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Original scientific paper

Knowledge of Cardiopulmonary Resuscitation and Automated External Defibrillator Use in the General Population

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Abstract

Introduction. Sudden cardiac arrest represents a significant public health issue worldwide. Laypersons are often the first responders in emergencies. Timely recognition of the distressed individual and providing aid is crucial. Education on basic life support procedures is essential to reduce mortality among affected individuals, alongside addressing laypersons' fear of performing cardiopulmonary resuscitation.

Aim. The aim of this study was to assess the knowledge of Croatian citizens regarding basic life support procedures and knowledge of automated external defibrillator use.

Methods. A cross-sectional study was conducted on 597 respondents in Croatia between November 2022 and April 2023. The research was carried out using an online questionnaire distributed through social media platforms. The questionnaire utilized a combination of Atlagić K. and Al Haliq's surveys. The obtained results were presented in frequency and percentage of respondents. Continuous variables were displayed using mean and standard deviation.

Results. The majority of respondents (89.9%) had attended a first aid course. Half of the respondents (56.3%) expressed readiness to provide assistance to an injured person. A high percentage of respondents (87.4%) recognized chest compressions as the most crucial measure during cardiac arrest. Only 52.8% of respondents were aware of the 30:2 compression-to-ventilation ratio. When it comes to who is allowed

to use an automated external defibrillator, only 35.2% of respondents knew that everyone can use it. A statistically significant difference was observed concerning the education level of respondents, with those with primary education being the least prepared to apply life-saving measures.

Conclusion. Respondents showed readiness to provide first aid; however, there was a knowledge gap despite attending first aid courses. This highlights the need for introducing education initiatives aimed at enhancing citizens' knowledge of administering first aid.

Introduction

Sudden cardiac arrest is the third leading cause of death in Europe (1). According to The Guidelines® - Resuscitation Registry data from 2017, the survival rate after cardiac arrest until hospital discharge is approximately 25% (1). Defibrillation in the critical first minutes of out-of-hospital cardiac arrest can improve survival (2).

The annual incidence of out-of-hospital cardiac arrest in Europe ranges between 67 to 170 per 100,000 inhabitants. Resuscitation is continued or attempted by medical personnel in about 50-60% of cases. The rate of bystander-initiated cardiopulmonary resuscitation (CPR) varies from country to country (average 58%). The use of automated external defibrillators (AEDs) remains low in Europe (average 28%). In the Republic of Croatia, for now, there is no register of resuscitation or any other form of systematic monitoring of resuscitation outcomes (3).

The actual frequency of out-of-hospital cardiac arrest in Europe is not known; available literature is based on emergency medical services reports. Therefore, the frequency may be underestimated since in certain countries, due to cultural or belief reasons, bystanders might not call emergency medical services at the time of a person's cardiac arrest. Other reasons for not seeking emergency assistance include instances where no one witnessed the event, and the patient is presumed dead, or the individual chooses not to initiate CPR. Hence, out-of-hospital cardiac arrest, when emergency medical assistance arrives, can be divided into two groups: those patients where CPR was initiated and those where CPR was not initiated (1). Addressing population knowledge gaps and education on patient needs are crucial for improving survival rates (4).

Chen et al. in their study found statistically significant differences in the willingness to use public AED based on participation in training, education level, residential location, family members with cardiovascular disease, population density, and the presence of elderly family members aged 65 or over ($p<.05$) (5). Alradini et al. detected strong association between knowledge of and willingness to use AEDs in emergency situations among the public (6). Knowledge of basic life support procedures is one of the essential skills that each person needs to adopt (7).

In the study by Wang et al. (8), three reasons were cited why laypersons do not initiate cardiopulmonary resuscitation: lack of practical knowledge, fear of injuring the patient, and inadequate familiarity with resuscitation technique skills. After undergoing online training, readiness to provide assistance increased. Public knowledge about the use of automated external defibrillators is generally low worldwide and unevenly distributed, varying from country to country. In their research, it was found that 34.5% of respondents knew what an automated external defibrillator was, yet half of the respondents could not answer any questions about the use of automated external defibrillators, and only 12.28% answered all questions correctly (8).

Aim

To explore the population's knowledge levels regarding resuscitation procedures and the use of automated external defibrillators. The specific objectives of this study are to determine whether differences exist based on place of residence, education level, and completion of a first aid course.

Methods

The conducted research was based on a cross-sectional study design. Participants completed an anonymous survey. Prior to survey completion, they were briefed on the purpose of the research, and participation was voluntary. The survey was conducted using Google Forms questionnaire. Assistance was provided to participants in accessing social media platforms. Approval for the research was obtained from the Ethics Committee of the University of Applied Health Sciences Zagreb. The cross-sectional study was conducted on the convenience sample in Croatia from November 2022 to April 2023. A total of 597 respondents participated in the study, consisting of 151 male and 446 female respondents. Participants voluntarily consented to take part in the study and participated via informed consent. They engaged in the research by completing an online questionnaire distributed publicly across various social media platforms.

Instruments

In the research, several instruments were utilized to gather comprehensive data. Firstly, demographic information was collected, which included details such as gender, age, education level, and place of residence of the respondents. This data provided a foundational understanding of the participants' backgrounds.

Additionally, the research employed a questionnaire developed by Atlagić K., titled "Knowledge and awareness of resuscitation procedures and the application of automated external defibrillators in the population" (9). This instrument was designed to assess the respondents' knowledge and awareness regarding resuscitation procedures and the use of automated external defibrillators. The questionnaire included a series of questions aimed at evaluating how well the general population understands and can apply these life-saving techniques.

Furthermore, the study incorporated another questionnaire from Al Haliq and colleagues, titled "Assessment on CPR Knowledge and AED Availability in Saudi Malls by Security Personnel: Public Safety Perspective" (10). This instrument covered basic questions related to basic life support (BLS), focusing particularly on the knowledge of CPR and the availability of AEDs, as understood and practiced by security personnel in Saudi malls.

Through these instruments, the research aimed to provide a detailed analysis of the participants' knowledge and awareness of critical life-saving procedures, as well as the availability and accessibility of AEDs in public spaces.

Statistics

The results obtained in the research were presented by frequency and percentage (%) of respondents. Correct individual responses were computed into Total score on "Knowledge and awareness of resuscitation procedures" scale. For that continuous variable the normality of distribution was assessed using the Shapiro-Wilk test and it showed statistically significant deviation from normal distribution ($p<0.001$), therefore beside mean and standard deviation also median and interquartile range is shown. Independent samples χ^2 test was used to evaluate the presence of statistically significant differences between groups based on completion of first aid during the driver's licence testing in respondents' knowledge of basic life support and the use of automated external defibrillators. Kruskal-Wallis was used as a non-parametric substitute for one-way analysis of variance to check the significance of differences between age and education groups on Knowledge and awareness scale.

Results

A total of 597 citizens has participated in the survey, 151 male (25.3%), and 446 female (74.7%). Table 1 shows sample demographic features.

Table 1. **Demographic features**

		n	%
Age	18 - 25	180	30.3
	26 - 35	131	22
	36 - 45	133	22.4
	46 - 55	103	17.3
	56 - 65	32	5.4
	65 +	16	2.7
Gender	Male	151	25.3
	Female	446	74.7
Level of education	Primary education	25	4.2
	Secondary education	320	53.6
	Bachelor degree	142	23.8
	Master degree or College degree	110	18.4
Type of settlement	Rural	296	49.6
	Urban	301	50.4
Area	Zagreb County	276	46.4
	The City of Zagreb	130	21.8
	Sisak-Moslavina County	40	6.7
	Istria County	11	1.8
	Bjelovar-Bilogora County	25	4.2
	Karlovac County	10	1.7
	Virovitica-Podravina County	5	0.8
	Primorje-Gorski Kotar Couty	11	1.8
	Zadar County	7	1.2
	Varaždin County	4	0.7
	Koprivnica-Križevci County	19	3.2
	Požega-Slavonia County	4	0.7
	Lika-Senj County	3	0.5
	Split-Dalmatia County	14	20.4
	Krapina-Zagorje County	9	1.5
	Brod-Posavina County	7	1.2
	Šibenik-Knin County	7	1.2
	Osijek-Baranja County	4	0.7
	Vukovar-Srijem County	3	0.5
	Dubrovnik-Neretva County	2	0.3
	Međimurje County	4	0.7
Do you have a driver's licence?	Yes	511	85.9
	No	84	14.1

Female respondents prevail in this sample (74.7%), as well as younger respondents (30.3%) aged 18 to 25 and additional 22% accounts for peopled aged 26 to 35.

Most respondents were from Zagreb County (46.4%) and the City of Zagreb (21.8%). More than half have completed secondary education (53.6%), while 18.4% have college degree, and 23.8% have bachelor's degree. Majority have driver's licence (85.9%).

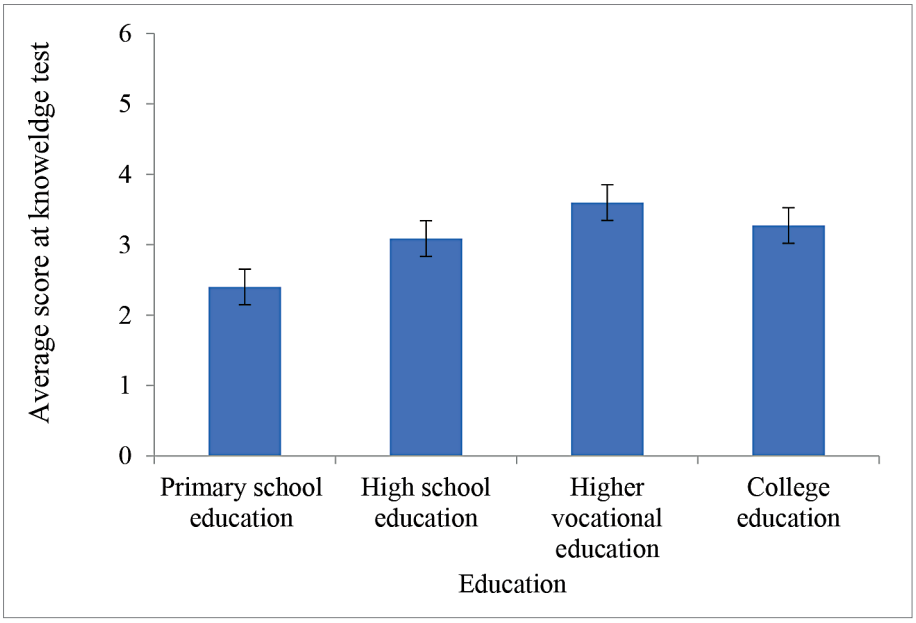
Questions related to knowledge and awareness about basic life support are shown in Table 2.

People with higher education levels have a higher percentage of correct answers compared to people with lower education levels in terms of questions: What is the next step if a person does not respond to a stimulus (sound, touch) (χ^2=14.975, df=3, p=0.002) and Compression ratio of artificial respiration during resuscitation of an adult in which two people participate (χ^2=16.701, ss=3, p=0.001). Given that Levene's test of homogeneity of variances showed statistical significance, instead of one-way ANOVA analysis, the Kruskal-Wallis test has been used to check the significance of the difference between the groups of respondents with regard to education in the average total score on the Scale of Knowledge and Awareness of Resuscitation Procedures. The Kruskal-Wallis test determined that the groups differed statistically significantly (p<0.001), with additional Mann-Whitney test between subgroups, in such a way that respondents with primary education had a lower average score (M=2.40, SD=1.08, Median=2, Interquartile Range=1), while those with a higher professional education had a higher average number of points on Knowledge (M=3.60, SD=1.24, Median=4, Interquartile Range=1.25), p<0.001 between two subgroups, as well as between primary and college education (M=3.28, SD=1.42, Median=3, Interquartile Range=2) with p=0.004. Maximum score on Graph 1 is 6, this indicates approximately one point better result for the two highly educated subgroups, but they achieved moderately high results overall.

Series of chi-square tests were used to determine if groups differ statistically significantly. Only in terms of the question "Do you know who is allowed to use an automatic external defibrillator" the respondents differ according to education, in such a way that those with higher education levels have a higher percentage of the correct answer (χ^2=46.047, df=3, p<0.001).

Table 2. **Percentage of population with correct answers in Knowledge related to basic life support according to their education**

n		Primary education		Secondary education		Bachelor's degree		Master's degree or PhD		*p*
		%	n	%	n	%	n	%		
What is the next step if a person does not respond to sound or touch?	Incorrect	14	56	134	41.9	42	29.6	30	27.3	**0.002**
	Correct	11	44	186	58.1	100	70.4	80	72.7	
What is the most beneficial for a person with cardiac arrest?	Incorrect	5	20	44	13.8	14	9.9	12	10.9	0.409
	Correct	20	80	276	86.3	128	90.1	98	89.1	
What should be compression ratio in resuscitation with two persons involved?	Incorrect	18	72	160	50	49	34.5	55	50	**0.001**
	Correct	7	28	160	50	93	65.5	55	50	
What should be the number of compressions for an adult without stopping?	Incorrect	21	84	214	66.9	87	61.3	67	60.9	0.105
	Correct	4	16	106	33.1	55	38.7	43	39.1	
What should be the depth of the chest compression for adults?	Incorrect	16	64	164	51.2	61	43	59	53.6	0.136
	Correct	9	36	156	48.8	81	57	51	46.4	
What is the correct hand position when resuscitating an adult person?	Incorrect	16	64	216	67.5	88	62	77	70	0.547
	Correct	9	36	104	32.5	54	38	33	30	



Graph 1. **Total score in knowledge related to basic life support according to their education**

Table 3. **Distribution of correct answers to the questions on knowledge and awareness of the application of AED regarding education**

n		Primary education		Secondary education		Bachelor's degree		Master's degree or PhD		*p*
		%	n	%	n	%	n	%		
What is the name of the device which saves lives by applying electric shock?	Incorrect	1	4	21	6.6	5	3.5	1	0.9	0.090
	Correct	24	96	299	93.4	137	96.5	109	99.1	
When AED is present, what is the next step?	Incorrect	18	72	190	59.4	78	54.9	58	52.7	0.259
	Correct	7	28	130	40.6	64	45.1	52	47.3	
Do you know who can use AED?	Incorrect	22	88	240	75	71	50	54	49.1	<0.001
	Correct	3	12	80	25	71	50	56	50.9	
Do you know what color the spot with AED is marked with?	Incorrect	15	60	171	53.4	68	47.9	55	50	0.566
	Correct	10	40	149	46.6	74	52.1	55	50	

Discussion

This research aimed to assess knowledge and awareness of resuscitation procedures and the use of automated external defibrillators. As previously mentioned, the importance of early recognition and initiation of resuscitation procedures cannot be overstated. The study aimed to ascertain the knowledge of citizens; thus, 597 participants were involved in the research, with 74.7% female and 25.3% male respondents. The majority of participants completed vocational secondary education (53.6%). Regarding the place of residence, the respondents from rural and urban areas were equally represented.

According to Gonzalez et al.'s research, 40% of respondents could not recognize an automated external defibrillator, and over 60% were unaware that laypersons could use an automated external defibrillator (11). The lack of training in the use of automated external defibrillators is evident. In countries like the United States, Sweden, and Japan, training has led to increased patient survival rates. However, there is still a significant lack of public knowledge and awareness regarding first aid (11). The first encounter with first aid occurs during attending driving school, where passing a first aid course is a requirement. Very often, this is the only exposure to a first aid course, especially if there is no requirement for first aid in the workplace (11).

Research conducted in Croatia by Atlagić (9) reported that 86.3% of respondents had completed a first aid course. Similarly, in our study, a comparable result was obtained, with 89.8% of respondents having completed first aid training. It was observed that 85.9% of individuals obtained their driver's license where they encountered first aid training.

Research conducted by Fan et al. in Hong Kong stated that the majority of respondents were not trained in providing first aid (65.8%), while 85.3% were not educated in using an automated external defibrillator (12). A significant majority of respondents would call for help (96.5%), but only 20.4% were willing to perform cardiopulmonary resuscitation, and merely 18% of respondents would use an automated external defibrillator (12). Furthermore, compared to Atlagić's work (9) regarding respondents' confidence in initiating cardiopulmonary resuscitation, it was noted that only 28.2% of respondents were ready to provide assistance (9). In our study, more than half of the respondents (56.3%) were willing to initiate resuscitation procedures on a person showing symptoms of cardiac arrest.

A study conducted in Vienna by Krammel et al. (13) indicated that 65% of respondents were aware of the importance of starting resuscitation procedures early, 52% would check the breathing of an injured person, while 31% would not check the breathing of an injured person. Concerning the importance of

chest compressions, only 58% of respondents indicated its importance in maintaining life during cardiac arrest (13).

In Al Haliq's study (10), a lack of knowledge about providing basic life support and using an automated external defibrillator was observed, as courses and education are conducted only in hospitals. They mention that poor knowledge is associated with a lack of education during schooling. In contrast, in other countries, it is mandatory to undergo basic life support and automated external defibrillator training before obtaining a driver's license, and in some countries, it is integrated into the high school curriculum (10). Almost all respondents (94.1%) believe that it is the moral obligation of every person to provide first aid to an unconscious person. A total of 47.1% of respondents consider using an automated external defibrillator during cardiac arrest (10). In their research, respondents would seek an automated external defibrillator: in a store 0.8%, at a bus station 3.4%, in a hospital 20.4%, at gatherings with a large number of people 20.6%, 26.8% do not know the answer, while 28% of respondents would seek it at all mentioned locations. A total of 4.5% of respondents had the opportunity to use an automated external defibrillator while providing first aid, and 18.8% tried it during a life support course (10). Very similar data were obtained in Atlagić's research (9), where only 13.3% had tried to use an automated external defibrillator during a first aid course, and 5% during the provision of first aid (9). More than half of the respondents (63.1%) know that the next step after confirming that a person does not respond to stimuli is to check for breathing (9). A high percentage of respondents, 87.4%, know that chest compressions are the most significant measure during cardiac arrest (9). Despite almost all respondents passing the first aid course, only 52.8% of respondents know that the compression-to-ventilation ratio is 30:2. Concerning the question of how deep compressions should be for an adult, only 34.8% of respondents answered correctly. Similarly, for hand placement during resuscitation, only 33.5% know that it is necessary to place two hands on the lower half of the sternum. Almost half of the respondents, 42.4%, know what to do when an automated external defibrillator arrives at the site of the accident. A total of 95.3% of respondents know that a defibrillator or automated external defibrillator is a device that can save a person's life by delivering an electrical impulse.

Only 35.2% of respondents believe that anyone can use an automated external defibrillator. Atlagić's research (9) yields similar results, with only 21.8% knowing the correct answer. Also, concerning the labelling of automated external defibrillators, our respondents demonstrate a higher level of knowledge. Slightly less than half of the respondents (48.2%) know that the location of an automated external defibrillator is indicated by the color green, while in Atlagić's study (9), only 33.9% identified it correctly. In the study by Krammel et al. (13) regarding the identification of automated external defibrillators, 97% recognized what it is, but only 57% stated that anyone can use it, and 21% believe that only doctors can use it. Out of the total number of respondents, 50% recognized the color of the standardized logo for an automated external defibrillator (13). Respondents showed an extremely high willingness to help, call emergency medical services (99.5%), provide first aid (97%), and even perform cardiac massage (92.1%). In this study, respondents demonstrate a higher level of knowledge related to the emergency number compared to Atlagić's research (9), where only 8.7% of respondents do not know the correct emergency number, while in Atlagić's study (9), 55.6% of respondents do not know the emergency number. Research conducted in Saudi Arabia by Al Haliq et al. mentions that over half of the participants (54.1%) were not aware of the emergency number (10).

Individuals with primary education levels are least ready to perform public resuscitation measures. Additionally, they are least prepared to use an AED and do not know what the device is used for. Conversely, individuals with higher vocational education demonstrate the highest readiness to apply an AED. Individuals with higher and university-level education have had the most opportunities to use an AED (during basic life support courses). There is a statistically significant difference related to education; individuals with primary education have a lower average score, while those with higher vocational education have a higher average score concerning knowledge.

Research in Australia found that individuals with higher education possess more knowledge about performing cardiopulmonary resuscitation. In the case of cardiac arrest, around two-thirds of respondents would perform resuscitation, while only 3% would locate a defibrillator (14). In Australia, community CPR training is not mandatory; it is only com-

pulsory in certain occupations (15-17). In Krammel et al.'s study (13) regarding gender differences concerning knowledge of life support and AED use, it was noted that women were more prepared to start basic life support. Regarding age, the youngest age group exhibited the best knowledge of applying basic life support measures and using an AED (13), and for future research it would be interesting to get deeper into gender and age differences. There was no gender difference observed in the conducted research, but a statistically significant difference was noted concerning age. The age group 65+ showed the least preparedness and confidence in using an AED. Individuals who attended a first aid course are more likely to be familiar with the device used to save a person's life by delivering an electrical impulse. Furthermore, they are more willing to provide assistance and start resuscitation compared to those who have not attended such a course.

This study identified that participants who attended a first aid course demonstrated greater readiness to seek help and initiate resuscitation procedures. From this, we can conclude that introducing educational programs for first aid is necessary to ensure that everyone has access to such education, regardless of whether they are drivers or not. It is important to note that although the participants had attended a first aid course and claimed readiness to start resuscitation procedures, slightly more than half of them were not familiar with the compression-to-massage ratio during resuscitation.

Limitations of the study

Research on the knowledge and awareness of the general population regarding resuscitation procedures and the use of automated external defibrillators may face several limitations:

Psychological factors: Feelings of discomfort or nervousness may limit people's readiness to participate in the research or openly share their views on resuscitation.

Demographic factors: Different groups of people may have varying levels of knowledge about resuscitation and AEDs, which could impact research outcomes.

Conclusion

One of the significant public health issues mentioned is out-of-hospital cardiac arrest. For a person to survive, the knowledge of the bystander encountering the injured person is extremely crucial. The key is recognizing cardiac arrest and initiating cardiopulmonary resuscitation. With the development of technology, automated external defibrillators have become accessible to the public, and their usage reduces the mortality rate of the injured person. There is a statistically significant difference concerning the level of education; individuals with primary education are the least prepared to apply resuscitation measures publicly. Additionally, they are the least prepared to use an automated external defibrillator. It is recommended to conduct education during schooling to reach the majority of the population.

The problem in Croatia is the lack of systematic first aid education, except during the process of obtaining a driver's license. Besides aiming to reduce mortality in emergencies, the goal of first aid education is also to reduce laypeople's fear. This study highlights the need to introduce mandatory citizen education. Ideally, education should be part of schooling, but it is also recommended to provide periodic citizen education to regularly refresh first aid knowledge and skills.

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ZNANJE O KARDIOPULMONALNOJ REANIMACIJI I UPOTREBI AUTOMATSKOGA VANJSKOG DEFIBRILATORA U OPĆOJ POPULACIJI

Sažetak

Uvod. Iznenadni srčani zastoj predstavlja znatan javnozdravstveni problem u cijelom svijetu. Laici su često prvi koji odgovaraju u hitnim slučajevima. Od presudne je važnosti pravodobno prepoznavanje unesrećene osobe i pružanje pomoći. Edukacija o osnovnim postupcima održavanja života ključna je za smanjenje smrtnosti među pogođenim pojedincima, uz rješavanje straha laika od izvođenja kardiopulmonalne reanimacije.

Cilj. Procijeniti znanje hrvatskih građana o osnovnim postupcima održavanja života i poznavanje upotrebe automatskoga vanjskog defibrilatora.

Metode. Provedeno je presječno istraživanje u kojem je sudjelovalo 597 ispitanika u Hrvatskoj od studenoga 2022. do travnja 2023. Istraživanje je provedeno s pomoću *online* upitnika distribuiranog putem platformi društvenih medija. U upitniku je primijenjena kombinacija anketa Atlagić K. i Al Haliq. Dobiveni rezultati prikazani su u frekvenciji i postotku ispitanika. Kontinuirane varijable prikazane su s pomoću srednje vrijednosti i standardne devijacije.

Rezultati. Većina ispitanika (89,9 %) pohađala je tečaj prve pomoći. Polovica ispitanika (56,3 %) izrazila je spremnost pružiti pomoć unesrećenoj osobi. Visoki postotak ispitanika (87,4 %) prepoznao je kompresiju prsnog koša kao najvažniju mjeru tijekom srčanog zastoja. Samo 52,8 % ispitanika bilo je svjesno omjera kompresije i ventilacije od 30 : 2. Kad je riječ o tome tko smije primjenjivati automatski vanjski defibrilator, samo 35,2 % ispitanika zna da ga može primjenjivati svatko. Uočena je statistički značajna razlika u stupnju obrazovanja ispitanika, pri čemu su oni s osnovnom školom najmanje spremni za primjenu mjera spašavanja života.

Zaključak. Ispitanici su pokazali spremnost za pružanje prve pomoći; međutim, postojala je praznina u znanju unatoč pohađanju tečajeva prve pomoći. To naglašava potrebu za uvođenjem edukativnih inicijativa usmjerenih na jačanje znanja građana o pružanju prve pomoći.

Ključne riječi: osnovno održavanje života, automatski vanjski defibrilator, znanje, stanovništvo