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Assessment of the knowledge level on basic and advanced resuscitation procedures in children among students of medicine

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Abstract

Knowledge and skills related to providing basic and advanced resuscitation procedures to children should be well known to all healthcare workers and students of medical faculties. It is essential to teach future doctors how to react correctly in situations where the health and life of children are in danger.

The aim of this work is to assess the level of knowledge of basic and advanced resuscitation procedures in children among students of medicine.

Tested population consisted of 162 students of the 1st to 6th year of studies at the Faculty of Medicine of the Medical University in Wrocław.The anonymous survey created by author contained 23 questions that referred to socio-demographic data as well as basic and advanced medical knowledge.

The respondents most often assessed their level of knowledge of basic resuscitation procedures in children as average (49%) and of advanced procedures as low (38%).Students received an average overall score of 9.7±2.9 points.In the section concerning basic resuscitation procedures the respondents received, on the average, 8.2±1.9 points. Only 27% of the students knew the correct answer to the question concerning the location of chest compressions in children. In the section on advanced resuscitation procedures, the students received an average score of 1.4±1.8 points out of a maximum of 7 points.It is worrying that only 68% of 5th year and 50% of 6th year students were able to give the correct value of defibrillation energy.Only 36% of 5th year and 10% of 6th year students gave the correct volume of fluid bolus in children.

The knowledge level of basic and advanced resuscitation procedures in children among medicine students is insufficient. It is important to focus more on practical classes on the resuscitation of children for students.

Key words: resuscitation, child, Emergency Medicine, first aid

Introduction

The ability to help another human being should be commonly known. Quick reaction and help provided by random witnesses on site of the incident very often increase the chances of survival of the victim and minimise the consequences of the suffered injuries [1]. Such life-threatening conditions as cardiac arrest and trauma are more common in adults than in children. However, a child's body is not just a smaller copy of an adult organism. The illnesses and pathophysiological responses in young patients are very often different than in adults [1]. This entails a necessity to possess specialist knowledge and ability to provide first aid to children. The statistics concerning road accident related traumas in children in the previous year are mortifying. According to the annual report prepared by the Road Traffic Office of the National Police Headquarters, children below 14 years of age took part in 2973 road accidents in the year 2016. 72 children died in these accidents while 3260 were injured [2].

Thus, it is very important for medical faculty students to possess the knowledge and abilities necessary to perform both basic and advanced resuscitation procedures in adults and children, as they may witness accidents and, in the future, they will also decide about the life and health of their patients. During their studies, they should acquire up-to-date knowledge compliant with the guidelines of such global organisations as, for example, the European Resuscitation Council (ERC) or the American Heart Association (AHA). Good knowledge of procedures and algorithms may prove useful for taking quick and accurate therapeutic decisions. It is also important for future physicians to be aware that their knowledge and skills

related to providing first aid to paediatric patients should be broadened and improved all the time, basing on the newest scientific research and changing algorithms of procedure. The European Resuscitation Council (ERC) strongly emphasises that trainings in resuscitation of both children and adults should be repeated every 3-6 months [1].

Purpose of work

The aim of this paper is to assess the level of knowledge on basic and advanced resuscitation procedures in paediatric patients among students of medicine.

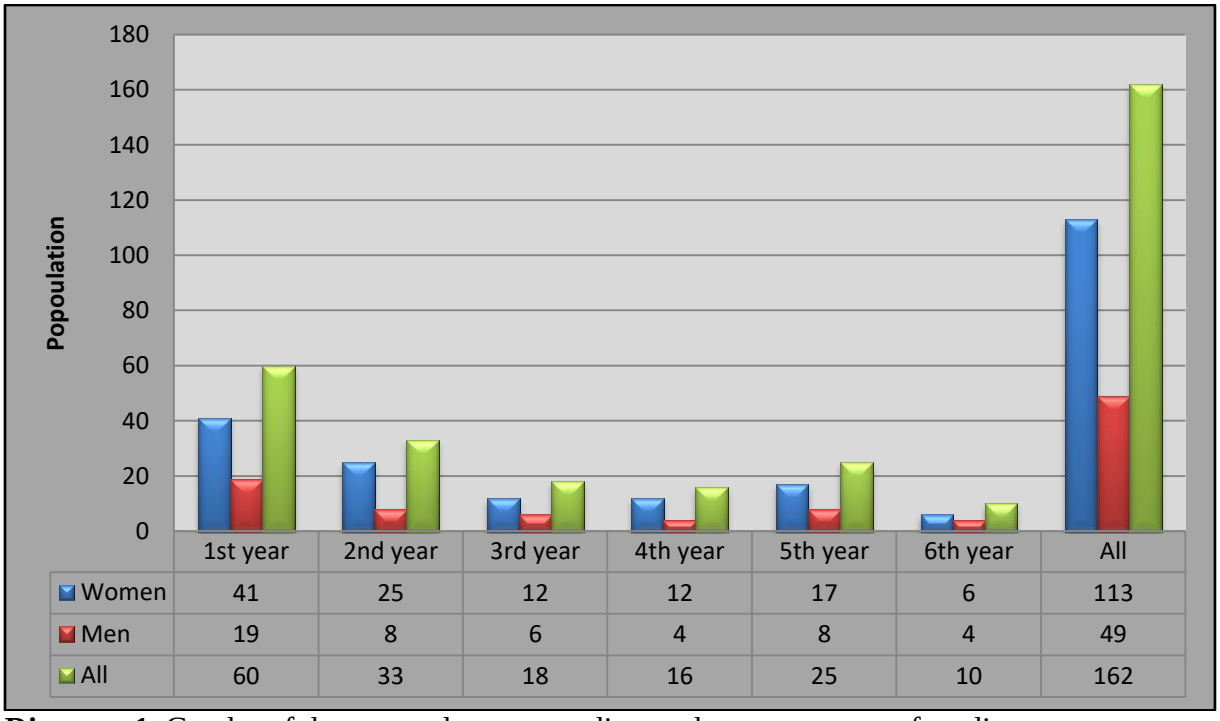
Material and methods

The applied research method was a diagnostic survey conducted with use of an anonymous poll questionnaire developed by the Author. The survey consisted of 3 sections that contained a total of 23 questions. The first section contained 4 questions concerning demographic data: gender, year of studies, and self-assessment of the respondent's knowledge of basic and advanced resuscitation procedures in children. The second section consisted of 12 single-choice questions concerning basic resuscitation procedures. The final section referred to advanced resuscitation procedures in children and it contained 7 questions. The questions in the survey concerned, among others: the correct compression/ventilation ratio in children, the procedure in cases of airway obstruction caused by a foreign body, drug dosage and values of defibrillation energy. All the questions were worded in compliance with the guidelines of the European Resuscitation Council of 2015 [1]. The analysis of answers to questions concerning advanced resuscitation procedures in children took into account only answers provided by 5^{th} and 6^{th} year students. This decision resulted from the study programme and the fact that classes in Emergency Medicine for medical students are introduced in the 5^{th} year and last until the end of the 1^{st} semester of the 6^{th} year, ending with an examination. Due to that, answers provided by students of earlier years of medical faculties might be unreliable and as such they might affect the test results in a negative way.

The survey was distributed electronically through social media to students of the Faculty of Medicine of the Silesian Piasts Medical University in Wrocław. Such method of distribution enabled each respondent to participate in the survey anonymously and sending the filled-in questionnaire was considered as giving consent to voluntary participation in the survey. The completeness of all the collected answers was verified. Data were subjected to statistical analysis with use of the Microsoft Excel software and the STATISTICA software package.

Results

162 medical students of the 1^{st} to 6^{th} year of studies at the Faculty of Medicine of the Medical University in Wrocław took part in the survey. 49 men and 113 women responded to the request to fill in the survey voluntarily (Diagram 1).



	1st year	2nd year	3rd year	4th year	5th year	6th year	All
Women	41	25	12	12	17	6	113
Men	19	8	6	4	8	4	49
All	60	33	18	16	25	10	162

Diagram 1. Gender of the respondents, according to the current year of studies.
(*Source: Own study)*

Additionally, the distribution of the group of respondents according to the year of studies was presented in the diagram below (Diagram 2).

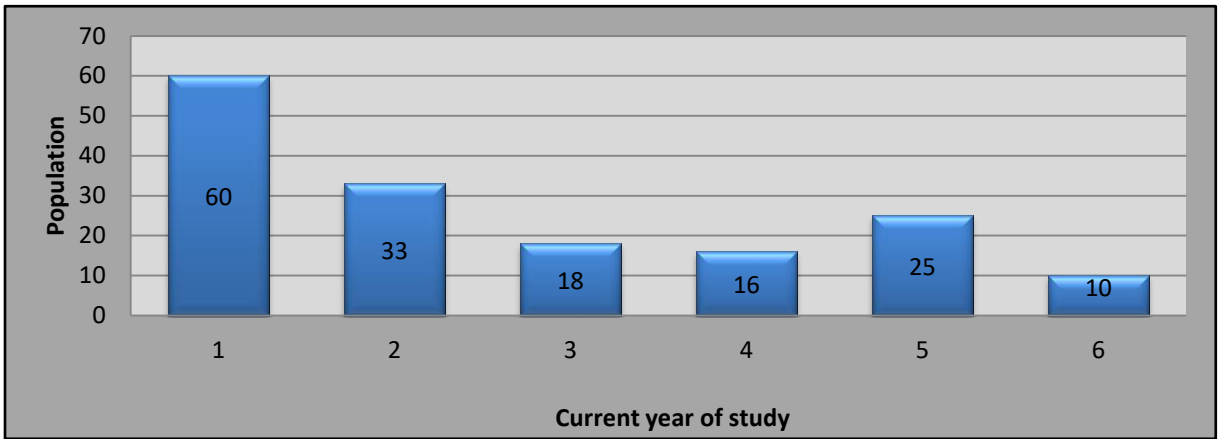


Diagram 2. Number of students of each year who participated in the survey.
(*Source: Own study)*

In the introductory section of the research tool, the respondents were asked to assess their knowledge of basic and advanced resuscitation procedures in children. The analysis shows that students are aware that their level of knowledge is average or low. The highest number of respondents assessed their knowledge of basic resuscitation procedures as "average" (49%), and the knowledge of advanced procedures as "low" (38%). All answers concerning the self-assessment of knowledge of resuscitation procedures provided by the respondents are shown in Table 1 and Diagram 3.

Declared level of knowledge	Very low n(%)	Low n(%)	Average n(%)	High n(%)	Very high n(%)
Basic resuscitation procedures in children	4 *(2)*	18 *(12)*	79 *(49)*	51 *(31)*	10 *(6)*
Advanced resuscitation procedures in children	38 *(23)*	62 *(38)*	55 *(34)*	6 *(4)*	1 *(1)*

Table 1. Self-assessment of students' knowledge of basic and advanced resuscitation procedures in children.
(*Source: Own study)*

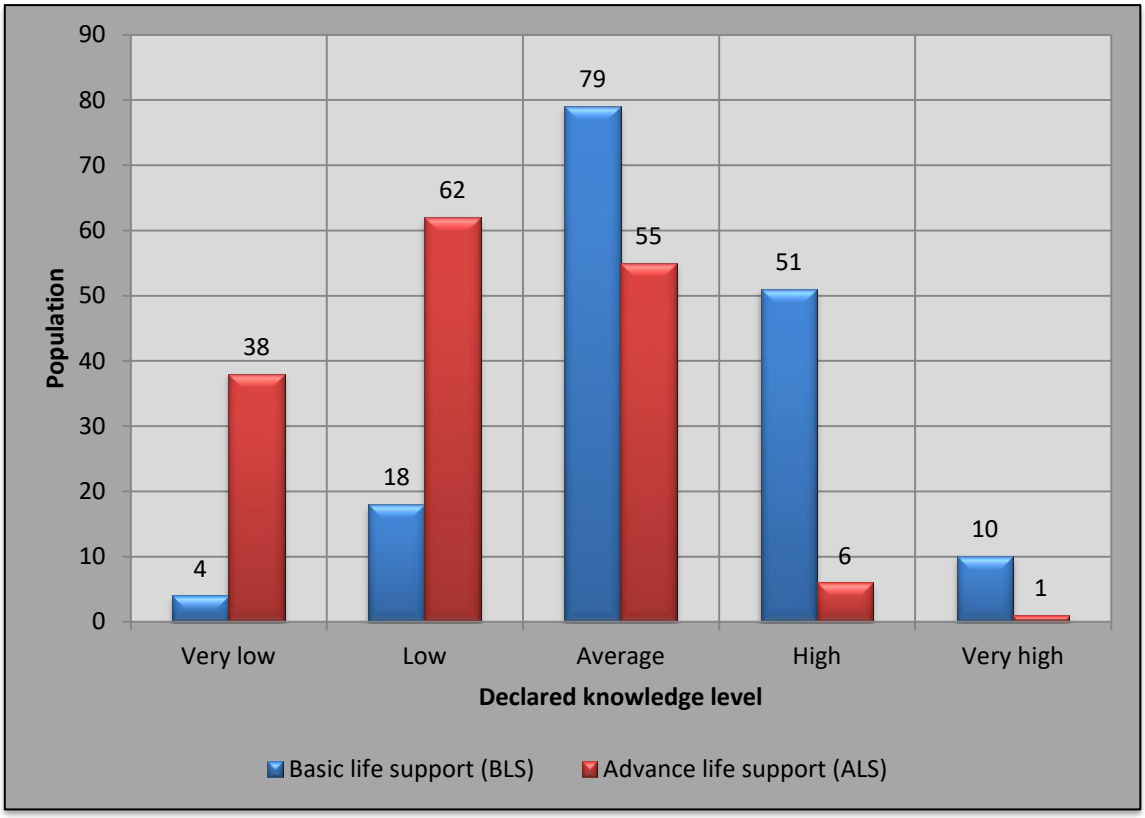


Diagram 3. Self-assessment of the knowledge level on basic and advanced resuscitation procedures in children among students of medicine.
(*Source: Own study)*

The questions in the second section of the survey tested the students' knowledge of basic and advanced resuscitation procedures in children. The students received an average overall score of 9.7 ± 2.9 points out of a maximum of 19 points. The questions were divided into two thematic categories. The first of them concerned basic resuscitation procedures in children (Table 2, Table 5). The average score in this section was 8.2 ±1.9 points out of a maximum of 12 points. For all years of studies, the simplest question was the one concerning clinical situations in which the child should be put in recovery position (94%). Over 80% of the respondents knew the correct answer to the question concerning the start of basic resuscitation procedure. Most of the respondents know both the correct frequency and depth of chest compressions in children (78% and 77% correct answers in the whole analysed group). The most difficult question concerned the location of chest compressions in children.

Only 27% answered this question correctly, by choosing the answer that it is the lower part of the sternum. It seems worrying that the use of automatic external defibrillator still remains relatively unknown. The analysis of the study demonstrates that only 31% of the respondents chose the correct answer. Moreover, approx. 39% of the students admitted that they did not know the answer. However, it seems optimistic that the share of correct answers to this question in the group of 5th and 6th year students was higher; respectively 48% and 50% answers were correct.

The students did amazingly well answering the questions on providing first aid to a child who is choking on a foreign body. Most of them answered all these questions correctly, regardless of the year of studies. The easiest question for students of all years proved to be: "What should be done if a child is choking, but remains conscious and is coughing effectively?" Only 3% of them did not know the answer and 2.5% gave the wrong answer. Students did not have problems choosing the correct answer to the question: "What should be done if a child over 1 year of age is choking, if the child remains conscious, but the cough is ineffective?" - 67% of the answers were correct. The respondents knew that abdominal thrusts (also called the Heimlich manoeuvre) may be performed only in children over 1 year old (71% correct answers) and that blows between the shoulder blades may be administered to children of all ages (73.5% correct answers).

Question	Answer variant:	Correct answers n(%)	Incorrect answers n (%)	Answer:"I don't know" n (%)
1. Basic resuscitation procedurein a child that is unresponsive (unconscious) and is not breathing should start with:	5 rescue breaths	132 *(81,5)*	30 *(19,5)*	0 *(0)*
2. The correct and most effective compression to ventilation ratio in CHILDREN is:	15 chest compressions : 2 rescue breaths	117 *(72,2)*	45 *(28,8)*	0 *(0)*
3. In all children, compressions should be administered to:	the lower part of the sternum	42 *(26,9)*	112 *(69,2)*	8 (5,9)
4. The correct depth of chest compressions in children over 1 year of age is:	depressing the sternum by at least 1/3 of the depth of the chest	123 *(76,9)*	20 *(12,4)*	19 *(11,7)*
5. The European Resuscitation Council recommends that one rescuer should perform chest compressions in infants (up to 1 year old):	with the tips of two fingers of one hand	91 *(56,2)*	67 *(41,4)*	4 *(2,4)*
6. What is the correct frequency of chest compressions in children:	100-120 compressions per minute.	126 *(77,8)*	27 *(16,7)*	9 *(5,5)*
7. The standard automatic external defibrillator (AED) can be used as in adults:	in children over 8 years of age.	50 *(30,9)*	49 *(30,2)*	63 *(38,9)*
8. Recovery position (side recovery position) should be used for children who are:	unconscious and breathing	153 *(94,4)*	9 *(5,6)*	0 *(0)*
9. What should be done if a child over 1 year of age is choking, if the child remains conscious, but the cough is ineffective?	First administer 5 blows between the shoulder blades and then 5 abdominal thrusts.	109 *(67,3)*	36 *(22,2)*	17 *(10,5)*
10. Abdominal thrusts (the Heimlich manoeuvre) may be performed:	only in children over 1 year of age.	115 *(71)*	27 *(16,7)*	20 *(12,4)*
11. Blows between shoulder blades can be administered:	in all children.	119 *(73,5)*	26 *(16)*	17 *(10,5)*
12. What should be done if a child is choking, but remains conscious and is coughing effectively?	Encourage them to cough	153 *(94,5)*	4 *(2,5)*	5 *(3)*

Table 2. Questions concerning basic resuscitation procedures in children and the percentage distribution of correct and incorrect answers.
(*Source: Own study)*

The questions in section two concerned advanced resuscitation procedures in children (Tables 3 and 4). The average overall score for all questions in this section was 1.4 ± 1.8 points out of a maximum of 7 points. The verification of all collected answers demonstrates that, unfortunately, the most commonly chosen answer was the option: "I do not know the correct answer to this question". The analysis shows that the easiest question was the one concerning the possibility to insert and use intraosseous access to supply medicines and fluids during the resuscitation of children (5^{th} year students gave 84% and 6^{th} year students – 90% correct answers). Most of the students of both years gave correct answers to the question concerning the value of defibrillation energy for a child weighing 8 kilograms (two-phase defibrillator) (5^{th} year – 68% and 6^{th} year – 50% correct answers). The drug amiodarone is well known to 5^{th} and 6^{th} year medical students. They know both the point of algorithm of advanced resuscitation procedures when the first dose should be administered and they are able to calculate the correct dose for a specific body weight of a paediatric patient. However, it seems worrying that only 40% of 5^{th} and 6^{th} year students gave a correct answer to the question concerning the dose of adrenaline that should be administered to a child weighing 10 kilograms. 80% of 6^{th} year students knew that the first dose of adrenaline should be administered to a child in cardiac arrest with a non-shockable rhythm as soon as possible after obtaining venous or intraosseous access. This question proved much more difficult for 5^{th} year students, of whom only 36% answered it correctly. The students also had difficulties with providing the correct value of fluid bolus while resuscitating a child. Only 36% of 5^{th} year students and 10% of 6^{th} year students answered this question correctly.

Question	Answer variant:	Correct answers n(%)	Incorrect answers n (%)	Answer:"I don't know" n (%)
13. The correct value of defibrillation energy in a child who weighs 8 kilograms is (two phase defibrillator):	32 J	38 *(23,5)*	9 *(5,5)*	115 *(71)*
14. A single dose of amiodarone administered during advanced resuscitation procedures in a child who weighs 8 kg is:	40 mg	27 *(16,7)*	15 *(9,3)*	120 *(74)*
15. The first dose of amiodarone in persistent ventricular fibrillation/ventricular tachycardia without a pulse in a child should be administered:	after the 3rd defibrillation	34 *(21)*	15 *(9,3)*	113 *(69,7)*
16. The first dose of adrenaline should be administered to a child with cardiac arrest in non shockable rhythm:	as soon as possible after venous or intraosseous access is available	33 *(20,4)*	27 *(16,6)*	102 *(63)*
17. A dose of adrenaline administered during advanced resuscitation procedures in a child who weighs 10 kg is:	100 µg	22 *(13,6)*	32 *(19,7)*	108 *(66,7)*
18. The correct value of fluid bolus while resuscitating a child is:	20 ml/kg bodyweight	18 *(11,1)*	22 *(13,6)*	122 *(75,3)*
19. Can intraosseous access be performed and used in a child for supplying drugs and fluids during resuscitation?	Yes	61 *(37,7)*	6 *(3,7)*	95 *(58,6)*

Table 3. Questions concerning advanced resuscitation procedures in children and the percentage distribution of correct and incorrect answers.
(*Source: Own study)*

Year of studies:	Answer variant:	Questions						
		13. The correct value of defibrillation energy in a child who weighs 8 kilograms is (two phase defibrillator):	114. A single dose of AMIODARONE administered during advanced resuscitation procedures in a child who weighs 8 kg is:	15. The first dose of amiodarone in persistent ventricular fibrillation/ventricular tachycardia without a pulse in a child should be administered:	16. The first dose of ADRENALINE should be administered to a child with cardiac arrest in non-shockable rhythm:	17. A dose of ADRENALINE administered during advanced resuscitation procedures in a child who weighs 10 kg is:	18. The correct value of fluid bolus while resuscitating a child is:	19. Can intraosseous access be performed and used in a child for supplying drugs and fluids during resuscitation?
V	Correct answers n(%)	17 *(68)*	14 *(56)*	15 *(60)*	9 *(36)*	10 *(40)*	9 *(36)*	21 *(84)*
	Incorrect answers n(%)	3 *(12)*	2 *(8)*	4 *(16)*	9 *(36)*	9 *(36)*	11 *(44)*	0 *(0)*
	Answer: "I don't know" n(%)	5 *(20)*	9 *(36)*	6 *(24)*	7 *(28)*	6 *(24)*	5 *(20)*	4 *(16)*
VI	Correct answers n(%)	5 *(50)*	4 *(40)*	5 *(50)*	8 *(80)*	4 *(40)*	1 *(10)*	9 *(90)*
	Incorrect answers n(%)	3 *(30)*	0 *(0)*	0 *(0)*	0 *(0)*	4 *(40)*	4 *(40)*	0 *(0)*
	Answer: "I don't know" n(%)	2 *(20)*	6 *(60)*	5 *(50)*	2 *(20)*	2 *(20)*	5 *(50)*	1 *(10)*

Table 4. Advanced resuscitation procedures in children: answers of respondents from the 5th and 6th years of study.
(*Source: Own study)*

Year of studies:	Basic and advanced resuscitation procedures in children		Basic resuscitation procedures in children		Advanced resuscitation procedures in children	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
1	9,6	± 2,0	9,0	± 1,5	0,6	± 1,2
2	8,1	± 2,2	7,5	± 1,8	0,5	± 1,6
3	8,3	± 2,4	7,0	± 1,6	1,3	± 2,1
4	9,3	± 3,6	7,5	± 2,3	1,8	± 2,4
5	12,4	± 5,5	8,6	± 2,2	3,8	± 1,3
6	11,5	± 4,2	7,9	± 1,3	3,6	± 0,7

Table 5. Summary of the average overall results of correct answers in specific sections of the research tool, considering the current year of studies.
(*Source: Own study)*

Discussion

The duty to render assistance to a person who is in a situation threatening an immediate danger of loss of life, or serious bodily injury results from the provisions of Article 162 of the Polish Penal Code. It is thus essential to educate the whole society, starting from the early age, on the principles of providing first aid. The main priority should be to provide the best education in this respect to healthcare employees, as they are obliged to educate the society and be the role models.

Children find themselves in situations that threaten their life or health less often than adults[1]. In 2016, 43 792 people were victims of road accidents, and 40 766 of them were injured. In Poland, children below 14 years of age participated in 2 973 road accidents. 72 children died, while 3 260 were injured [2]. It is worth remembering that the course of illnesses and their pathomechanisms are often different in young people [1]. This proves that the knowledge and skills related to basic resuscitation procedures in children should be commonly known. Persons who work and are in contact with children should know the procedures of providing first aid thoroughly. This refers in particular to healthcare workers and medical students who will most likely find themselves in a situation that requires to treat such patients in the future.

In the analysed study, in the section concerning basic resuscitation procedures in children, students scored on the average 8.2 ± 1.9 points out of a maximum of 12 points. The analysis of this result demonstrates that it is unsatisfactory. Even more so, as the surveyed group was composed of medical faculty students. In similar surveys conducted by other authors, the knowledge of medical students was also quite poor [3, 4].

The analysis of own survey results demonstrates that nearly ¾ medical students in Wrocław knew the correct compression/ventilation ratio in providing CPR to children. The comparison of these results with the results achieved by 4th year students of the Faculty of Medicine at the Medical University in Poznań, discussed in the study by Dąbrowski et al. [5], the students in Wrocław answered this question much better. This results from the fact that only 50% of students in Poznań knew the most effective and correct compression to ventilation ratio in resuscitating children.

The conducted research also demonstrated that the most difficult problem for medical students was to determine the correct place of chest compressions in children (27% correct answers). In the study by Dąbrowski et al. [5] most of the students were not able to specify the correct location of chest compressions in infants, either (24% correct answers). The

obtained data demonstrate that this aspect should be presented by instructors clearly, in a way that is understandable for all students.

Only 30% of the respondents knew that a standard automatic external defibrillator (AED) for adults can be effectively used in children over 8 years of age. In the study by Tomaszek L. et al. [6] the authors mentioned that approximately half of the surveyed nurses did not know about the possibility to use an AED, either.

On the other hand, the level of knowledge of students from Wrocław about first aid in cases of choking in children is surprisingly high. Most of the students answered these questions correctly, with a result of over 67%. The survey of a group of teachers from various types of schools in Siemianowice Śląskie demonstrated that over 13% of the respondents knew the procedure of providing first aid in cases of choking [7]. Better results were achieved by preschool teachers from the Lubelskie Voivodeship, who gave 78% correct answers to a question on the same topic [8]. The comparison of these results with those achieved by school teachers shows that knowledge about providing first aid in cases of choking is common, to a large extent, only in groups whose work involves taking care of children.

In the analysed study, in the section concerning advanced resuscitation procedures in children, students scored on the average 1.4 ± 1.8 points out of a maximum of 7 points. The analysis of the answers demonstrates that the students' knowledge on that topic is very poor. The comparison of these results to those achieved by paramedics, doctors and nurses in surveys conducted by other authors reveals that the knowledge of the students of the Medical University in Wrocław is also insufficient [9-11]. In most of the questions, the students chose the answer: "I do not know the correct answer to this question".

The most correct answers were given to the question concerning the possibility to insert and use intraosseous access to supply medicines and fluids during the resuscitation of children (5^{th} year students gave 84% and 6^{th} year students – 90% correct answers). Their knowledge in this area does not differ significantly from that of paramedics from the Emergency Rescue Teams and Hospital Emergency Room from the survey conducted by Czyż R. et al., where 88% and 90% of the respondents gave correct answers [10].

The students had difficulties in determining the value of defibrillation energy in a child who weighed 8 kilograms (two-phase defibrillator). Only approximately half of them knew the correct answer to that question. The knowledge of the formula for calculating the proper value of defibrillation energy for the given paediatric patient should be essential for future doctors. According to the guidelines of the European Resuscitation Council (ERC) of 2015, the recommended dose equals 4J/kg bodyweight in the first and each subsequent defibrillation [1]. Quick electric therapy with the correct energy value is the most effective treatment of cardiac arrest with a shockable rhythm (ventricular fibrillation or ventricular tachycardia without a pulse) [1, 12, 13]. Medical students from the Medical University in Wrocław presented a similar level of knowledge in this area as the surveyed healthcare personnel in other studies [9, 10, 11, 13, 14]. The knowledge of paramedics, analysed by Goddet et al. [13] brought approximately 57% correct answers, while in the study by Czyż et al. only approx. 66% of the respondents gave a correct answer to such question [10].

Drug doses used during cardiopulmonary resuscitation in children are different than those used in adults [1]. They are determined pursuant to the principles of Evidence Based Medicine. [1]. As far as adrenaline is concerned, the dose during CPR in children is 10 μg/kg bodyweight [1]. In the analysed survey, only 40% of 5^{th} and 6^{th} year students knew the correct dosage of adrenaline. In the study by Czyż et al. [10], 67% of the surveyed paramedics knew the correct adrenaline dose. In the study by Goddet et al. [13] 89% of the respondents gave correct answers, while in the survey by Szarpak et al. - 99% [9] and 94% [11]. The volume of the first dose of amiodarone used in non-shockable rhythm (ventricular fibrillation or ventricular tachycardia without a pulse) is 5mg/kg bodyweight [1]. Correct answers were

given, respectively, by 56% and 40% 5th and 6th year students.On the other hand, in the survey of paramedics' knowledge by Czyż et al., 67% respondents knew the correct dose [10], while in the study by Szarpak et al. 95 % [9] and 85 % [11].

In the event of cardiovascular failure caused by hypovolemia in children a controlled supply of fluids is recommended [1, 15]. Regardless of the type of cardiovascular failure, isotonic crystalloids administered in form of a bolus at the dose of 20 ml/kg are recommended for initial fluid therapy in infants and children [1]. Unfortunately, the analysis of the research material revealed that the knowledge of respondents was insufficient in this area as well. Only 36% of 5th year students and 10% of 6th year students answered this question correctly. In the study conducted by Szarpak et al., only 10% of primary care physicians gave correct answers to a similar question. In the same study, the share of correct answers in the group of paramedics was higher and amounted to 79% [9]. Similar results were obtained in another survey by Szarpak et al. (78%) [11] and in the study by Czyż et al. (63%) [10].

Conclusions

The analysis of the survey results led to the following conclusions:

1. The level of knowledge on basic and advanced resuscitation procedures in children among students of medicine is insufficient.
2. It is recommended to increase the number of both practical and theoretical classes on resuscitation procedures in children for medical students.
3. It seems desirable to focus more on teaching simple, intuitive schemes and algorithms of procedures in situations when the life of paediatric patients is threatened, among students of all medical faculties.

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