



# KNOWLEDGE, ATTITUDES AND BEHAVIOR OF MEDICAL STUDENTS REGARDING APPROPRIATE COVID-19 PROTECTION: A CROSS-SECTIONAL STUDY OF CROATIAN AND BOSNIAN MEDICAL STUDENTS

Petra Kovačević<sup>1</sup>, Ivana Gusar<sup>2</sup>, Marija Ljubičić<sup>2</sup>, Nika Samardžić<sup>3</sup>, Doroteja Caktaš<sup>4,5</sup>,  
Matej Lovrić<sup>6</sup>, Klara Lauš<sup>3</sup>, Petra Pantalon<sup>7</sup>, Juraj Pantalon<sup>8</sup>, Ana-Marija Gusar<sup>3</sup>  
and Katarina Vukojević<sup>3,9</sup>

<sup>1</sup>University of Zagreb, School of Dental Medicine, Zagreb, Croatia;

<sup>2</sup>University of Zadar, Department of Health Studies, Zadar, Croatia;

<sup>3</sup>University of Mostar, School of Medicine, Mostar, Bosnia and Herzegovina;

<sup>4</sup>Dubrava University Hospital, Department of Plastic, Reconstructive and Aesthetic Surgery, Zagreb, Croatia;

<sup>5</sup>University of Zagreb, School of Medicine, Zagreb, Croatia;

<sup>6</sup>Department of Emergency Medicine, Mostar Health Center, Mostar, Bosnia and Herzegovina;

<sup>7</sup>Zadar Health Center, Zadar, Croatia;

<sup>8</sup>Juraj Pantalon Dental Clinic, Zadar, Croatia;

<sup>9</sup>University of Split, School of Medicine, Split, Croatia

**SUMMARY** – The aim of this cross-sectional study was to determine the knowledge, attitudes and behavior of medical students in relation to COVID-19 according to different medical schools and duration of studies. A validated questionnaire was administered to 192 medical students at two universities in Croatia and one from Bosnia and Herzegovina. Fisher-Freeman-Halton and Kruskal-Wallis tests were used to examine differences among study groups. The association of variables was tested with a linear regression model. A negative correlation was found between adherence to measures and attitudes ( $\beta=-0.36$ ;  $p<0.001$ ). Studying at the University of Zagreb was positively associated with students' knowledge about COVID-19 ( $\beta=0.24$ ;  $p=0.033$ ) but negatively with students' attitudes ( $\beta=-0.26$ ;  $p=0.013$ ). Compared to the last study year students, second-year students had lower knowledge ( $\beta=-0.28$ ;  $p=0.040$ ) and statistically nonsignificant negative attitudes ( $\beta=-0.24$ ;  $p=0.055$ ). Fifth-year students had more negative attitudes ( $\beta=-0.24$ ;  $p=0.008$ ) compared to sixth-year students. The association between knowledge and attitudes was weak and statistically borderline nonsignificant ( $\beta=0.14$ ;  $p=0.056$ ). The lack of association between knowledge and attitudes requires additional research to identify the potential factors that favor the formation of attitudes toward appropriate protection against COVID-19.

**Keywords:** *Medical students; Knowledge; Attitudes; Behavior; COVID-19*

Correspondence to: *Asst. Prof. Ivana Gusar, PhD*, University of Zadar, Department of Health Studies, Splitska 1, HR-23000 Zadar, Croatia  
E-mail: igusar@unizd.hr

Received May 2, 2023, accepted February 21, 2024

## Introduction

The emergence of the COVID-19 pandemic worldwide represents the greatest challenge in recent human history<sup>1</sup>. The pandemic caused disruptions in all aspects of life on a global scale<sup>2</sup>. The first confirmed case of infection with the COVID-19 virus in Croatia was recorded on February 25, 2020<sup>3,4</sup>, and in Bosnia and Herzegovina on March 17, 2020<sup>5</sup>. Already in March, Croatia introduced strict epidemiological measures such as banning public and sports events, closing educational institutions, shops, restaurants, and state borders<sup>6</sup>. Similar measures were introduced in Bosnia and Herzegovina but already in April the measures were significantly relaxed<sup>7</sup>. The provision of up-to-date information related to the pandemic, emphasis on the importance and adherence to measures were emphasized daily by representatives of the governments of all countries, including Croatia<sup>8</sup> and Bosnia and Herzegovina<sup>9</sup>. Education of the entire population about disease prevention, possible routes of virus transmission, and epidemiological protocols and procedures plays an important role in preventing and slowing down the spread of infection<sup>10</sup>. The knowledge and attitudes of each individual represent important determinants of behavior, which is of exceptional importance, especially during the outbreak and duration of a pandemic<sup>11-13</sup>.

The severity of the pandemic and the unprecedented speed of its spread continue to pose a challenge not only to state structures but also to health and education systems. Especially in these systems, the pandemic is a turning point for the adoption of new protocols in the suppression of the pandemic and the provision of health care but also in the education of future health workers<sup>14</sup>. As future health professionals, medical students made an important contribution to the work of the health system during the COVID-19 pandemic by assisting health professionals in numerous countries<sup>15</sup>. In the most pronounced waves of the pandemic, active involvement of students in the work of health systems was a practice in some parts of Croatia<sup>16</sup> and Bosnia and Herzegovina<sup>17</sup>. It is precisely the need of medical students to be actively involved in the

fight against the pandemic that further highlights the importance of medical students' knowledge, attitudes and behavior. This is important not only for personal protection but also for active health activities in the local community. Studies confirm that medical students and health professionals in such circumstances act as role models for the society<sup>10</sup>. Activities that include exchange of information on suppression of the pandemic and education of the population on acting in accordance with current recommendations have a significant effect on suppression of the spread of the pandemic<sup>10,18</sup>.

The available studies that examined the knowledge, attitudes and behaviors of medical students provide different results. For example, results of a study conducted in Egypt that aimed to assess the knowledge, attitudes and behavior of medical students in relation to COVID-19 indicated an unsatisfactory level of their knowledge<sup>15</sup>. Furthermore, research results from Poland also indicate a generally low level of knowledge among medical students about COVID-19<sup>10</sup>. However, completely opposite results about the satisfactory level of knowledge of medical students and positive attitudes toward COVID-19 are reported by the authors of a study conducted in Jordan<sup>19</sup>. Furthermore, Hasan *et al.*, who conducted a study with the aim of comparing the knowledge, attitudes, and practices toward COVID-19 in the United Arab Emirates of students of health and non-health professions, state that both groups of students have an appropriate level of knowledge, good attitudes, and low-risk behavior toward COVID-19<sup>20</sup>. Italian medical students had a high level of general knowledge about COVID-19 and practiced preventive behaviors<sup>21</sup>.

Precisely because of the inconsistency of the results presented in the available relevant literature and the importance of a more detailed insight into the COVID-19 related knowledge, attitudes and behavior of medical students in our area, the aim of this study was to determine the COVID-19 related knowledge, attitudes and behavior of medical students from three universities in two neighboring countries and to compare students' knowledge, attitudes and practice regarding different faculties and study duration.

## Participants and Methods

### *Participants*

Students were recruited from two universities from Croatia (University of Split and University of Zagreb) and one university from Bosnia and Herzegovina (University of Mostar). Inclusion criteria were age between 18 and 30 years and studying medicine at one of the three universities. Exclusion criteria were age older than 30 years and attending other studies within the mentioned universities. A total of 2514 students attended the study of medicine at all three universities. A total of 192 medical students participated voluntarily and anonymously in the research (response rate 7.63%). All students gave their consent to participate in the study.

### *Ethical approval*

All procedures performed in this study were in accordance with ethical standards and with the Helsinki Declaration and its later amendments or comparable ethical standards.

### *Study design*

The study was cross-sectional and conducted between May and June 2021.

### *Data collection*

In agreement with the students representing study years from the mentioned studies, the link to the Google forms online anonymous questionnaire with explanation of the goal and purpose of the research was forwarded to all students.

### *Instrument*

The research used a structured questionnaire to assess the knowledge and attitudes and use of personal protective equipment during the coronavirus disease<sup>22</sup>. The first part of the questionnaire contained 16 questions examining the sociodemographic characteristics of students such as age, gender, university, year of study, and place of residence. The second part of the questionnaire contained 13 questions designed to evaluate knowledge about appropriate COVID-19 protection. The authors defined the questions in this part of the questionnaire in accordance with the World Health Organization

(WHO) recommendations<sup>22</sup>. The third part of the questionnaire contained 10 statements describing attitudes related to appropriate COVID-19 protection and participants selected answers on a 1-5 scale. Total score on attitude scale was 50, and it was calculated by summing up the points obtained on each answer<sup>22</sup>.

### *Statistical analysis*

Distribution of the results was verified with the Kolmogorov-Smirnov test. Categorical variables were expressed as frequencies and percentages. To check differences among students, the Fisher-Freeman-Halton test or Kruskal Wallis test was used, depending on the distribution of the results. The association among students' sociodemographic characteristics, epidemiological behavior, knowledge and attitudes was tested using a linear regression model.

## Results

### *Demographic data*

Students' mean age was 22.83 (SD 1.99). Female gender prevailed (79.2%), while 20.8% of students were male. The largest number of students lived in an urban environment (73.4%) and were in the sixth year of studies (20.8%). The largest number of students lived in a family with more than two members (84.8%) (Table 1).

A significant difference was noted in students' knowledge of appropriate COVID-19 protective measures, considering the university where they were studying. Compared to other students, students attending University of Zagreb believed that mask should be replaced when it becomes wet ( $p=0.032$ ). Students of the University of Zagreb and Split more often pointed out that one of the preventive measures of infection was proper hand washing ( $p=0.016$ ), and that protective equipment should be used when driving a car (when you are alone in the car) ( $p=0.019$ ), as well as that cotton masks had the same effectiveness in protection as standard surgical masks (0.016) (Table 2).

In overall results of the questionnaire that examined the attitudes of medical students about appropriate COVID-19 protection, there was no significant

Table 1. Sociodemographic characteristics of students (N=192)

Variable		Split (N=73)	Zagreb (N=70)	Mostar (N=49)	Total (N=192)
		n (%)	n (%)	n (%)	n (%)
Gender	Male	8 (11.0)	24 (34.3)	8 (16.3)	40 (20.8)
	Female	65 (89.0)	46 (65.7)	41 (83.7)	152 (79.2)
Residence	City	54 (74.0)	58 (82.9)	29 (59.2)	141 (73.4)
	Suburban settlement	14 (19.2)	5 (7.1)	13 (26.5)	32 (16.7)
	Village	5 (6.8)	7 (10.0)	7 (14.3)	19 (9.9)
Year of study	First	13 (18.1)	1 (1.4)	9 (18.4)	23 (12.1)
	Second	14 (19.4)	4 (5.8)	17 (34.7)	35 (18.4)
	Third	9 (12.5)	20 (29.0)	8 (16.3)	37 (19.5)
	Fourth	0 (0.0)	20 (29.0)	4 (8.2)	24 (12.6)
	Fifth	21 (29.2)	6 (8.7)	6 (12.2)	33 (17.4)
	Sixth	15 (20.8)	18 (26.1)	5 (10.2)	38 (20.0)
Living	Alone	11 (15.3)	9 (12.9)	5 (10.2)	25 (13.1)
	In a family with more than two members	60 (83.3)	58 (82.9)	44 (89.9)	162 (84.8)
	With a partner	1 (1.4)	3 (4.3)	0 (0.0)	4 (2.1)

difference in attitudes depending on the place of study (Table 3).

By looking at individual statements from the questionnaire for the assessment of attitudes, a significant difference was recorded in the statement: Without protective equipment, I do not go to buy food and hygiene items ( $p < 0.001$ ), and the statement: People suffering from chronic diseases are recommended to wear protective equipment ( $p = 0.017$ ) (Supplement 1). Students who studied at the University of Split significantly more strongly supported the use of protective equipment when going out to buy groceries and hygiene items, as well as the recommendation that people suffering from chronic diseases should use protective equipment (Supplement 1).

Furthermore, it was observed that students from the University of Zagreb used protective equipment when driving a car, using public city transport and walking ( $p < 0.001$ ), while students studying at the University of Split adhered to the prevention measures recommended by the Civil Staff of the Republic of Croatia ( $p < 0.001$ ). Students studying at the University of Split and Zagreb observed social distancing measures significantly more often than students studying at

the University of Mostar ( $p < 0.001$ ). Considering the students' place of study, a significant difference was recorded in the use of the type of protective equipment ( $p = 0.023$ ). Students studying at the University of Split used a protective mask more often (94.5%) compared to students from the University of Zagreb (88.6%) and Mostar (77.6%). When leaving the house, 10.0% of students at the University of Zagreb, 4.1% of students at the University of Split and 16.3% of students at the University of Mostar did not use masks or gloves (Table 4).

Finally, the results based on the linear regression model showed that students of the University of Zagreb had higher level of COVID-19 knowledge than students of the University of Mostar but the lowest level of COVID-19 attitudes. We found negative association between the age and knowledge but this association was statistically borderline nonsignificant ( $\beta = -0.24$ ;  $p = 0.055$ ). In comparison with last-year students, second-year students had poorer knowledge ( $\beta = -0.28$ ;  $p = 0.040$ ) and statistically nonsignificant negative attitudes ( $\beta = -0.24$ ;  $p = 0.055$ ), while fifth-year students had more negative attitudes ( $\beta = -0.24$ ;  $p = 0.008$ ) compared to sixth-year students. Studying

Table 2. Students' knowledge about COVID-19 appropriate personal protective equipment use according to study place (N=192)

Statement	Answer	University						p*
		Mostar (N=49)		Split (N=73)		Zagreb (N=70)		
		n	%	n	%	n	%	
The mask should be replaced when it becomes damp.	Correct**	45	91.8	64	87.7	69	98.6	0.032
	Incorrect	4	8.2	9	12.3	1	1.4	
It is allowed to disinfect gloves with alcohol to keep them clean during use.	Correct**	30	61.2	39	53.4	37	52.9	0.654
	Incorrect	19	38.8	34	46.6	33	47.1	
Gloves protect against infection caused by contact.	Correct	38	77.6	59	80.8	49	70.0	0.324
	Incorrect**	11	22.4	14	19.2	21	30.0	
Protective equipment should be used when driving a personal vehicle (when you are driving with a person who is not from your household).	Correct**	41	83.7	67	94.4	65	92.9	0.119
	Incorrect	8	16.3	4	5.6	5	7.1	
I can use gloves and masks multiple times.	Correct	6	12.2	9	12.3	3	4.3	0.171
	Incorrect**	43	87.8	64	87.7	67	95.7	
One of the infection preventive measures is proper hand washing.	Correct**	46	93.9	73	100.0	70	100.0	0.016
	Incorrect	3	6.1	0	0.0	0	0.0	
The mask protects against respiratory infection.	Correct**	41	83.7	60	82.2	52	74.3	0.379
	Incorrect	8	16.3	13	17.8	18	25.7	
Protective equipment should be used when driving a personal vehicle (when you are alone in the car).	Correct	5	10.2	3	4.1	0	0.0	0.019
	Incorrect**	44	89.8	70	95.9	70	100.0	
Cotton masks have the same protection efficiency as standard surgical masks.	Correct	10	20.4	11	15.1	3	4.3	0.016
	Incorrect**	39	79.6	62	84.9	67	95.7	
When I put the mask on, it should cover both my nose and mouth.	Correct**	49	100.0	71	97.3	70	100.0	0.339
	Incorrect	0	0.0	2	2.7	0	0.0	
I should use a mask and gloves every time I leave the house.	Correct	17	34.7	30	41.7	17	24.3	0.087
	Incorrect**	32	65.3	42	58.3	53	75.7	
It is necessary to perform hygienic hand washing after removing the protective gloves.	Correct**	44	89.8	69	94.5	66	94.3	0.583
	Incorrect	5	10.2	4	5.5	4	5.7	
Protective equipment should be used when using public city transport.	Correct**	48	98.0	73	100.0	69	98.6	0.526
	Incorrect	1	2.0	0	0.0	1	1.4	

\*p Fisher-Freeman-Halton test; \*\*correct answer

Table 3. Students' attitudes about appropriate COVID-19 protection according to study place (N=192)

Variable	Split (n=73)		Zagreb (n=70)		Mostar (n=49)		p*
	Sum of ranks	Mean rank	Sum of ranks	Mean rank	Sum of ranks	Mean of rank	
Attitudes	7104.500	98.673	7350.500	102.090	4073.000	84.854	0.227

\*Kruskal-Wallis test

Table 4. Students' COVID-19 related behavior according to study place (N=192)

Statement	Answer	University						p*
		Mostar (N=49)		Split (N=73)		Zagreb (N=70)		
		n	%	n	%	n	%	
Do you use protective equipment when driving a car, using public city transport, or walking?	Yes	20	40.8	49	68.1	62	88.6	<0.001
	No	29	59.2	23	31.9	8	11.4	
Do you adhere to the recommended prevention measures by the Civil Staff of the Republic of Croatia?	I don't comply at all	0	0.0	0	0.0	0	0.0	<0.001
	I adhere occasionally	20	40.8	8	11.0	6	8.6	
	I follow most measures	24	49.0	48	65.8	53	75.7	
	I adhere to all measures	5	10.2	17	23.3	11	15.7	
Do you adhere to social distancing measures?	Yes	22	44.9	52	72.2	54	77.1	<0.001
	No	27	55.1	20	27.8	16	22.9	
Every time you leave the house (store, visiting family members or friends) do you use?	A mask	38	77.6	69	94.5	62	88.6	0.023
	Gloves	0	0.0	0	0.0	1	1.4	
	Mask and gloves	3	6.1	1	1.4	0	0.0	
	None of the above	8	16.3	3	4.1	7	10.0	

\*p Fisher-Freeman-Halton test

at the University of Zagreb was positively associated with students' knowledge about COVID-19 ( $\beta=0.24$ ;  $p=0.033$ ) but negatively with students' attitudes ( $\beta=-0.26$ ;  $p=0.013$ ). Adherence to measures and attitudes was negatively associated ( $\beta=-0.36$ ;  $p<0.001$ ). Association between knowledge and attitudes was weak and statistically nonsignificant ( $\beta=0.14$ ;  $p=0.056$ ). Detailed results are shown in Table 5.

## Discussion

The main goal of this study was to determine COVID-19 related protection knowledge, attitudes and practice (behavior) of medical students from three universities in two neighboring countries, and to compare students' knowledge, attitudes and practices regarding different schools and study duration.

The results showed a weak association between knowledge and attitudes, negative association between adherence to measures and attitudes, and an associa-

tion between place of study and students' knowledge, attitudes and behavior. However, medical students from different universities in the Republic of Croatia and Bosnia and Herzegovina, despite their territorial proximity and similar involvement in the COVID-19 pandemic, still had somewhat different COVID-19 protection knowledge, attitudes and behaviors. Students from the School of Medicine in Zagreb had the best knowledge, students from the School of Medicine in Split used protective equipment most often, and students from the School of Medicine in Mostar expressed the best attitudes.

Despite the generally high percentage of correct answers to the questionnaire, which was designed to assess students' knowledge of appropriate COVID-19 protective measures, a significantly higher percentage of correct answers to certain questions was recorded among students who studied at the courses in the Republic of Croatia. In more detail, all students studying in Split and Zagreb correctly answered the questions that mainly related to the rules of using

Table 5. Association among students' sociodemographic characteristic, epidemiological behavior, knowledge and attitudes using linear regression model

	Knowledge			Attitude		
	$\beta$	t	p	$\beta$	t	p
Age	-0.24	-1.93	0.055	-0.03	-0.27	0.784
Gender (female was reference group)						
Male	-0.04	-0.51	0.611	0.06	0.87	0.386
Environment (urban was reference group)						
Rural	-0.01	-0.16	0.874	0.08	1.22	0.224
University (University of Mostar was reference group)						
University of Split	0.00	0.00	0.998	-0.05	-0.53	0.596
University of Zagreb	0.24	2.15	0.033	-0.26	-2.50	0.013
Year of study (6 <sup>th</sup> year of study was reference group)						
1 <sup>th</sup> year of study	-0.22	-1.61	0.110	-0.09	-0.72	0.471
2 <sup>th</sup> year of study	-0.28	-2.07	0.040	-0.24	-1.93	0.055
3 <sup>th</sup> year of study	-0.14	-1.18	0.239	-0.15	-1.34	0.182
4 <sup>th</sup> year of study	-0.02	-0.26	0.793	0.05	0.51	0.610
5 <sup>th</sup> year of study	-0.03	-0.36	0.717	-0.24	-2.68	0.008
Contact with COVID-19 (yes was reference group)						
No contact	-0.03	-0.39	0.695	0.11	1.60	0.111
Don't know	0.03	0.41	0.685	-0.09	-1.30	0.195
Need of education (yes was reference group)						
No need	0.17	1.64	0.103	-0.16	-1.58	0.116
Don't know	0.20	1.92	0.057	-0.09	-0.95	0.342
Use protective equipment (yes was reference group)						
Not use	0.09	1.12	0.263	-0.15	-1.96	0.052
Adherence measures of Civil Protection Directorate (yes was reference group)						
Adherence occasionally	0.17	1.70	0.091	-0.36	-3.89	<0.001
Adherence of social distance (yes was reference group)						
No adherence	-0.23	-2.40	0.018	0.08	0.87	0.383
Attitude	0.15	1.93	0.056			
Knowledge				0.14	1.93	0.056

$\beta$  = beta coefficient; t = coefficient t-value; p = level of statistical significance

*Supplement 1. Students' attitudes about appropriate COVID-19 protection with regard to place of study (N=192)*

Statement	Answer	University						p*
		Mostar (n=49)		Split (n=73)		Zagreb (n=70)		
		n	%	n	%	n	%	
I believe that hygienic hand washing can reduce the risk of infection with COVID-19.	Strongly disagree	2	4.1	7	9.7	11	15.7	0.113
	Somewhat disagree	2	4.1	0	0.0	3	4.3	
	Neither agree nor disagree	2	4.1	1	1.4	2	2.9	
	Somewhat agree	11	22.4	18	25.0	8	11.4	
	Strongly agree	32	65.3	46	63.9	46	65.7	
I maintain social distance with the use of protective equipment (mask or gloves).	Strongly disagree	2	4.1	2	2.9	2	2.9	0.375
	Somewhat disagree	4	8.2	4	5.7	5	7.1	
	Neither agree nor disagree	10	20.4	13	18.6	5	7.1	
	Somewhat agree	20	40.8	26	37.1	37	52.9	
	Strongly agree	13	26.5	25	35.7	21	30.0	
Gloves and masks protect against diseases caused by COVID-19.	Strongly disagree	1	2.0	1	1.4	4	5.7	0.370
	Somewhat disagree	2	4.1	3	4.1	5	7.1	
	Neither agree nor disagree	8	16.3	3	4.1	6	8.6	
	Somewhat agree	22	44.9	38	52.1	34	48.6	
	Strongly agree	16	32.7	28	38.4	21	30.0	
Regardless of the price. I always buy enough protective gear.	Strongly disagree	3	6.1	2	2.7	6	8.6	0.801
	Somewhat disagree	5	10.2	7	9.6	7	10.0	
	Neither agree nor disagree	13	26.5	18	24.7	11	15.7	
	Somewhat agree	14	28.6	24	32.9	24	34.3	
	Strongly agree	14	28.6	22	30.1	22	31.4	
Healthcare workers have a higher risk of infection with COVID-19.	Strongly disagree	0	0.0	5	6.9	5	7.1	0.553
	Somewhat disagree	2	4.1	1	1.4	1	1.4	
	Neither agree nor disagree	1	2.0	3	4.2	3	4.3	
	Somewhat agree	10	20.4	11	15.3	15	21.4	
	Strongly agree	36	73.5	52	72.2	46	65.7	
I feel safe when I wear a mask or gloves.	Strongly disagree	5	10.2	4	5.5	7	10.0	0.104
	Somewhat disagree	4	8.2	2	2.7	1	1.4	
	Neither agree nor disagree	11	22.4	17	23.3	11	15.7	
	Somewhat agree	16	32.7	32	43.8	41	58.6	
	Strongly agree	13	26.5	18	24.7	10	14.3	
Without protective equipment, I don't go shopping for groceries and hygiene items.	Strongly disagree	4	8.2%	2	2.7%	4	5.7%	<0.001
	Somewhat disagree	6	12.2%	2	2.7%	2	2.9%	
	Neither agree nor disagree	8	16.3%	1	1.4%	4	5.7%	
	Somewhat agree	10	20.4%	7	9.6%	8	11.4%	
	Strongly agree	21	42.9%	61	83.6%	52	74.3%	

Supplement 1. *ctnd.*

Statement	Answer	University						p*
		Mostar (n=49)		Split (n=73)		Zagreb (n=70)		
		n	%	n	%	n	%	
Protective equipment is extremely important in my environment (business, family, etc.).	Strongly disagree	5	10.2%	3	4.1%	4	5.7%	0.378
	Somewhat disagree	5	10.2%	4	5.5%	3	4.3%	
	Neither agree nor disagree	10	20.4%	11	15.1%	12	17.1%	
	Somewhat agree	15	30.6%	20	27.4%	27	38.6%	
	Strongly agree	14	28.6%	35	47.9%	24	34.3%	
The measure of social distancing is one of the good measures to prevent the spread of infection.	Strongly disagree	0	0.0%	3	4.1%	3	4.3%	0.162
	Somewhat disagree	0	0.0%	5	6.8%	2	2.9%	
	Neither agree nor disagree	6	12.2%	9	12.3%	3	4.3%	
	Somewhat agree	19	38.8%	23	31.5%	20	28.6%	
	Strongly agree	24	49.0%	33	45.2%	42	60.0%	
People suffering from chronic diseases are recommended to wear protective equipment.	Strongly disagree	0	0.0%	0	0.0%	4	5.7%	0.017
	Somewhat disagree	0	0.0%	1	1.4%	0	0.0%	
	Neither agree nor disagree	5	10.2%	1	1.4%	0	0.0%	
	Somewhat agree	4	8.2%	6	8.3%	6	8.6%	
	Strongly agree	40	81.6%	64	88.9%	60	85.7%	

\*p Fisher-Freeman-Halton test

protective equipment. The above may be a direct consequence of the extremely strong media coverage of the pandemic in Croatia<sup>23</sup>, public appearances by health professionals for the purpose of educating not only health workers but also the general population, and implementation of strict epidemiological measures<sup>24</sup>. Similar results are highlighted by other authors who conducted a survey of knowledge of health care professionals regarding COVID-19 in a medical college<sup>14,19,21,25</sup>. On the other hand, the slightly lower percentage of correct answers on the knowledge questionnaire of medical students studying at the University of Mostar can be explained by the weaker possibility of additional information, monitoring of publicity, and implementation of epidemiological measures due to a greater burden of regular contact formal education than is the case at medical studies in Croatia. Namely, in contrast to the schools in Croatia, where classes were mostly held online, at the schools in Bosnia and Herzegovina, classes were still mostly held in school premises<sup>26</sup>.

The results of this research indicate differences in attitudes about the need to use protective equipment when going out to buy groceries or hygiene items. The majority of students studying in Croatia agreed with the above statement, which may also be a consequence of the valid and strongly media-monitored epidemiological measures at the time of conducting this research, which, due to upcoming local elections, suggested the use of a protective mask when staying in open spaces<sup>27</sup>. In support of the fact that the stated attitude is not the result of formal medical education of students only and exclusively, the results of research that included the general population in the Republic of Croatia and established that the respondents, regardless of whether they belonged to the health or non-health population, had similar attitudes about the use of masks and gloves<sup>22</sup>. Furthermore, almost 90% of medical students, regardless of the place of study, believed that people suffering from chronic diseases should be recommended to use protective equipment during the COVID-19 pandemic. The above result

clearly points to the effectiveness of formal education during medical studies<sup>28</sup>.

Students differed among themselves regarding their behavior during the COVID-19 pandemic. Namely, in behaviors related to the use of protective equipment, adherence to recommended measures, adherence to social distancing measures, and type of protective equipment they used, a difference was recorded depending on the university where they studied. Students from the University of Zagreb adhered significantly more often to the recommended measure of using protective equipment when driving a personal vehicle, using public transport or when walking compared to students from Split and Mostar, and students from the University of Mostar applied this measure least often. The results described, as well as the result that indicated differences between students in Croatia and Bosnia and Herzegovina regarding the degree of adherence to the epidemiological measures prescribed, probably were a consequence of the fact that the strict measures applied exclusively to the territorial area of the Republic of Croatia. Although in Bosnia and Herzegovina, there was an obligation to comply with a series of epidemiological measures<sup>29</sup>, the media point out that there is non-compliance with the valid measures, as well as insufficient supervision over their implementation<sup>30</sup>. However, in addition to the established differences between students in Croatia and Bosnia and Herzegovina, the results also indicated different behavior of students at the University of Zagreb and the University of Split. Namely, students of the School of Medicine in Zagreb used protective equipment more often when driving and adhered to the recommended measure of social distance more often compared to students from the University of Split, while students from Split used masks more often than students from Zagreb. It is possible that environmental factors and the area in which they study and live due to their characteristics caused exactly these differences. Namely, students from Zagreb are located in a larger territorial area and probably use public transport more often than students from Split and Mostar<sup>31</sup>. The stated reason may also be the cause of differences in adherence to social distancing measures, as students move more often in crowded public spaces and areas<sup>31</sup>. Bačić and Šuljok also state similar regional differences regarding the use of protective equipment and adherence to

social distancing<sup>31</sup>. Namely, the authors point out that in Dalmatia compared to other regions of Croatia, the prescribed measures are slightly less respected, as well as that protective masks are used somewhat more often in large cities<sup>31</sup>. We should certainly not ignore the fact that during this research, the area of Split was strongly affected by the pandemic, which certainly influenced greater sense of security of students from Split when using a protective mask, as well as the more frequent use of protective equipment when leaving their own home.

The results related to the examination of the connection between students' knowledge, attitudes and behavior about appropriate COVID-19 protection with regard to sociodemographic characteristics indicate that students from Zagreb have better knowledge than students from Mostar but more negative attitudes. Such results could be explained by the oversaturation of information about COVID-19 and the pronounced representation of information in the public, which potentially leads to resistance and formation of negative attitudes<sup>32</sup>. Despite the results of earlier research that indicate that students of health and non-health studies, as well as health and non-health workers have a satisfactory level of knowledge about COVID-19<sup>20</sup>, the results of this research recorded significant differences between students with regard to the place of study, year of study, and adherence to recommended epidemiological measures. Namely, students who studied in Zagreb expressed better knowledge but more negative attitudes compared to students who studied in Mostar. As stated earlier, it is possible that strong media coverage of the pandemic in Croatia, along with regular specific medical education of students, had a positive effect on the acquisition of new knowledge about COVID-19 but also more negative attitudes of students due to the oversaturation of information<sup>33</sup>. Just opposite results were published by the authors from Egypt, who point out that students in higher years of study have a higher level of knowledge about COVID-19, as well as more positive attitudes towards COVID-19, which they connected with the previously acquired specific knowledge of the students<sup>15</sup>. However, some authors state that the level of study is not decisive in students' knowledge, attitudes and behavior about appropriate COVID-19 protection. For example, the authors of a

study that included health and non-health students state that both have a satisfactory level of knowledge about COVID-19, positive attitudes, and correct behaviors in terms of the prevention of COVID-19<sup>20</sup>. Furthermore, a study conducted in Croatia that examined differences between health and non-health workers also highlights the generally enviable level of knowledge and moderately positive attitudes of the population regardless of belonging to the health profession<sup>22</sup>. However, when comparing the results of the aforementioned study, one should definitely take into account the different time of conducting it. Namely, the mentioned study was carried out a year earlier, which certainly could have influenced the difference in the results. In our sample, second-year students had a significantly lower level of knowledge compared to the last, sixth-year students, which was also reflected in marginally more negative attitudes of second-year students. Similar deviations were not recorded among students of other study years. Despite the relatively weak connection between the second year of study and poorer knowledge of students, this result potentially indicates a possible negative effect of online classes during the previous first year of study on the level of students' knowledge<sup>34</sup>. The fact that online education is not complete compensation for classic teaching in the classroom and at clinical workplaces is confirmed by other medical students around the world<sup>35,36</sup>; the more so, there are significant differences and inequalities in online teaching<sup>37</sup>. Furthermore, although fifth-year students did not have worse knowledge, significantly more negative attitudes were recorded compared to sixth-year students. A possible reason for this result is the fact that, despite attending clinical subjects that provide them with a broad base of specific medical knowledge, fifth-year students have not yet attended an epidemiology course. It is possible that only after completing the epidemiology course, students will effectively use the acquired knowledge and form their own views on appropriate COVID-19 protection. So, completely unexpectedly and contrary to the results of earlier research, the knowledge levels and attitudes of the students involved in this research were not consistently monitored. Although knowledge is a prerequisite for establishing positive attitudes and promoting positive behavior<sup>38</sup>, it did not have a positive impact on attitudes. More clearly, the relationship between

knowledge and attitudes in this research was very weak. It is possible that the aforementioned was influenced by social media and the internet, which, due to oversaturation, led to a weaker connection<sup>38</sup>.

Moreover, adherence to measures prescribed by the Civil Protection Headquarters and adherence to social distancing measures were not consistently conditioned by students' knowledge and attitudes either. For example, worse attitudes were recorded among students who occasionally complied with the measures of the civil protection headquarters, despite the absence of significant differences in knowledge compared to students who complied with the measures, while students who did not comply with social distancing measures had worse knowledge without significant differences in student attitudes.

Although these valuable findings demonstrate the importance of students' knowledge of COVID-19 protection, this study had several limitations that make it difficult to generalize the results. First, this was a cross-sectional study, so it was not possible to determine the causality of the level of knowledge. Second, a relatively small sample could influence certain results, especially in the regression model. Third, representation of students with regard to the year of study and institution where they studied was uneven. Despite these limitations, this study highlights the importance of understanding medical students' knowledge of COVID-19 protection and raising awareness of how to manage the knowledge through formal education process.

## Conclusion

The results of this study recorded generally good knowledge of medical students about appropriate COVID-19 protection, attitudes and behavior. Considering the university where they studied, the students partly differed from each other in their knowledge, attitudes and behavior. The results of students' knowledge and attitudes about appropriate COVID-19 protection were not consistently monitored, which suggests the need of more research in order to identify additional potential factors that favor the establishment of students' knowledge, as well as the formation of their attitudes toward appropriate COVID-19 protection.

## References

- McCaffery KJ, Dodd RH, Cvejic E, Ayrek J, Batcup C, Isautier JM, Copp T, Bonner C, Pickles K, Nickel B, Dakin T, Cornell S, Wolf MS. Health literacy and disparities in COVID-19-related knowledge, attitudes, beliefs and behaviours in Australia. *Public Health Res Pract.* 2020 Dec 9;30(4):30342012. doi: 10.17061/phrp30342012
- Karim Z, Javed A, Azeem MW. The effects of Covid-19 on Medical Education. *Pak J Med Sci.* 2022 Jan-Feb;38(1):320-2. doi: 10.12669/pjms.38.1.5269
- COVID-19 – Announcement of the first case. Croatian Institute of Public Health. 2020. [cited 2022 Feb 13] Available from: [hzzj.hr/priopcenja-mediji/covid-19-priopcenje-prvog-slucaja](https://hzzj.hr/priopcenja-mediji/covid-19-priopcenje-prvog-slucaja)
- Vargantolić AM, Pastorčić Grgić M, Grgić MV. The impact of COVID-19 pandemic on diagnosis and treatment in otorhinolaryngology patients in Croatia. *Acta Clin Croat.* 2022 Oct;61(Suppl 4):11-8. doi: 10.20471/acc.2022.61.s4.1
- Trnacevic A, Mujkanovic A, Al-Salloum N, Sakusic A, Trnacevic E, Jusufovic E, Hukic F, Jahic R, Stratton R. COVID-19 in northeast Bosnia and Herzegovina and patient's length of hospitalization. *BMC Infect Dis.* 2021 Apr 19;21(1):367. doi: 10.1186/s12879-021-06034-6
- Directorate of Civil Protection. The decision of the Civil Protection Directorate of the Republic of Croatia in order to prevent the spread of the new coronavirus infection has been in force since midnight. 2020. [cited 2022 Feb 13]. Available from: <https://civilna-zastita.gov.hr/vijesti/odpionoci-na-snazi-odluke-stozera-civilne-zastite-rh-u-svrhu-sprjecavanja-sirenja-zaraze-novim-koronavirusom/2271>
- Jeftić A, Ikizer G, Tuominen J, Chrona S, Kumaga R. Connection between the COVID-19 pandemic, war trauma reminders, perceived stress, loneliness, and PTSD in Bosnia and Herzegovina. *Curr Psychol.* 2021 Oct;22:1-13. doi: 10.1007/s12144-021-02407-x.
- Grbeša M. Communicating COVID-19 pandemic: media coverage of the Headquarters and the use of persuasion strategies in Croatia. *Anali Hrvatskog politologskog društva* 2020;17(1):57–78. doi: 10.20901/an.17.03
- Prašović Gadžo S. Komuniciranje Vlade Federacije Bosne i Hercegovine tijekom pandemije COVID-19. *South East Eur J Commun.* 2021;3(1):71-85. doi: 10.47960/2712-0457.2021.1.2.71
- Sarzyńska K, Czwojdzinski E, Kuźniarski A, Rayad S, Piwowar A, Jankowska-Polańska B. Medical students' knowledge about COVID-19 and evaluation of the effectiveness of the applied preventive strategies. *Arch Pub Health.* 2022;80(1):1-13. doi: 10.1186/s13690-022-00873-8
- Abdelhafiz AS, Mohammed Z, Ibrahim ME, *et al.* Knowledge, perceptions, and attitude of Egyptians towards the novel coronavirus disease (COVID-19). *J Community Health.* 2020;45(5):881-90. doi: 10.1007/s10900-020-00827-7
- Bates BR, Moncayo AL, Costales JA, Herrera-Cespedes CA, Grijalva MJ. Knowledge, attitudes, and practices towards COVID-19 among Ecuadorians during the outbreak: an online cross-sectional survey. *J. Community Health.* 2020;45(6):1158-67. doi: 10.1007/s10900-020-00916-7
- Zhong BL, Luo W, Li HM, Zhang QQ, Liu XG, Li WT, Li Y. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci.* 2020 Mar 15;16(10):1745-52. doi: 10.7150/ijbs.45221
- Cervera-Gasch Á, González-Chordá VM, Mena-Tudela D. COVID-19: Are Spanish medicine and nursing students prepared? *Nurse Educ Today.* 2020 Sep;92:104473. doi: 10.1016/j.nedt.2020.104473
- Abd El Fatah SAM, Salem MR, Hakim ASA, El Desouky ED. Knowledge, attitude, and behavior of Egyptian medical students toward the novel coronavirus disease-19: a cross-sectional study. *Open Access Maced J Med Sci.* 2020;8(T1):443-50. doi: 10.3889/oamjms.2020.5279
- Večernji list. I studenti medicine lovit će kontakte. 2020. [cited 2022 Feb 13]. Available from: <https://www.vecernji.hr/vijesti/i-studenti-medicine-lovit-ce-kontakte-1440824> (in Croatian)
- Radiosarajevo.ba. Studenti Medicinskog fakulteta stižu u pomoć radnicima Doma zdravlja. 2021. [cited 2022 Feb 13]. Available from: <https://radiosarajevo.ba/vijesti/bosna-i-hercegovina/studenti-medicinskog-fakulteta-stizu-u-pomoc-doma-zdravlja/404250> (in Bosnian)
- Ojulung J, Mitonga KH, Ipinge SN. Knowledge and attitudes of infection prevention and control among health science students at University of Namibia. *Afr Health Sci.* 2013 Dec;13(4):1071-8. doi: 10.4314/ahs.v13i4.30
- Khasawneh AI, Humeidan AA, Alsulaiman JW, Bloukh S, Ramadan M, Al-Shatanawi TN, Awad HH, Hijazi WY, Al-Kammash KR, Obeidat N, Saleh T, Kheirallah KA. Medical students and COVID-19: knowledge, attitudes, and precautionary measures. A descriptive study from Jordan. *Front Public Health.* 2020 May 29;8:253. doi: 10.3389/fpubh.2020.00253

20. Hasan H, Raigangar V, Osaili T, Neinavaei NE, Olaimat AN, Aolymat I. A cross-sectional study on university students' knowledge, attitudes, and practices toward COVID-19 in the United Arab Emirates. *Am J Trop Med Hyg.* 2021 Jan;104(1):75-84. doi: 10.4269/ajtmh.20-0857
21. Wheeler DR, Chibbaro S, Karoutis I, Safa A, Tinterri B, Calgaro G, Chung Yin W, Zaed I. A study investigating the knowledge and responses of Italian medical students to the COVID-19 pandemic. *Pathog Glob Health.* 2021 Jun;115(4):250-7. doi: 10.1080/20477724.2021.1878447
22. Marendić M, Bokan I, Buljan I, Dominiković P, Suton R, Kolčić I. Adherence to epidemiological measures and related knowledge and attitudes during the coronavirus disease 2019 epidemic in Croatia: a cross-sectional study. *Croat Med J.* 2020 Dec 31;61(6):508-17. doi: 10.3325/cmj.2020.61.508
23. Gusar I, Konjevoda S, Babić G, Hnatešen D, Čebohin M, Orlandini R, Dželalija B. Pre-vaccination COVID-19 vaccine literacy in a Croatian adult population: a cross-sectional study. *Int J Environ Res Public Health.* 2021 Jul 2;18(13):7073. doi: 10.3390/ijerph18137073
24. Tokić A, Gusar I, Nikolić Ivanišević M. Job satisfaction and mental health in Croatia during the COVID-19 pandemic. *Društvena istraživanja.* 2021;30(2):401-21. doi: 10.5559/di.30.2.11
25. Neupane HC, Shrestha N, Adhikari S, Angadi S, Shrestha BK, Gauli B. Knowledge of health care professionals and medical students regarding Covid-19 in a tertiary care hospital in Nepal. *JNMA J Nepal Med Assoc.* 2020 Jul 31;58(227):480-6. doi: 10.31729/jnma.4995
26. Miloshevska L, Gajek EG, Delibegović Džanić N, Hatipoğlu Ç. Emergency online learning during the first Covid-19 period: students' perspectives. *ExELL Explorations in English Language and Linguistics.* 2020;8(2):110-43. doi: 10.2478/exell-2021-0002
27. Croatian Institute of Public Health. Recommendations for the prevention of infection with the disease COVID-19 during the holding of election assemblies [Preporuke za sprječavanje zaraze bolešću COVID -19 tijekom održavanja izbornih skupova]. Croatia: 2021. [cited 2022 Feb 13]. Available from: <https://vijesti.hrt.hr/hrvatska/hzjz-preporuke-za-skupove-uoci-dopunskih-i-pazinskih-izbora-2836210> (in Croatian)
28. Pjevač N, Pavleković G, Vrcić-Keglević M, Lovrić-Benčić M, Šmalcelj A, Luetić T. Croatian training model for medical teachers. *Croat Med J.* 2013;54(6):585-8. doi: 10.3325/cmj.2013.54.585
29. Crisis Staff of the Federal Ministry of Health. Orders of the Crisis Staff of the Federal Ministry of Health. [Naredbe kriznog stožera Federalnog ministarstva zdravstva]. 2021. [cited 2022 Feb 13]. Available from: <https://covid19.fmoh.gov.ba/novost/62/naredbe-kriznog-stozera-staba-federalnog-ministarstva-zdravstva> (in Bosnian)
30. BHRT. FBiH Crisis Staff: Extend epidemiological measures for the next 14 days. Krizni štab FBiH: Produžiti epidemiološke mjere za narednih 14 dana. 2021. [cited 2022 Feb 13]. Available from: <https://bhrt.ba/krizni-stab-fbih-produziti-epidemioloske-mjere-za-narednih-14-dana/> (in Bosnian)
31. Bagić D, Šuljok A. Put a mask and keep distance – a study of determinants of protective behavior against COVID-19 disease in the Republic of Croatia. *Sociologija i Prostor.* 2021;59:119-47. doi: 10.5673/sip.59.0.5
32. Biasio LR. Vaccine literacy is undervalued. *Hum Vaccin Immunother.* 2019;15(11):2552-3. doi: 10.1080/21645515.2019.1609850
33. Biasio LR, Carducci A, Fara GM, Giammanco G, Lopalco PL. Health literacy, emotionality, scientific evidence: elements of an effective communication in public health. *Hum Vaccin Immunother.* 2018;14(6):1515-6. doi: 10.1080/21645515.2018.1434382
34. Dautbašić A, Bećirović S. Teacher and student experiences in online classes during COVID-19 pandemic in Serbia, Bosnia and Herzegovina and Croatia. *MAP Social Sciences.* 2022;2(1):9-17. doi: 10.53880/2744-2454.2022.2.1.9
35. Dwivedi A, Qiu XM, Dwivedi SS, Tariq MR, Jha SK, Sigdel D. Impact of online lectures on medical students during COVID-19 pandemic. *J Med Dent Sci Res.* 2021;9(4):433-7.
36. Sekine M, Watanabe M, Nojiri S, *et al.* Effects of COVID-19 on Japanese medical students' knowledge and attitudes toward learning in relation to performance on achievement tests. *PLoS ONE.* 2022;17(3 March):1-14. doi: 10.1371/journal.pone.0265356
37. Wilcha RJ. Effectiveness of virtual medical teaching during the COVID-19 crisis: systematic review. *JMIR Med Educ.* 2020 Nov 18;6(2):e20963. doi: 10.2196/20963
38. Hamza MS, Badary OA, Elmazar MM. Cross-sectional study on awareness and knowledge of COVID-19 among senior pharmacy students. *J Community Health.* 2021;46(1):139-46. doi: 10.1007/s10900-020-00859-z

## Sažetak

## ZNAJNA, STAVOVI I PONAŠANJE STUDENATA MEDICINE U VEZI SA ZAŠTITOM OD COVID-19: PRESJEČNO ISTRAŽIVANJE HRVATSKIH I BOSANSKOHERCEGOVAČKIH STUDENATA MEDICINE

*P. Kovačević, I. Gusar, M. Ljubičić, N. Samardžić, D. Caktaš, M. Lovrić, K. Lauš, P. Pantalon, J. Pantalon, A-M. Gusar i K. Vukojević*

Cilj ovoga presječnog istraživanja bio je utvrditi znanja, stavove i ponašanje studenata medicine u vezi s COVID-19 s obzirom na različite fakultete i trajanje studija. Validirani upitnik primijenjen je kod 192 studenta medicine na dva sveučilišta u Hrvatskoj i jednom iz Bosne i Hercegovine. Za ispitivanje razlika između studijskih skupina primijenjen je Fisher-Freeman-Haltonov test i Kruskal-Wallisov test. Povezanost varijabla testirana je modelom linearne regresije. Utvrđena je negativna povezanost između pridržavanja mjera i stavova ( $\beta = -0,36$ ;  $p < 0,001$ ). Studiranje na Sveučilištu u Zagrebu pozitivno je povezano sa znanjem studenata o COVID-19 ( $\beta = 0,24$ ;  $p = 0,033$ ), ali negativno sa stavovima studenata ( $\beta = -0,26$ ;  $p = 0,013$ ). U usporedbi sa studentima zadnje godine studija, kod studenata druge godine zabilježeno je slabije znanje ( $\beta = -0,28$ ;  $p = 0,040$ ) i statistički neznčajni negativni stavovi ( $\beta = -0,24$ ;  $p = 0,055$ ). Studenti pete godine imali su negativnije stavove ( $\beta = -0,24$ ;  $p = 0,008$ ) u odnosu na studente šeste godine. Povezanost između znanja i stavova bila je slaba i statistički granično neznčajna ( $\beta = 0,14$ ;  $p = 0,056$ ). Nepostojanje povezanosti između znanja i stavova zahtijeva dodatna istraživanja kako bi se identificirali potencijalni čimbenici koji pogoduju formiranju stavova prema odgovarajućoj zaštiti od COVID-19.

Ključne riječi: *Student medicine; Znanja; Stavovi; Ponašanja; COVID-19*