

ATTITUDES AND PRACTICES TOWARDS COVID-19 AND SEASONAL FLU VACCINES AND VACCINATION IN THE GENERAL POPULATION AND AMONG MEDICAL PROFESSIONALS

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The COVID-19 pandemic has led to the development of several types of vaccines, among which messenger RNA (mRNA)-based vaccines have represented a significant breakthrough. This study aimed to evaluate attitudes towards COVID-19 and seasonal influenza vaccination among the general population and individuals with a medical background. A questionnaire was developed to collect sociodemographic data, personal health information, vaccination status, and information on participants' attitudes towards and knowledge of vaccines. The profile of the typical participant was an employed woman with tertiary education, living with another person in an urban area and reporting generally good health. The typical participant had received at least two doses of the Sputnik V vaccine. Participants generally expressed favourable attitudes towards regular COVID-19 vaccination. The results showed no apparent differences between participants with and without a medical background regarding vaccine choice, the decision to receive a third dose, or seasonal influenza vaccination. Similarly, no apparent differences were observed in attitudes towards the AstraZeneca vaccine or mandatory COVID-19 vaccination between respondents with and without a medical background.

Keywords: COVID-19, seasonal flu, vaccine, attitudes toward vaccination

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INTRODUCTION

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, has profoundly impacted global health, leading to widespread illness, disruption of daily life, and significant socio-economic challenges. Just before the outbreak, in 2019, the WHO recognized vaccine hesitancy as a threat to global health. According to the WHO, vaccine hesitancy "threatens to reverse progress made in tackling vaccine-preventable diseases." The pandemic may have influenced these trends. Before the COVID-19 pandemic, the prevalence of vaccine hesitancy, as assessed using the conventional Parental Attitudes toward Childhood Vaccines (PACV) Scale, ranged from 5% to 34.7% across different countries. In Turkey, vaccine hesitancy and refusal have increased over the past decade; cases of vaccination refusal were previously rare but have risen rapidly since 2015. A survey conducted in Turkey between September and December 2021 found that 9.38% of parents were hesitant about vaccination, while 70.14% reported needing additional information regarding childhood immunization (1). According to Higgins et al., vaccination hesitancy and parental attitudes toward mandatory (routine) immunization in Colorado, USA, remained similar before and during the COVID-19 pandemic, at approximately 20.4%, a finding consistent with European data (2). In Europe, influenza vaccination coverage among healthcare workers (HCWs) varies by season; across the 2015/2016, 2016/2017, and 2017/2018 seasons, coverage ranged from 16% to 63% (median 30%). Belgium, England, and Wales have traditionally maintained good coverage (close to the WHO target level), while Italy, Norway, Hungary, Slovenia, and Eastern European countries generally report the lowest rates (3). In the 2021 season, England recorded the highest coverage among HCWs, at 76.4%. Over the period 2018–2023, vaccination coverage among HCWs in England ranged from 69% in 2018 to 49.6% in 2023, reaching a peak of 76.79% in 2021. Ireland likewise reported one of the highest HCW seasonal influenza vaccination rates in Europe, ranging from 42% to 71.28% over the same period, with a rate of 48.3% in 2023 (4). The greatest global success in seasonal influenza immunization among HCWs was achieved during the 2021 season. According to an Italian study, approximately 30.5% of HCWs reported changing their minds about influenza vaccination during the COVID-19 pandemic and subsequently chose to be vaccinated (5). It is a paradox that, although a high percentage of HCWs acknowledge the importance of influenza vaccination, coverage still falls short of the target level.

Public health strategies such as testing, contact tracing, quarantine, and social distancing play a crucial role in controlling the spread of the virus. Additionally, medical management includes supportive care for mild cases, hospitalization for severe cases, and the use of antiviral medications or monoclonal antibodies in certain situations (6). Nonetheless, widespread vaccination campaigns represent a key component in preventing severe illness and reducing the overall impact of the pandemic on public health.

To date, the European Medicines Agency (EMA) has authorized six COVID-19 vaccines for use and marketing, while the World Health Organization (WHO) is reviewing applications from 14 manufacturers for emergency use listing and/or prequalification. Depending on the production technology, vaccines differ in formulation and storage requirements. Vaccines based on innovative technology include messenger RNA (mRNA) vaccines. Comirnaty® (developed by BioNTech and Pfizer) and Spikevax (formerly the COVID-19 Moderna vaccine), both mRNA-based, were available for administration in Serbia. Viral vector vaccines available in the Republic of Serbia included Vaxzevria® (formerly the Oxford–AstraZeneca COVID-19 vaccine) and Gam-KOVID-Vac (Sputnik V), whereas Jcovden® (formerly the Janssen COVID-19 vaccine) was not marketed in the country. The inactivated SARS-CoV-2 vaccine (Vero cell), manufactured by Sinopharm (BIBP), was also available to citizens of the Republic of Serbia. In addition, vaccines based on viral protein subunit and/or recombinant protein subunit platforms are currently available, while ongoing research may lead to the development of novel vaccine platforms or the modification of existing vaccines (7).

The COVID-19 vaccination campaign in Serbia began as a voluntary, emergency-recommended immunization program in response to the global health crisis caused by SARS-CoV-2. The campaign officially began between December 28 and December 30, 2020, starting with the vaccination of residents of social care institutions, who were identified as the highest-risk group. The first dose of SARS-CoV-2 vaccine administered in Serbia in December 2020 was the Pfizer-BioNTech vaccine (Comirnaty, BNT162b2), the first vaccine to receive emergency use authorization both globally and in Serbia.

The Chinese vaccine (Sinopharm BBIBP-CorV) was introduced in late January 2021, followed by the Russian vaccine (Gam-KOVID-Vac, Sputnik V) in February. Additionally, the Covishield and Vaxzevria (ChAdOx1 nCoV-19/AZD1222) vaccines began to be administered in March 2021. Together, these vaccines formed the core of Serbia's

national vaccination program against SARS-CoV-2, aiming to achieve widespread immunity and control the pandemic. Vaccination was not mandatory for any segment of the population, including healthcare workers; instead, it was strongly recommended based on medical risk assessment and public health priorities. The campaign followed a risk-based prioritization model, with subsequent groups including healthcare professionals (starting January 5, 2021), the elderly, individuals with chronic illnesses, and other vulnerable or high-exposure populations.

Vaccination was organized through an online platform that allowed individuals to register their interest and receive information about vaccine availability. The program expanded progressively as vaccine supplies increased, with booster doses becoming available to eligible individuals beginning in August 2021. This approach ensured that vaccination efforts were tailored to the risk level of each group, balancing public health priorities with respect for individual choice.

In the Republic of Serbia, the COVID-19 vaccination campaign was accompanied by information disseminated by the authorities through various traditional and digital media (8). Legitimate vaccine information was provided primarily by National Regulatory Authorities and healthcare providers (9), as well as traditional media outlets such as national television, national newspapers, and local newspapers. During an immunization campaign, vaccine choice may depend on several factors, most of which are deeply personal but can also be shaped by external influences. A study conducted among the Serbian population identified five main reasons for hesitancy toward COVID-19 vaccination: concern over side effects, doubts about effectiveness, insufficient testing, mistrust of authorities, and conspiracy theories (8). Vaccine hesitancy is commonly defined as a spectrum of behaviors ranging from outright refusal to delayed acceptance of vaccination. However, some scholars conceptualize vaccine hesitancy as an attitude closely associated with, but not identical to, vaccination behavior in general (10). Considering the above, the present study aimed to evaluate the attitudes of medical professionals and the general public toward COVID-19 and seasonal influenza vaccination in Serbia. General data on respondents' well-being, vaccination profiles, and sources of vaccination information were also collected and analyzed to provide a clearer picture of vaccine hesitancy.

METHODS

Participants

For this study, a questionnaire based on relevant KAP (Knowledge, Attitudes, and Practices) research guidelines was used. Prior to data collection, approval was obtained from the Ethics Committee of the Faculty of Pharmacy, University of Belgrade (approval number 1434/2, dated 14 July 2021).

The questionnaire was developed at the Department of Social Pharmacy and Pharmaceutical Legislation for the thesis "Willingness to Vaccinate and Information Provided to the General Public about COVID-19 Vaccines" (candidate: Andjela S. Marinković; mentor: Prof. Dr. Dušanka Krajnović). Additional questions concerning willingness to receive a COVID-19 booster dose (third dose) were incorporated later for this research; however, this extension did not alter the ethical framework or violate any principles of ethical conduct and therefore did not require further approval. Additionally, the author and mentor of the same thesis granted permission for the use of the questionnaire in this research and contributed to the data analysis and the preparation of this paper.

All participants were verbally informed about the objectives, procedures, and purpose of the study prior to participation. They were informed that participation was entirely voluntary and that they could withdraw at any time without any negative consequences. Participants provided verbal consent to participate, and the anonymous nature of the study further minimized any potential risk to their privacy. The questionnaire did not contain any identifying information, such as names, surnames, or contact details, or any other data that could be used to identify participants, ensuring complete anonymity of all responses. Collected data were used exclusively for statistical analysis and presented in aggregate form. All electronic data were securely stored on a password-protected device accessible only to the research team. Given the nature of the study, which did not involve the collection of personal identifiers, the risk to participants was assessed as minimal. The study was conducted in accordance with fundamental principles of ethical research and applicable law.

This study included a total of 150 participants who completed the questionnaire between October 1 and October 31, 2021, evenly divided into two groups: 74 members of the general population and 76 healthcare workers. This distribution was designed to enable a direct comparison of knowledge, attitudes, and practices (KAP) regarding COVID-19 and seasonal influenza between the

general public and medical professionals.

Due to technical constraints and the pandemic environment, a convenience sampling method was used, including adult residents of Serbia who met the inclusion criteria: being 18 years of age or older, having the capacity to provide informed consent, and being able to complete the questionnaire independently.

Participants with medical education—including physicians, pharmacists, nurses, and other medical staff—were included to gather specific insights from individuals with professional exposure to infectious diseases and frequent patient interaction.

The sample size of 150 respondents was determined based on methodological guidelines for small- to medium-scale KAP studies, as well as practical considerations such as available time, resources, and access to respondents, given the constraints posed by the COVID-19 pandemic, including limited access to participants. The selected sample size allowed for timely data collection while maintaining a reasonable degree of precision, in line with similar rapid-response surveys conducted under emergency public health conditions. This number was deemed sufficient to perform basic descriptive and comparative statistical analyses with an acceptable level of reliability and precision. The combination of random and purposive sampling provided a balanced and contextually relevant overview of the two key population groups, reconciling timeliness and logistical feasibility with acceptable statistical rigor.

Questionnaire structure

The first part of the questionnaire addressed sociodemographic data, including age, family status, education level, and financial status. The second part addressed personal health, examining respondents' attitudes and health conditions. The level of interest in one's health was assessed using a five-point Likert scale (not interested, slightly interested, moderately interested, very interested, and strongly interested), while overall health status was assessed using a four-point Likert scale (very poor, poor, average, and excellent). Respondents were also asked to evaluate their well-being over the preceding two weeks using the following response options: all the time, most of the time, more than half the time, less than half the time, sometimes, never. During the survey, respondents demonstrated a high level of interest in their personal health, with 44.7% reporting that they were interested "a lot" and 36.0% indicating that they were "very interested." Regarding their self-rated health status, 42.0%

of respondents rated their health as good, 38.8% as average, 13.3% as excellent, and 4.7% as poor. The third part addressed influenza and COVID-19 vaccination. Seasonal influenza vaccination behavior was assessed using a single-item question: "Have you been vaccinated?", with a binary response option (Yes/No). The results showed that 26.7% of respondents reported receiving the seasonal influenza vaccine annually, while 73.3% reported that they did not. No statistically significant differences were observed in seasonal influenza vaccination rates between respondents with a medical background and those from the general population. Among respondents with a medical background, 25.0% reported receiving the vaccine, compared with 28.4% of respondents from the general population. The corresponding proportions of unvaccinated respondents were 75.0% and 71.6%, respectively. These findings are consistent with results from an Italian study conducted before the COVID-19 pandemic, which reported seasonal influenza vaccination rates ranging from 5% to 34% among HCWs (5). Data from the Italian study conducted during the 2021 influenza season showed that influenza vaccination coverage among HCWs reached 53.6% ($p < 0.001$), whereas no comparable coverage was observed in our study (5). The fourth section addressed the type of COVID-19 vaccine received, as well as respondents' attitudes towards and knowledge of COVID-19 vaccination.

Statistical analysis

Categorical variables were summarized using frequencies and percentages and presented in tabular form to assess vaccination readiness and public awareness of COVID-19 and seasonal influenza vaccines. Normality of data distribution was tested using the Kolmogorov–Smirnov test. The χ^2 test was used to compare categorical variables in univariate analysis. Statistical significance was defined as $p < 0.05$. Statistical analysis was performed using SPSS v.18 (Chicago, IL, USA).

RESULTS

Sample structure

A total of 150 respondents participated in the study, of whom 104 (69.3%) were female, and 46 (30.7%) were male. Of the total sample, 76 (50.7%) respondents had medical-science education, while 74 (49.3%) had no medical education, allowing for comparisons of their responses (Table 1). Regarding age distribution, 4.67% of respondents were aged 18–30 years, 40.00% were aged 31–45 years, and 55.33% were over 45 years of age. The target group

was selected based on sociodemographic and health-related characteristics, including age, sex, employment status, income, and health status, as well as the age categories for which the COVID-19 vaccine was approved. The majority of respondents had a monthly income ranging from 40,000 to 150,000 RSD and lived with other household members (Table 1).

Health and daily activities of the study population

At the time of the interview, respondents reported above-average interest in their health and generally rated their health status as average or good. It is also worth noting that approximately 40% of respondents had a chronic illness (Table 2). In this section, respondents were asked about their emotional and affective state during the two weeks preceding the survey. According to their responses, respondents felt cheerful, relaxed, calm, and engaged with matters of interest, and generally felt fulfilled most of the time during the two weeks before completing the questionnaire (Table 2).

Vaccination profile of the study population and attitudes towards vaccination

Respondents rarely reported receiving the seasonal influenza vaccine, and most had not received it in the same

year they received the COVID-19 vaccine (Table 3). Approximately 90% of respondents had received two doses of the COVID-19 vaccine (Table 3). In response to the question "What is the main reason for vaccination against COVID-19?", most respondents cited two reasons: concern for their own health and a sense of responsibility toward their family. Conversely, unvaccinated respondents reported that they had not been vaccinated either due to a prior Covid-19 infection or due to a general attitude against

Table 2. Health and daily activities-related questions and answers from the study population

Question number	Question	Answer	Total (%)
1	How much interest you have in your health	Slightly	1.3
		Moderately	18
		Above average	44.7
		Intensive	36
2	Subjective health status	Very bad	0.7
		Bad	4.7
		Average	38.7
		Good	42.7
		Excellent	13.3
3	Do you have any chronic medical condition	Yes	42.7
		No	57.3
4	I felt cheerful and in good spirits*	Never	0
		Almost never	20.8
		Less than half of the time	21.5
		More than half of the time	34.2
		Most of the time	21.5
5	I felt calm and at ease*	All the time	2
		Never	3.3
		Almost never	16.7
		Less than half of the time	28
		More than half of the time	32
6	I felt refreshed and relaxed*	Most of the time	18
		All the time	2
		Never	8
		Almost never	24.7
		Less than half of the time	32
7	My daily life was filled with things that interested me*	More than half of the time	24
		Most of the time	8
		All the time	2.7
		Never	0.7
		Almost never	27.3
		Less than half of the time	22
6	Total monthly income	More than half of the time	28
		Most of the time	21.3
		All the time	0.7
		Never	0.7
		Almost never	27.3

*The period of time the participants were referred to recall while answering included the previous two weeks

Table 1. Sociodemographic characteristics of the respondents from the total sample

Question number	Question	Answer	Total (%)
1	Place of residence	<10,000 people	1.3
		10,000-100,000 people	12.7
		>100,000 people	86
2	Gender	Male	30.7
		Female	69.3
3	Job-related category	Student	3.3
		Employed	86
		Retired	10.7
4	Education level	Primary	2
		Secondary	42
		Highest education (Master or PhD)	56
5	Do you have medical education	Yes	50.7
		No	49.3
6	Total monthly income	< 20,000 RSD	2
		20,000-39,999 RSD	9.4
		40,000-79,999 RSD	34.2
		80,000-150,000 RSD	34.9
		>150,000 RSD	19.5
7	Living with	Alone	18.7
		With someone	81.3

Table 3. Vaccination profile and attitudes towards vaccination of the study population

Question number	Question	Answer	Total (%)
1	Do you receive seasonal flu vaccine regularly?	Yes	26.7
		No	73.3
2	Have you received the seasonal flu vaccine this year?	Yes	32.7
		No	67.3
3	Have you received a vaccine against COVID-19?	Yes – one dose	2
		Yes – two doses	90.7
		No	7.3
4	What is the main reason for vaccination against COVID-19?*	Traveling – COVID passport	6.7
		Care for health	48.9
		Following recommendations	3.5
		Faster pandemic resolution	18
		Responsibility and care for family	44.8
		Employees request	2.8
3	What is the reason for not taking vaccines against COVID-19?	Had COVID-19	41.7
		I am not in a risk group	16.7
		I do not take vaccines generally	33.3
		I do not want to	8.3

*More than one answer was available

vaccination (Table 3). Among the available vaccines, respondents most often chose Sputnik V, followed by Sinopharm, then Pfizer/BioNTech, and finally Vaxzevria® (Oxford-AstraZeneca), chosen by approximately 8% (Table 4). Approximately 94% of respondents received two vaccine doses, and 55% believed that a third dose should be of the same vaccine as the first two (Table 4). Additionally, 70% of respondents believed that vaccination should be mandatory in Serbia. When asked whether they belonged to a risk group, approximately 32% responded affirmatively (Table 4). Vaccine refusal was generally low (8); however, some respondents indicated that they would refuse certain vaccines, predominantly Oxford-AstraZeneca (Table 5). Approximately 65% of respondents stated that the Vaxzevria® (Oxford-AstraZeneca) vaccine would not be an option for them, as its safety profile and effects were subject to additional monitoring in some countries. Data presented in Table 5 show that 87.2% of respondents believe it is necessary to continue adhering to epidemiological measures even after vaccination, while 12.8% believe it is not. Additionally, 9.4% of respondents believe that the COVID-19 vaccine can cause infertility, while

Table 4. Vaccination profile of the study population

Question number	Question	Answer	Total (%)
1	If you are vaccinated for COVID-19, what vaccine was it?	Pfizer/BioNTech COVID19	22.7
		Sputnik V (Gam-KOVID-Vak)	40.4
		AstraZeneca	7.8
		Sinopharm (BBIB-CoV)	28.4
2	If you received two doses of vaccine, do you want to receive a third?	Yes	94
		No	5.7
3	Would a third dose of vaccine be the same as the first two?	Yes	55
		No	45
4	Should vaccination be mandatory?	Yes	70
		No	30
5	Do you fall into a group of respondents with high risk?	Yes	32.7
		No	67.3

90% believe it does not. When respondents suspected they had a COVID-19 infection, they were most likely to confirm this with a medical practitioner, with a significantly smaller proportion relying on other sources of information (Table 5). Respondents reported obtaining information about COVID-19 vaccination primarily from medical doctors and official websites, but also, to a considerable extent, from various social media platforms (Table 5).

Interviewed respondents reported that 60% had not searched the internet for information about COVID-19 vaccines (Figure 1). They reported either requiring assistance in distinguishing false from accurate information or experiencing little difficulty in doing so (Figure 2). Approximately 90% of respondents believed they should follow epidemiological recommendations after vaccination (Figure 3). Television was the primary source of information related to COVID-19 and vaccines, ahead of medical practitioners, with pharmacists and social media cited least frequently (Figure 4). The findings indicate that respondents placed particular importance on comprehensive coverage of topics (59.3%), up-to-date information (51.3%), and information from official sources (52.0%). Furthermore, 64.7% of respondents considered the presentation of differing opinions important (Figure 5). Most respondents rarely reported experiencing difficulties in understanding instructions related to therapy or medication or in following similar procedures, and generally felt confident completing medical questionnaires during examinations.

Table 5. Knowledge and attitudes about COVID-19 vaccination

Question number	Question	Answer	Total (%)
1	Is there a COVID-19 vaccine that you would refuse to take?	Pfizer/ COVID19	1.4
		Sputnik V (Gam-KOVID-Vak)	4.2
		AstraZeneca	13.2
		Sinopharm (BBIB-CoV)	4.9
		Moderna (Moderna mRNA 1237)	4.9
		I would not refuse any vaccinee	69.4
		I would refuse every vaccinee	1.4
2	Would you receive a vaccine whose effects are being closely monitored in other countries (e.g., AstraZeneca)?	Yes	34
		No	66
3	Should you follow epidemiological recommendations after you receive two doses of vaccine?	Yes	87.2
		No	12.8
4	Do you think that the COVID-19 vaccine can cause infertility?	Yes	9.4
		No	90.6
5	What was your main source of information in case you suspect COVID-19 infection?	Social media	11
		Television	16.4
		Medical practitioner	60.6
		Pharmacist	5.1
		Health-related web pages	16.7
		Official web pages*	7.4
		Other	0.7
6	What was your main source of information about COVID-19 vaccines?**	Social media	11.4
		Television	25.4
		Medical practitioner	48.7
		Pharmacist	6.1
		Health-related web pages	14.3
		Official web pages*	34.2
		Medical journals for professionals	10.7

*Official web pages given by the government of RS and the Ministry of Health (Public Health Institute Batut); **some respondents gave more than one answer.

Comparison between the attitude of medical and non-medical personnel

Table 6 indicates that there were no statistically significant differences in vaccine choice based on respondents' health education background. There was likewise no statistically significant difference in preference for a third dose between respondents with medical education and the general public. No statistically significant differences were found in responses regarding seasonal influenza vaccination between the two groups. Similarly, no statistically significant differences were observed in attitudes toward mandatory vaccination between the two subgroups, suggesting that medical education was not a significant factor in these responses (Table 6).

DISCUSSION

This study was conducted among the general population in October 2021. The most common respondent profile was that of an employed woman with the highest level of education (a Master's or PhD degree), living with someone in a place of residence with a population exceeding 100,000 and reporting a monthly income between 80,000 and 150,000 RSD. Nearly equal proportions of respondents fell into the 40,000–79,999 RSD and 80,000–150,000 RSD income categories (34.2% and 34.9%, respectively). These characteristics are broadly consistent with the socio-economic profile of Serbian society; however, other segments of the population, particularly those without employment or higher education, were underrepresented (11). In some countries, attitudes toward vaccination have been influenced by financial circumstances when vaccination was not provided free of charge (12). In Serbia, however, vaccination was provided free of charge; therefore, financial background should be considered separately from factors that may directly influence the vaccination process.

Examining attitudes toward COVID-19 and seasonal influenza vaccination helps us understand public opinion and improve vaccination awareness. This is particularly relevant given the resurgence of diseases that had previously been significantly reduced, such as pertussis, rubella, and measles (13). In Serbia, approximately 70% of respondents do not receive the influenza vaccine annually (Table 3), consistent with findings from a study conducted in April/May 2021, "Readiness of the General Population for Vaccination against COVID-19," which reported that only 8.2% of respondents received the seasonal influenza vaccine regularly. Even during the 2020/2021 season, the

Table 6. Comparison between the vaccine profile in respondents with and without medical education

Question	Answer	Respondents (number, %)		Statistical parameters
		With medical education	Without medical education	
Vaccine type	Pfizer/BioNTech COVID19	19 (25.3%)	13 (19.7%)	χ^2 (Df) = 4.683 (4); p = 0.321
	Sputnik V (Gam-KOVID-Vak)	34 (45.3%)	23 (34.8%)	
	AstraZeneca	5 (6.7%)	6 (9.1%)	
	Sinopharm (BBIB-CoV)	17 (22.7%)	23 (34.8%)	
	None	0 (0%)	1 (0.7%)	
Third dose	Yes	71 (94.7%)	62 (93.9%)	χ^2 (Df) = 0.350 (1); p = 0.852
	No	4 (5.3%)	4 (6.1%)	
Flue vaccination	Yes	19 (25%)	21 (28.4%)	χ^2 (Df) = 0.219 (1); p = 0.640
	No	57 (75%)	53 (71.6%)	
Would you receive AstraZeneca?	Yes	24 (31.6%)	27 (36.5%)	χ^2 (Df) = 0.402 (1); p = 0.562
	No	52 (68.4%)	47 (63.5%)	
Obligatory vaccination?	Yes	56 (73.7%)	49 (66.2%)	χ^2 (Df) = 0.402 (1); p = 0.562
	No	20 (26.3%)	25 (33.8%)	

Collecting information about vaccines
In the past four weeks, have you looked for vaccine-related information on the Internet?

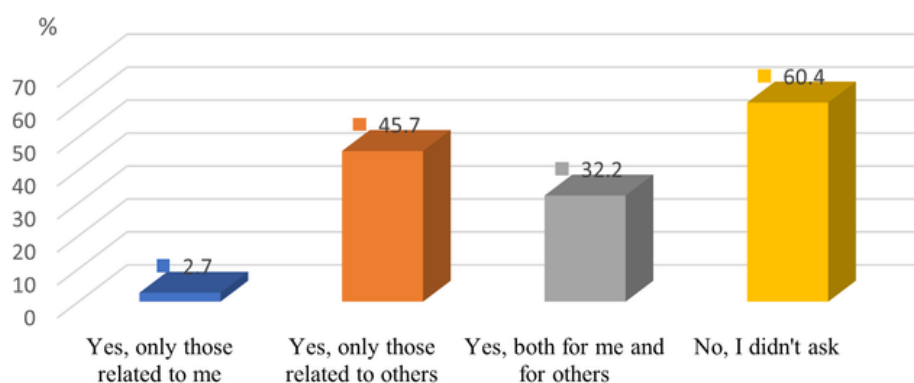


Figure 1. In the past four weeks, have you looked for vaccine-related information on the Internet?

same study reported a rate of 9.1% (14). These results align with epidemiological data on influenza vaccination rates among individuals aged 65 and older in Serbia, at 15.2% for the 2022 season and 14.03% for the 2023 season, according to WHO immunization data for Serbia (15). Although influenza is not widely perceived by the general population as a major health threat, a large-scale study has estimated that influenza is responsible for between 15,000 and 70,000 deaths worldwide annually (16). Seasonal influenza therefore continues to place a burden on the healthcare system. Given that 33% of respondents in our

study do not receive vaccines in general, these findings could help inform future promotional campaigns aimed at overcoming identified barriers to immunization.

In the study population, approximately 91% of respondents had received two doses of the COVID-19 vaccine (Table 3), consistent with findings from other European population studies, such as those conducted in the UK and Denmark (17). In general, a second dose produces a more reliable immune response and greater effectiveness than a single dose (7). People receive COVID-19 vaccines to protect themselves and their families from the virus. By getting vaccinated, individuals reduce their risk of infection and of subsequently transmitting the virus to family members. Vaccination not only helps prevent illness and severe complications but also contributes to community immunity, which in turn helps protect vulnerable individuals at higher risk of severe illness, such as older adults, immunocompromised individuals, and those with underlying health conditions (chronic disease). Receiving the COVID-19 vaccine therefore benefits not only the individual

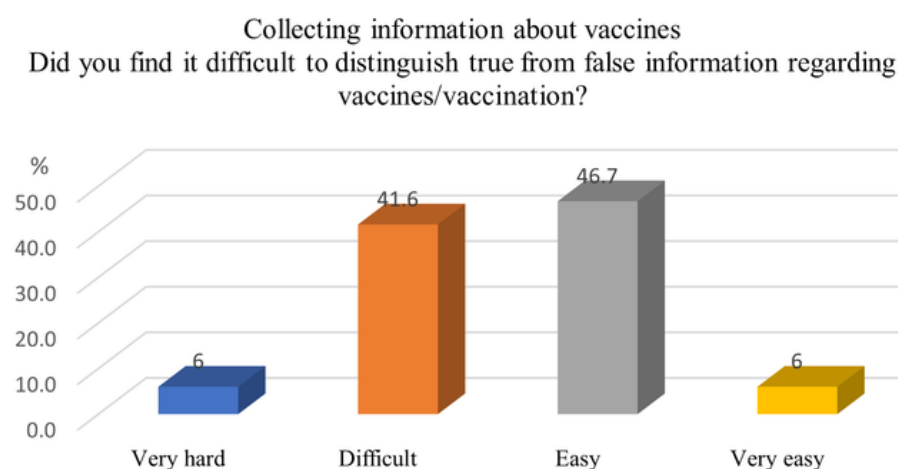


Figure 2. Did you find it difficult to distinguish true from false information regarding vaccines/vaccination?

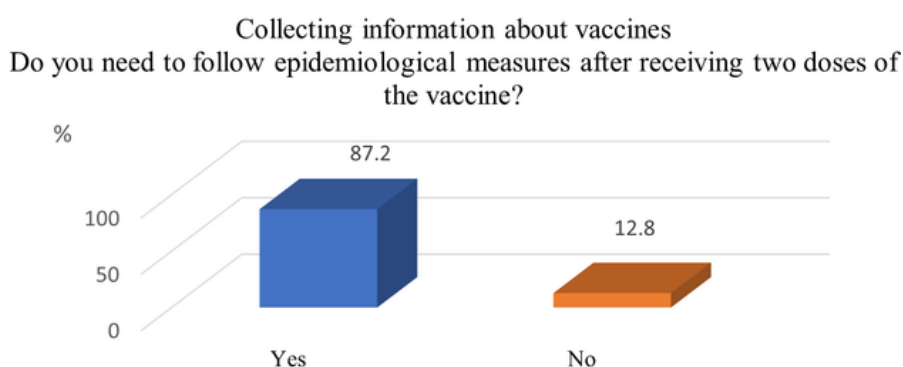


Figure 3. Do you need to follow epidemiological measures after receiving two doses of the vaccine?

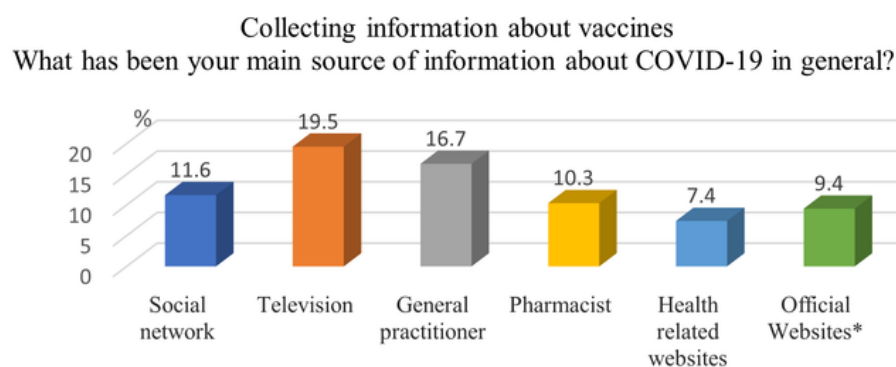


Figure 4. What has been your main source of information about COVID-19 in general?

but also plays a crucial role in safeguarding the health and well-being of their families and communities (18). Consistent with this, respondents in the study population reported that they were vaccinated to protect their own health and prevent transmission of infection within their families. This is further reflected in the attitude of 70% of respondents who believe that COVID-19 vaccination should be mandatory. A study conducted in the Balkan region similarly indicates a relationship between trust in political authorities and vaccination response (19).

Vaccine hesitancy has been identified as a significant global health threat, driven in part by misguided safety concerns that have contributed to the spread of diseases such as measles, diphtheria, and pertussis (20). Religious beliefs and the influence of political leaders may also play a significant role in vaccine refusal. Personal or philosophical beliefs are likewise relevant, with some individuals believing that immunity acquired through natural infection is superior to vaccination, that the side effects of vaccines outweigh their benefits, or that a healthy lifestyle alone is sufficient to prevent disease (21). In the present study population, the most commonly reported reason for not receiving the COVID-19 vaccine was the perception that vaccination was unnecessary following a previous COVID-19 infection (Table 3).

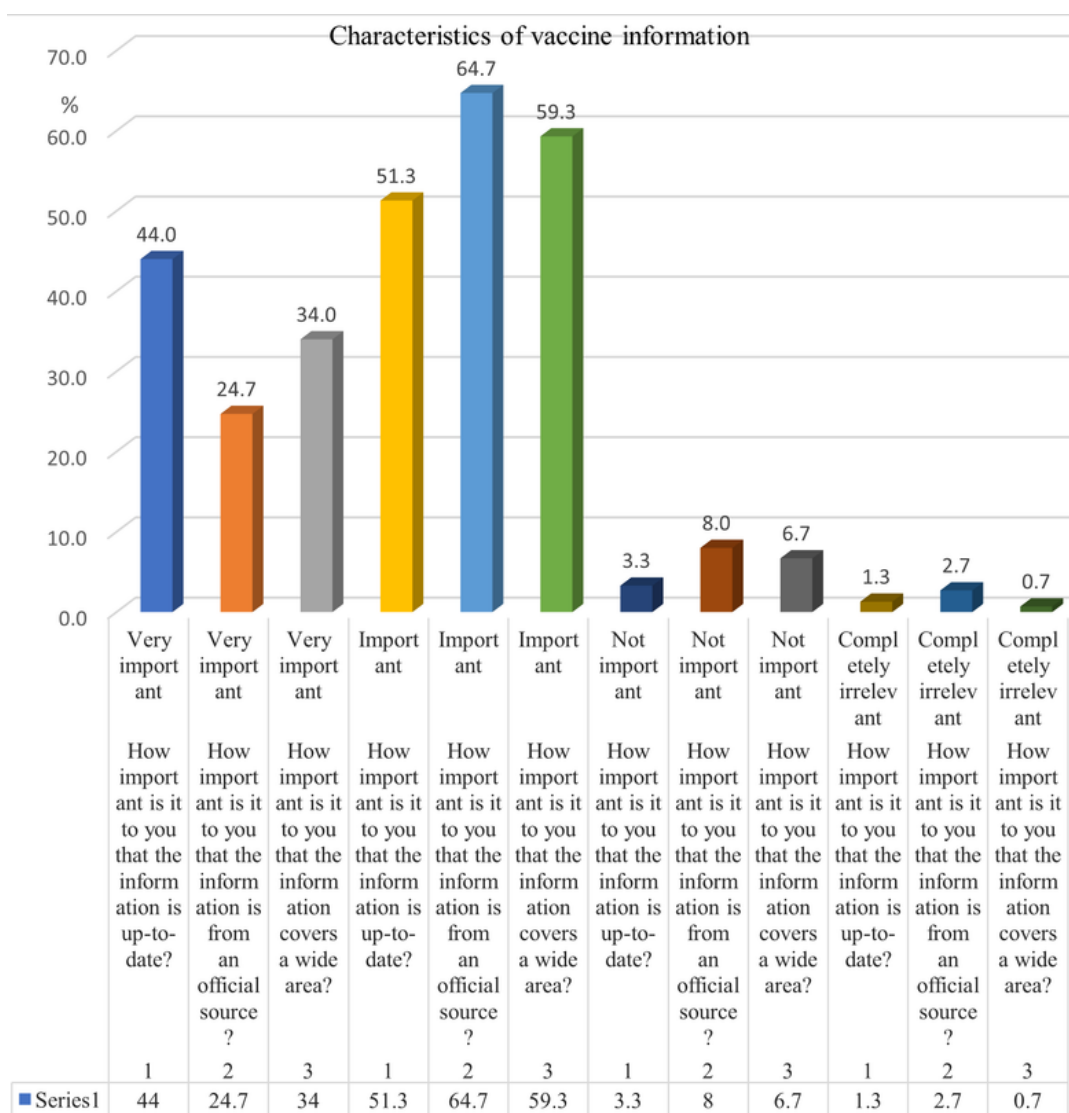


Figure 5. Characteristics of vaccine information

A meta-analysis showed that mRNA vaccine technology demonstrated the highest overall efficacy and effectiveness among the available vaccine types (8). During the period of this study, the only mRNA-based vaccine available in Serbia was Comirnaty® (Pfizer), chosen by approximately 21% of respondents—almost 50% fewer than Gam-KOVID-Vac (Sputnik V), the most frequently selected vaccine (Table IV). Compared with other data, this is a somewhat unusual finding; however, considering that COVID-19 immunization in the Republic of Serbia began in January 2021, when Sputnik V and Sinopharm were the most widely available vaccines and mRNA vaccine supplies were limited, this result is not unexpected. This finding only partially corresponds with the April/May 2021 study "Readiness of

the General Population for Vaccination against COVID-19," in which the majority of respondents expressed interest in the Sinopharm vaccine (23.8%) and Comirnaty® (Pfizer-BioNTech) (19.8%) (14). COVID-19 vaccines developed using viral vector platforms to deliver genetic material and stimulate an immune response, such as Vaxzevria® (Oxford-AstraZeneca), have been associated with public concerns regarding various adverse events reported following both the first and second doses (22,23). Consistent with this, most respondents in the present study indicated that they would refuse this particular vaccine (Table 5), as its safety profile and effects were still under additional review in some countries at the time of the survey. During the pandemic, and even in the post-pandemic period, it is well

established that individuals with chronic conditions (e.g., chronic obstructive pulmonary disease, diabetes, obesity) are more prone to severe or complex clinical presentations of COVID-19 (24). Approximately 32% of respondents reported belonging to a higher-risk group, while approximately 42% reported having a chronic medical condition. Respondents reported an above-average interest in their health and generally considered their health status to be average or good. Patients with chronic illnesses should be vaccinated to help prevent disease progression (25). The majority of respondents reported taking greater-than-average care of their health and feeling in relatively good health overall. The presence of chronic diseases and heightened health concerns may represent factors that motivate respondents to seek vaccination and follow official recommendations.

In this section of the questionnaire, respondents were asked about their emotional and affective state during the two weeks preceding the survey. According to their responses, respondents felt cheerful, relaxed, calm, and engaged with matters of interest, and generally felt fulfilled most of the time during this period. One could argue that respondents experienced heightened anxiety during the pandemic, which may be reflected in their reported willingness to continue following Covid-19 recommendations even after vaccination. It has been reported that individuals with pre-existing mental health conditions, such as anxiety disorders or depression, are more prone to increased anxiety during a pandemic (26). Given the timing of the study, these findings suggest that respondents had largely returned to their everyday routines following the pandemic lockdown period.

Information relevant to vaccination decision-making, whether in favor of or against vaccination, can originate from numerous sources. During the pandemic, individuals faced considerable pressure, as it was often difficult to avoid such information. Since the onset of the pandemic, there has been a marked rise in conspiracy theories, which have been associated with reduced compliance with protective measures and vaccination (27). Approximately 40% of respondents had searched the internet for information about vaccines. Finding reliable information about vaccines and vaccination was a challenging task for most respondents. Claims regarding the potential for vaccines to cause infertility (28) have been associated with vaccine refusal in other populations, although such beliefs were not reported by respondents in the present study. Traditional information sources, such as television, were among the sources most frequently associated with vaccine

hesitancy (29), while medical doctors appeared to have comparatively less influence on respondents' willingness to be vaccinated. Respondents in the present study indicated that they primarily received information about Covid-19 vaccination from their doctors or from official websites where government recommendations were published. This suggests that the population in Serbia received adequate information either from medically trained personnel or from official sources.

Adequate medical training equips healthcare professionals with a comprehensive understanding of vaccine safety profiles, efficacy, and administration protocols, enabling them to address patient concerns and provide accurate information. Moreover, a solid foundation in immunology and infectious disease allows healthcare providers to support public health efforts by promoting vaccine uptake, countering misinformation, and fostering community trust in vaccines and vaccination (30). Several studies have identified doctors and other medical professionals as having greater knowledge of, and more favorable attitudes toward vaccination (31,32). In the present study, however, no such discrepancy in knowledge or attitudes toward Covid-19 vaccination was found between medically trained and non-medically trained respondents in the Serbian population.

Study limitation

One limitation of this study relates to participant selection. Although the questionnaire was made publicly available (shared across several companies), it was completed predominantly by highly educated individuals, which does not proportionally represent the general population, including less-educated groups. Additionally, half of the respondents had a medical education, representing both a strength and a limitation of the study. While this enabled comparisons of attitudes and understanding of vaccines between medically and non-medically educated individuals, the composition of the sample may have influenced responses to questions concerning health preservation and self-management.

The results of this study show that the examined population, living predominantly in urban areas, was largely vaccinated with Sputnik V and showed limited interest in seasonal influenza vaccination. Respondents generally expressed positive attitudes toward vaccination overall, with many supporting mandatory Covid-19 vaccination. It is also worth noting that respondents expressed a high degree of distrust toward the Oxford-AstraZeneca vaccine, which was widely perceived as

experimental. Finally, and most notably, respondents — regardless of their medical education background — held very similar attitudes toward vaccine type and booster (third) dose choice, as well as toward seasonal influenza vaccination, sharing both an unfavorable view of the Oxford-AstraZeneca vaccine and a favorable view of mandatory Covid-19 vaccination. The Covid-19 pandemic serves as a reminder to both the general public and healthcare professionals of the pandemic potential of influenza and other infectious diseases.

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Author Contributions

Conceptualization: D.K. and V.M.; Investigation: K.P., A.M., and B.F.; Data curation: K.P., A.M., and B.F.; Formal analysis: A.M.G.; Writing — Original Draft Preparation: K.P.; Writing — Review and Editing: D.K., V.M., B.F., and A.M.G. All authors have read and approved the published version of the manuscript.

Statement of Ethics

This study protocol was reviewed and approved by the Ethics Committee of the Faculty of Pharmacy, University of Belgrade, approval number 1434/2 issued on 14.07.2021. Prior to completing the survey, all participants were fully informed about the study's objective, nature, and the voluntary basis of their participation. The questionnaire was completely anonymous, non-invasive, and contained no sensitive personal data; therefore, formal written informed consent was not required. Participation and submission of the completed survey constituted implied informed consent.

Statement of Competing Interest

The authors declare no relevant conflicts of interest.

Statement of Data Availability

The datasets generated and/or analyzed during this study are included within this article and are available from the corresponding author upon reasonable request.

Statement of Generative AI Technologies Use

No generative AI was used.

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