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Are the final-year medical students competent enough to tackle the immunization challenges in their practice?

Da li su studenti završne godine medicine dovoljno kompetentni da savladaju izazove imunizacije u svojoj praksi?

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Abstract

Background/Aim. The competence of healthcare workers (HCWs) to advocate the importance of immunization to persons who are hesitant about vaccines is extremely important. The aim of this study was to evaluate the final-year medical students' competencies related to immunization challenges in their practice using their knowledge, attitudes, and study practices. **Methods.** The cross-sectional study was conducted among 442 final-year students of the Faculty of Medicine, University of Belgrade, Serbia. The instrument used for data collection was an anonymous questionnaire consisting of 38 questions. Hierarchical multiple regression analysis was conducted to identify the predictive value of different factors in immunization knowledge among medical students. **Results.** The median total knowledge score with the interquartile range was 7 ± 3.00 out of 13. There was a statistically significant positive correlation between the knowledge score and the grade point average (GPA) ($r = 0.207$, $p < 0.001$). Thirty-five percent of students felt moderately capable of conducting work regarding vaccination without supervision. Furthermore, 92.1% of students considered that additional training and information channels about immunization needed to be implemented in curricula for HCWs. The results of the hierarchical regression analysis showed that gender, age, GPA, study duration, self-confidence regarding immunization knowledge, the flu, and hepatitis B vaccination status explained a total of 36% of the variance in the immunization knowledge score. Less than two-thirds of students believed they had enough knowledge to reassure a person hesitant about immunization. **Conclusion.** The results of our study showed an average level of knowledge about immunization among final-year medical students. As less than two-thirds of students believe that they have enough knowledge to reassure a hesitant person, there is a need for a better understanding and improving the parts of the curricula of medical faculties regarding immunization.

Key words:
attitude to health; health knowledge, attitudes, practice; students, medical; surveys and questionnaires; vaccination; vaccines.

Apstrakt

Uvod/Cilj. Kompetentnost zdravstvenih radnika da objasne važnost imunizacije osobama koje se dvoume u vezi sa vakcinama izuzetno je važna. Cilj rada bio je da se procene kompetencije studenata završne godine medicine u vezi sa izazovima imunizacije u praksi koristeći njihovo znanje, stavove i praksu. **Metode.** Studija preseka sprovedena je među 442 studenta završne godine Medicinskog fakulteta Univerziteta u Beogradu. Za prikupljanje podataka korišćen je anonimni upitnik koji se sastojao od 38 pitanja. U cilju identifikacije prediktivne vrednosti različitih faktora koji utiču na znanje o imunizaciji među studentima medicine, sprovedena je hijerarhijska analiza multiple regresije. **Rezultati.** Medijana ukupnog skora znanja sa interkvartilnim opsegom bila je 7 ± 3,00 od 13. Postojala je statistički značajna pozitivna korelacija između rezultata znanja i proseka ocena ($r = 0,207$, $p < 0,001$). Za obavljanje poslova u vezi sa vakcinacijom bez nadzora umereno sposobnim osećalo se 35% studenata. Takođe, 92,1% studenata smatralo je da je u nastavnim planovima i programima za zdravstvene radnike potrebno uvođenje dodatne obuke i kanala informisanja o imunizaciji. Rezultati hijerarhijske regresione analize pokazali su da su pol, starost, prosek ocena, dužina studiranja, samopouzdanje u pogledu znanja o imunizaciji, vakcinalni status povezan sa gripom i hepatitisom B objašnjavali ukupno 36% varijanse u skoru znanja o imunizaciji. Manje od dve trećine studenata je verovalo da ima dovoljno znanja da uveri osobu koja okleva oko stava o imunizaciji. **Zaključak.** Rezultati našeg istraživanja pokazali su prosečan nivo znanja o imunizaciji među studentima završne godine medicine. S obzirom na to da je manje od dve trećine studenata verovalo da ima dovoljno znanja da uveri kolebljivu osobu, postoji potreba za boljim razumevanjem i unapređenjem delova nastavnih planova i programa medicinskih fakulteta koji se odnose na imunizaciju.

Ključne reči:
stav prema zdravlju; zdravlje, znanje, stavovi, praksa; studenti medicine; ankete i upitnici; vakcinacija; vakcine.

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Introduction

At the moment when the world is amidst an unprecedented pandemic, the competence of healthcare workers (HCWs) to advocate the importance of immunization to persons who are hesitant about vaccines is more important than ever [1]. The vaccine coverage is not high enough to provide the herd immunity needed for preventing outbreaks of various vaccine-preventable diseases [2–5]. Multiple factors contributed to this, including the lack of adequate knowledge about immunization benefits and risks in the general population, lack of understanding of the severity of the diseases from which the vaccines protect, the activities of the anti-vaccination movement, and the spread of misinformation via the internet and social networks. All of that led to losing confidence in the importance, effectiveness, and safety of immunization [6–9].

In 2012, the World Health Organization Regional Office for Europe developed the Tailoring Immunization Programs (TIP) approach to help countries achieve high and equitable vaccination uptake [10]. The TIP approach is based on three pillars, one of which is the theoretical model, which draws its messages from evidence gathered through behavioral science. This model sees capability, opportunity, and motivation as the key factors necessary to implement any (positive) health behavior. Capability, among other things, relates to the knowledge of HCWs. It emphasizes the need for HCWs to possess the necessary knowledge and education about vaccine safety, effectiveness and efficacy, contraindications, adverse events following immunization, potential risks related to vaccine-preventable diseases, national vaccination law, and regulations, vaccination coverage, as well as the skills to tailor their communication to different caregiver positions on vaccination [10].

Studies that aim to examine the knowledge of HCWs and medical students on immunization offer insights into the gaps in knowledge about immunization that may exist among health professionals. There are indications that the senior medical students do not possess sufficient knowledge about vaccination because of the lack of competency-based curricula for vaccination at medical faculties [11]. Finding and addressing these gaps can be crucial in ensuring adequate vaccine coverage among this key target group, as well as among their patients, which is especially important in the light of the COVID-19 pandemic. Therefore, the aim of this study was to evaluate the final-year medical students' competencies related to immunization challenges in their practice using their knowledge, attitudes, and study practices.

Methods

The cross-sectional study was conducted among sixth-year students of the Faculty of Medicine, University of Belgrade, between December 17 and December 23, 2019. All sixth-year students were included, of whom 442 filled in the questionnaire during their regular practical sessions (response rate 82.6%). The study was approved by the Institutional Review Board of the Faculty of Medicine, University of Belgrade (No. 29/III-11, from March 28, 2016). All participants gave written consent to participate in the study.

The instrument used for data collection was an anonymous questionnaire consisting of 38 questions. The questionnaire was made based on the literature data [12–14]. The first part of the questionnaire contained demographic characteristics and the student's grade point average (GPA). The second part, the student's knowledge about immunization, was obtained through 13 questions regarding the immunization schedule in the Republic of Serbia (RS), herd immunity, the recent measles outbreak in the RS, elimination and eradication of infectious diseases, contraindications for vaccination, and adverse events following immunization.

The section aimed at investigating the attitudes of the participants on immunization contained 14 questions regarding the importance of vaccines for children, their safety and effectiveness, advocates of the anti-vaccination attitudes, the trust of the general public in the system of public health, and the ascertainment of the level in which the student's environment supports immunization.

The section of the questionnaire regarding the practices of immunization comprised six questions: students' vaccination status against hepatitis B infection and the flu, self-assessment of the capability of unsupervised work on immunization, and the arguments that the student would use in a real-life practical situation. Data on vaccination status against hepatitis B infection and the flu were based on students' self-report.

Statistical analysis

Methods of descriptive statistics, correlation analysis, and the Mann-Whitney *U* test were used in the data analysis. Further, hierarchical multiple regression analysis was conducted to identify the predictive value of different factors in immunization knowledge among medical students. The dependent variable in this model was the knowledge score. The predictor variables were separated into four blocks. Sociodemographical variables (age and gender) were entered in the first block; GPA and study duration comprised the second block, followed by the attitude about self-confidence regarding immunization knowledge in the third block. Finally, the fourth block included vaccination status regarding the flu and hepatitis B. Keeping in mind that the whole study population was included in the hierarchical regression analysis, the ratio of valid cases (n = 442) to the number of independent variables (n = 7) was 63.1 to 1, which was equal to or greater than the minimum ratio.

Results

Male students comprised 155 (35.1%) of the whole (442) sample. The mean age of the participants was 24.8 ± 1.6 years, and the median GPA with the interquartile range was 8.6 (8.0–9.2). Concerning the knowledge about immunization, the vast majority of students were aware that the measles, mumps, rubella (MMR) vaccine does not cause autism (92.6% correct answers), that in the last measles out-

break in the RS, there were lethal outcomes (88.3% correct answers), while 86.7% of students knew what revaccination is (Table 1). One-fifth of students (19.9%) did not know that the vaccine against tuberculosis is included in the routine immunization schedule for children and adolescents in the RS. The question with the least number of correct answers was the one in which the students had to name 11 diseases for which vaccines are included in the routine immunization schedule for children and adolescents in the RS. The median total knowledge score was 7 ± 3.00 (out of 13 points). A statistically significant correlation was observed between the knowledge score and students' GPA ($r = 0.207$, $p < 0.001$).

Table 2 contains the students' answers to the questions regarding their attitudes toward immunization. A high percentage of students perceived that vaccines are important for children (96.8%), that vaccination needs to be mandatory (96.3%), that vaccines offer more benefits than risks (95.6%), and that they are effective (95.2%). Moreover, 92.1% of students consider that additional training and information channels about immunization need to be implemented in the curricula for HCWs. On the contrary, only 2.1% of students think that the general public has enough trust in the public health system, and 9.5% believe that the manufacturers of vaccines are concealing their adverse effects.

Table 1

The knowledge of students regarding vaccination

Statement	Correct answer, n (%)
The routine vaccination schedule for children and adolescents includes vaccines against the following diseases (multiple answers):	30 (6.8)
Against which diseases should the healthcare workers be immunized according to the Rulebook on immunization?	135 (30.5)
What is herd immunity?	268 (60.5)
What level of herd immunity is necessary to prevent an outbreak of measles?	262 (59.1)
How many cases of measles were there in the last outbreak in Serbia?	70 (15.8)
Were there any lethal cases in the last outbreak of measles in Serbia?	391 (88.3)
Is there still a need to vaccinate children against diseases that are eliminated or eradicated from these parts, such as diphtheria and poliomyelitis?	368 (83.1)
What is revaccination?	384 (86.7)
What are the general contraindications for immunization?	239 (54.0)
What are the most frequent adverse effects following immunization?	122 (27.5)
How often do severe adverse effects (such as encephalitis after administration of the MMR vaccine) occur?	35 (7.9)
Do you think that the MMR vaccine causes autism?	402 (92.6)
Do you think that preservatives, adjuvants, and stabilizers used in vaccines are toxic?	201 (46.2)

n – number of students; MMR – measles, mumps, rubella.

Table 2

Attitudes of students regarding immunization

Statement	Yes	No	Not sure	Do not know
Do you think vaccination needs to be mandatory for children and adolescents?	418 (96.3)	9 (2.1)	7 (1.6)	/
Do you think that more vaccines need to be mandatory for healthcare workers?	336 (78.5)	92 (21.5)	/	/
Do you consider vaccines important for children?	419 (96.8)	8 (1.8)	5 (1.2)	1 (0.2)
Do you think vaccines are safe?	380 (87.4)	7 (1.6)	45 (10.3)	3 (0.7)
Do you feel that you have enough knowledge to address the concerns of a person hesitant about vaccination?	274 (63.4)	29 (6.7)	115 (26.6)	14 (3.2)
Do you believe that vaccines are effective?	414 (95.2)	5 (1.1)	11 (2.5)	5 (1.1)
Do you believe that vaccines offer more benefits than risks?	413 (95.6)	6 (1.4)	11 (2.5)	2 (0.5)
Do you think the manufacturers of vaccines are concealing their adverse effects?	41 (9.5)	178 (41.2)	152 (35.2)	61 (13.8)
Do you feel that additional training and information channels about immunization need to be implemented for healthcare workers?	394 (92.1)	19 (4.4)	15 (3.5)	/
Does the general public have enough trust in the public health system?	9 (2.1)	316 (73.1)	107 (24.8)	/

All values are expressed as numbers (percentages) of students.

The practices of students related to immunization are shown in Table 3. The majority of participants stated that they feel informed to a great extent about immunization (53.0%), that their parents and friends support immunization completely (70.8% and 48.0%, respectively), or to a great degree (23.0% and 40.9%, respectively). Thirty-five percent of students stated that they feel moderately capable of conducting work regarding vaccination without supervision. Only 10 (2.3%) students have received their flu shot each year for the last 3 years, while 339 (78.1%) students had received the hepatitis B vaccine at some point in life.

The students believed that public figures (36.9%) and the internet and social media (36.2%) were the main means of propagating anti-vaccination attitudes (Figure 1).

When asked about how they would respond to parents that are hesitant about vaccination, most of the students stated that they would explain that the benefits of vaccination greatly (84.4%) outweigh the risks. Many of the students would state that numerous research on large samples of children showed no link between immunization and autism (76.1%) and that the most frequent adverse effects following immunization are mild (68.4%) (Figure 2). Students singled

Table 3

Attitudes and practices of students regarding immunization

Statement	Not at all	Not much	Moderately	To a great degree	Completely
In your opinion, how informed are you about immunization?	3 (0.7)	11 (2.5)	166 (38.2)	230 (53.0)	24 (5.5)
How supportive are your parents of immunization?	1 (0.2)	9 (2.1)	17 (3.9)	100 (23.0)	308 (70.8)
How supportive are your friends of immunization?	3 (0.7)	9 (2.1)	36 (8.3)	177 (40.9)	208 (48.0)
How capable do you feel to conduct work regarding vaccination and vaccines without the supervision of a more experienced physician?	73 (16.9)	123 (28.5)	151 (35.0)	67 (15.5)	18 (4.2)

All values are expressed as numbers (percentages) of students.

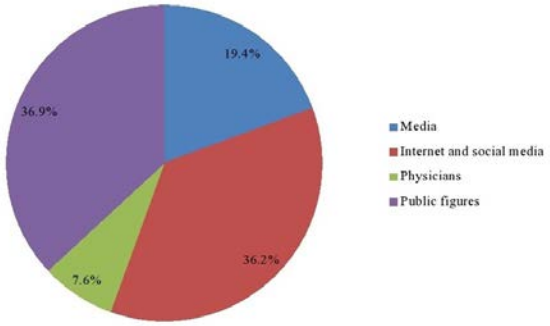

Fig. 1 – The most important advocates of anti-vaccination attitudes.

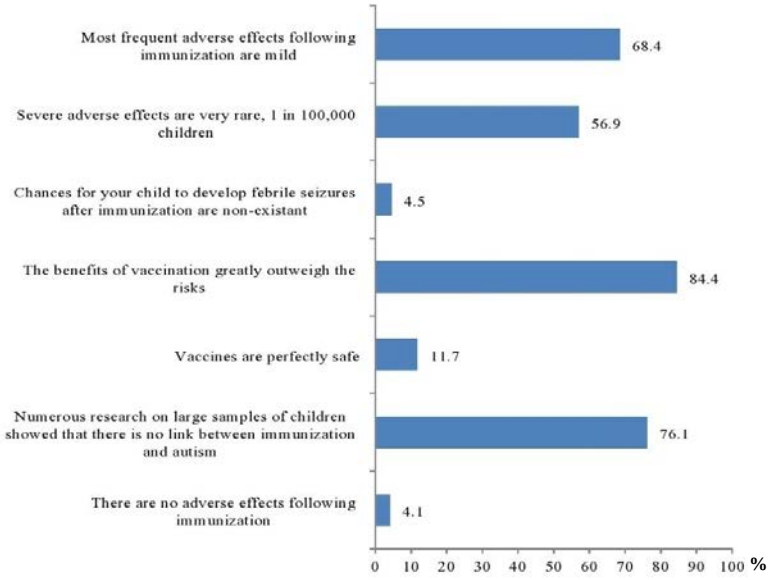

Fig. 2 – The arguments that students would use to reassure parents who are hesitant about vaccinating their child.

out the opinion that vaccines cause autism as the most important misconception about immunization in the general population (Figure 3).

The hierarchical regression analysis (Table 4) showed that the age and gender of medical students accounted for 17% of the variance of immunization knowledge score as a dependent variable ($p < 0.01$) (model 1). When GPA and duration of studies were added, another 5% of the variance was explained ($p < 0.05$). Adding the attitude regarding self-confidence about immunization knowledge (model 3) increased the proportion of variance explained for an additional 5% ($p < 0.01$). Finally, the inclusion of the flu and hepatitis B vaccination status in the 4th model explained an additional 9% of the variance. It means that gender, age, GPA, study duration, self-confidence regarding immunization knowledge, the flu, and hepatitis B vaccination status explained a total of 36% of the variance in the immunization knowledge score.

Discussion

The problem of vaccine hesitancy is present not only in the general population but also among HCWs [12–16]. That is especially significant since HCWs are the primary source of information regarding immunization for parents, and the level of trust the patient has for his physician is deeply correlated with the final decision of the patient whether or not they will accept the vaccines [17–19]. HCWs who are hesitant about immunization are less successful in responding to parents' concerns regarding the immunization of their children [13, 17].

The median knowledge score on immunization in our sample of final-year medical students was 7 out of 13 points. The mean knowledge score observed in a study among students in nursing, medical, and pharmacy programs at two universities in the USA was 3.34/5 [20]. In our study, 60.5% of students knew the correct definition of herd immunity, while 59.1% knew what level of herd immunity is needed to pre-

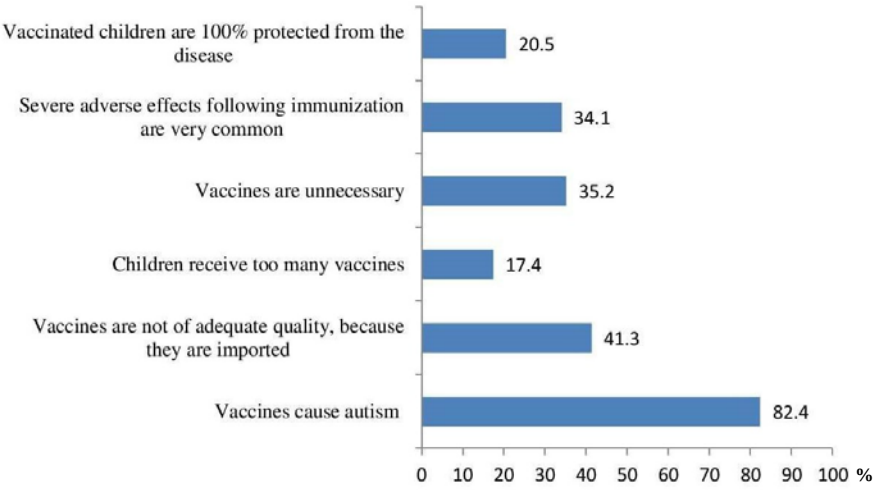

Fig. 3 – The most important misconceptions about immunization in the general population.

Table 4

Summary of hierarchical regression analysis of variables predicting immunization knowledge score

Variable	Model 1			Model 2			Model 3			Model 4		
	B	SE (B)	β	B	SE (B)	β	B	SE (B)	β	B	SE (B)	β
Gender	0.36	0.19	0.09	0.33	0.19	0.08	0.33	0.19	0.09	0.19	0.19	0.05
Age	-0.16	0.06	**-0.14****	-0.09	0.06	-0.08	-0.09	0.06	-0.08	-0.11	0.06	-0.10
GPA				0.40	0.14	**0.16****	0.39	0.14	**0.15****	0.31	0.13	**0.12***
Study duration				0.001	0.001	0.001	0.001	0.001	0.005	0.00	0.001	0.014
Self-confidence regarding immunization knowledge							0.01	0.004	**0.15****	0.01	0.004	**0.12***
Flu vaccination										-0.60	0.30	**-0.09***
Hepatitis B vaccination										-0.73	0.16	**-0.23****
R^2		0.17			0.22			0.27			0.36	
F for change in R^2		**6.080***			**4.351***			**9.480***			**13.811**	

GPA – grade point average; B – unstandardized beta coefficient; SE – standard error; β – standardized beta coefficient; R^2 – coefficient of determination; F – F test of overall significance.
***$p < 0.05$; ****$p < 0.01$.**

vent an outbreak of measles. Similar results were observed in a study conducted in a sample of university students in Poland, where 66.6% of students correctly responded to this question [21]. An interesting observation is that 4/5 of the students in our study knew that the vaccine against tuberculosis is included in the routine immunization schedule since this vaccine was included in the immunization schedule in the the RS back in 1927. In the segment analyzing the practices related to immunization, the students stated that they consider themselves pretty informed about immunization (53.0%), and the largest percentage of students (35.0%) responded that they feel moderately capable of conducting work regarding vaccination and vaccines without supervision. Only 2.3% of students have received flu shots each year for the last three years. In contrast with our results, a study performed among healthcare students in Canada showed that 88.4% of students consider receiving annual flu shots important [22]. A Knowledge, Attitude, and Practice (KAP) study performed among medical college students in China has pointed out that the top 3 reasons among medical students for not getting a flu shot were poor knowledge of the vaccine, perceived lack of need for immunization due to good health, and worries about adverse reactions [23].

The students who participated in the study believe that the most important promoters of anti-vaccination attitudes are public figures (36.9%) and the internet and social media (36.2%). The activities of the anti-vaccination movement are considered responsible for the rise in the number of parents who refuse to vaccinate their children in the last 20 years. The technological advances of modern society have facilitated the dissemination of these messages. Because of this, the importance of HCWs in providing the general public with the correct information and advice about immunization is greater than ever [24].

The results of research conducted to assess the knowledge and attitudes about immunization among future HCWs have shown that the level of knowledge varies significantly depending on the curriculum [25, 26]. A project performed at the University of Munich, Germany, identified that not all relevant vaccination learning objectives were included in the curriculum at the University [11]. Implementing a competency-based curriculum on immunization can help the students acquire skills to communicate adequately about vaccination with the general public, and it can also make them capable of making decisions independently [11]. The principle of the competency-based curriculum is to integrate all of the important learning objectives about immunization into a single teaching program, instead of students traditionally studying it superficially inside various subjects like microbiology, epidemiology, immunology, infectious diseases, pediatrics, public health, etc.

The importance of improving the knowledge, confidence, and communication tools of (future) HCWs has also been recognized by the European Joint Action on Vaccination. It emphasizes the need for educational activities in medical and paramedical curricula on vaccines and vaccination programs in Europe [27]. The benefits of such educational programs and activities have been shown in the populations of physicians as well, for instance, in a KAP study performed at the Mayo Clinic among physicians working in the internal medicine department [28]. This study, in which the participants were questioned prior to and after an education program on immunization, showed that the knowledge scores of the physicians, as well as their patients' influenza and whooping cough immunization rates, increased significantly after the educational program [28].

Our study has several limitations. First, the cross-sectional design of the study makes it difficult to infer causality with high confidence. Another important issue is the self-reporting assessment of practices instead of using real-life situations; therefore, an information bias could be present.

Conclusion

The results of our study have shown an average level of knowledge regarding immunization among final-year medical students of the University of Belgrade. It is alarming that barely two-thirds of students consider themselves competent enough to answer the concerns of a person who is a vaccine hesitator. That underlines the need for a better understanding and improving the parts of the curricula of medical faculties regarding immunization because it can offer insights into how knowledge, attitudes, and beliefs of students regarding immunization are formed and how to better train them for practice in immunization in their future work.

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