for herd immunity, as it has already been suggested [28]. Furthermore, results of some studies showed that married individuals were more prone to get vaccinated than the unmarried ones [21, 29, 30]. With exception of other cities in Vojvodina, where married status was positively associated with vaccination, in all other three locations marital status was not an independent variable for receiving the COVID-19 vaccine.

Results of numerous studies worldwide strongly indicate that high education level and high-income status were associated with positive attitudes toward vaccination against COVID-19 [22, 23, 25, 28]. One of the probable reasons for this finding may be the fact that people with higher-level of education may

have a better understanding of both COVID-19 and immunization than those with less formal education [29]. Previously published data also showed that employed people, especially in professional and managerial occupations [25, 30] were more willing to accept COVID-19 vaccine. As expected, our results showed that respondents with higher level of education were more likely to be vaccinated than their counterparts. The present study also showed that health care workers, university faculty members, and those employed in the government sector were more likely to get vaccinated than their counterparts in all four investigated locations. Considering the fact that health care workers perceived a greater risk to get infected, as well as their high level of understanding all aspects of COVID-19, it is expectable that health care workers are more likely to be vaccinated than the others [31]. Indeed, we found that 83% of enrolled health care workers were vaccinated with at least one dose of COVID-19 vaccine.

We found that the participants who had family members/close friends or others who died due to COVID-19 and those planning for future seasonal influenza vaccination, were five and eight times, respectively, more likely to receive a vaccine than those in comparing groups. In contrast to other vulnerability factors, in our study the presence of chronic diseases was not significantly associated with the higher probability of getting vaccinated against COVID-19. Similar findings had been published before [6], and this was explained by the uncertainty about vaccine effectiveness, potential side effects and fear of disease deterioration and a lack of trust in vaccines that might have contributed to hesitancy. Fortunately, there are also findings which strongly indicate that participants with chronic disease, who may have severe health problems if they are diagnosed with COVID-19, are more willing to

get vaccinated than those belonging to other groups they were compared with [32].

It is well known that the spread of the SARS-CoV-2 virus is the perfect storm for conspiracy theories, and that the situation has significantly worsened since the COVID-19 pandemic included lockdowns [33]. This is especially important considering the inadequate knowledge about COVID-19 vaccination in particular, as well as existence of strong anti-vaccination movement in our region with their noticeable negative influence and destructive messages towards vaccination in general [34].

Our study has some limitations. First, it was a cross-sectional study, so our results primarily present a picture of the public response at the time point of this research. Second, our data were obtained by on-line self-administered questionnaire that may lead to biases due to limited participation of some members of the community, such as illiterate and those from rural settlements who did not have access to the internet. Third, there were only 3% of respondents aged 15 – 19 years (37 out of total 1,418). It should be also mentioned that, in accordance with National recommendation [15], subjects of this age group were vaccinated only with Pfizer-BioNTech BNT162b2 vaccine and therefore we cannot include their counterparts of the same age who would potentially prefer to get other available COVID-19 vaccines in Serbia. Fourth, although our online questionnaire was available across Serbia, it limits the generalizability of our results because they were not proportionally available

in all regions of our country, i.e. our recruited sample was not statistically representative of the Serbian population as a whole. Taking into account that the participation in our study was voluntary, this study has a potential for self-selection bias by the predominant participation of the subjects being previously vaccinated against COVID-19. Finally, there is a possibility that not every participant fully understood the connotations of the questions or that some of them answered questions based on what they considered to be expected from them, which all may influence the quality of our data, and therefore, our results should be interpreted with some caution.

Conclusion

In conclusion, dissemination of information on coronavirus disease 2019 vaccines, tailored to specific community needs across Serbia, may provide wider acceptance and increase the coverage of vaccination against coronavirus disease 2019. According to our findings, the main predictors of vaccination against coronavirus disease 2019 among our participants were information about having family members/close friends or others who died from coronavirus disease 2019 and intention to get vaccinated against influenza in the future. There is an urgent need to conduct further studies that assess intentions, beliefs, and attitudes towards vaccines against coronavirus disease 2019 among the population throughout the Republic of Serbia.

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