



ISSN 2545-2533

Received: 10.11.2023

Accepted: 25.11.2023

First online: 26.11.2023

Published: 31.12.2023

## Knowledge of CPR and first aid for children among pedagogy students.

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### Author Contributions (CRediT Taxonomy):

Conceptualization - A  
Data Curation - B  
Formal Analysis - C  
Funding Acquisition - D  
Investigation - E  
Methodology - F  
Project Administration - G  
Resources - H  
Software - I  
Supervision - J  
Validation - K  
Visualization - L  
Writing (Draft Preparation) - M  
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## ABSTRACT

**INTRODUCTION:** At home, the parents take care of the child's safety, but when the child is in school or kindergarten, it is the educator that takes care of the child. The awareness of dangers the child is exposed to at every moment of his or her activity during the day obliges educators to have up-to-date knowledge of first aid. The marked differences in anatomy, physiology and mechanisms of life-threatening conditions make the principles of first aid differ from those of an adult. First aid courses organised for both educators and pedagogy students should focus on highlighting these differences and learning how to deal with individuals of all ages. The aim of the study is to assess the level of knowledge and practical skills among pedagogy students and to identify aspects requiring adjustments to the curriculum of future teachers.

**MATERIALS AND METHODS:** The study was conducted in 2022 at the Institute of Pedagogy at the University of Siedlce, Poland. Sixty-three pedagogy students participated in it. For the purpose of the study, a survey questionnaire covering the principles of first aid for children and a practical task evaluation sheet were created. Practical skills were assessed using the Resusci Junior QCPR simulator and a 0-15 point rating scale.

**RESULTS:** The study included as many as 63 students of early childhood and pre-school pedagogy. The mean score achieved on the theory test was  $M=11.49$  out of a possible 14 points ( $SD\pm 1.24$ ). The highest number of correct answers were given by students for the following questions: actions performed when assessing the child's breathing ( $n=63$ ; 100%) and placing the child in the safe position ( $n=61$ ; 96.8%). In contrast, the fewest correct answers were related to the rate of chest compressions ( $n=27$ ; 42.9%). In the practical task, as many as 15 child CPR activities were considered. The average points scored by students on the practical task was  $M=6.73$  out of a possible 15 points ( $SD\pm 2.73$ ). The average quality of compressions performed was  $M=28.59\%$  ( $SD\pm 30.41$ ), breaths  $M=17.7\%$  ( $SD\pm 17.70$ ) and chest compression depth was  $M=20.29\%$  ( $SD\pm 27.98$ ).

**CONCLUSIONS:** The level of theoretical knowledge and practical skills of pedagogy students is clearly insufficient to provide effective first aid to children. Significant differences were observed among students taking first aid classes onsite versus remotely. Having theoretical knowledge does not translate into practical skills. It seems that it is necessary to modify the curriculum for training future educators in first aid for children.

**KEY WORDS:** First aid, educator, child, CPR, knowledge, skills.

## INTRODUCTION

A child in the general sense is defined as a person who has not yet fully reached maturity. Pursuant to the normative acts in force in Poland (the Act on the Ombudsman for Children), every human being from conception until adulthood is considered a child [1]. Due to their young age, the child is a physically as well as mentally immature person and therefore requires not only special care and attention, but also due legal protection, before as well as after birth [2]. Children are by nature mobile creatures who are unable to predict dangers that they may come across. At home, the parents take care of the child's safety, but when the child is in school or kindergarten, it is the educator that takes care of the child. In the event of a threat to life or health, he or she is obliged to administer first aid and call an emergency medical services (EMS) team if necessary.

Pursuant to the Act on State Emergency Medical Services of 8 September 2006 (Polish Journal of Laws 2006 no. 191 item 1410), first aid is: "a set of actions pursued to save a person in a state of sudden health risk performed by a person at the scene of an accident (...)" [3]. An accident can occur either at home, on the street or at an educational institution. Due to their young age, pupils are more prone to various types of accidents and injuries, while teachers are the main authority responsible for health and life of children at school. Anything, small objects, sharp parts of toys or even food, can pose a threat to children. The awareness of dangers the child is exposed to at every moment of his or her activity during the day obliges educators to have up-to-date knowledge of first aid.

Pursuant to the Regulation of the Minister of National Education and Sport of 31 December 2002 (Polish Journal of Laws 2003 No. 6, item 69), all employees of educational establishments are required to undergo a first aid training course [6]. However, it should be noted that no arrangements have yet been made for how often educators and employees of educational establishments should repeat training. Therefore, it is not possible to check the level of theoretical and practical skills, as well as to verify whether such knowledge is up-to-date. On the other hand, periodic first aid training to brush up on or improve existing knowledge would not only have a positive impact on the level of knowledge, but would also result in a better ability to cope with stressful situations, as confirmed by the European Resuscitation Council guidelines. It would also help to develop the habit of mandatory further training and improvement [7]. Being aware that first aid knowledge and practical skills at an appropriate level help minimise the stress that increases when an pupil suffers an injury at an educational establishment. A child's physiological reaction to sustaining an injury is to cry and scream. Sometimes, the exposure of stress, fear or panic through an adult can increase anxiety felt by the child. This is why it is so important to maintain composure and try to calm the child down. Unfortunately, this very often poses a huge challenge for the carer [8].

It is important to remember that a child is not a "little adult." The marked differences in anatomy, physiology and mechanisms of life-threatening conditions make the principles of first aid differ from those of an adult. It is particularly important to have knowledge of physiological differences during, e.g. cardiopulmonary resuscitation or in the case of aspiration of a foreign body into the airway.

The early recognition of a medical emergency and initiation of cardiopulmonary resuscitation (CPR) in sudden cardiac arrest (SCA) has a significant impact on reducing hypoxia, which directly translates into minimising the occurrence of neurological deficits [9]. The post-SCA syndrome, or "Post-Cardiac Arrest Syndrome" (PCAS), includes hypoxia and ischaemia of the brain and respective organs, myocardial malfunction, as well as diseases preceding the episode [10]. It is important to remember that chest compressions performed at the correct frequency, speed and depth help maintain adequate blood flow through the heart muscle and brain. On the other hand, the position of the hands on the chest, the force of pressure or the volume of air blown during rescue breathing should be different from that in the case of adults [11].

First aid courses organised for both educators and pedagogy students should focus on highlighting these differences and learning how to deal with individuals of all ages. Stress, chaos and shouting from witnesses to the incident and the injured person can cause confusion and uncertainty about the actions being performed. The current university teaching system provides for first aid classes for the duration of one academic semester. In multiple cases, this is the only form of acquiring knowledge in this area during the five years of studies [12].

The authors attempted to determine the level of knowledge and skills of pedagogy students in first aid, including CPR in the child. The survey aims to identify subject areas that need supplementing or correcting in the curriculum for future teachers, as supervisors of students at educational establishments. Due to the COVID-19 pandemic period, some students underwent the training course remotely, which allowed a comparison of the quality of teaching in the group that did the course onsite.

## MATERIALS AND METHODS

The study occurred in 2022 at the Institute of Pedagogy at the University of Siedlce (Poland). The study included second-, third- and fourth-year students of pre-school and early childhood education. To conduct the study, we used a research tool of our own design in the form of a survey questionnaire and a practical task evaluation sheet (according to the OSCE format – objective structured clinical examination). The survey questionnaire contained as many as 23 questions (nine sociodemographic and 14 substantive questions covering the topic area of first aid for children). Respondents expressed written consent to participate in the study, and the results obtained were anonymised. Practical skills were assessed using the Resusci Junior QCPR simulator (Figure 1) and a scoring sheet (0-15 points), including activities such as:

1. safety assessment;
2. assessment of the victim's response to stimuli;
3. breath assessment;
4. correct diagnosis of cardiac arrest;
5. performance of 5 rescue breaths;
6. starting CPR;

7. call for help;
8. reassessment of vital functions;
9. placing in a safe position on the side;
10. control of vital functions.
- 11-15. resuscitation quality parameters determined by a computer system.



**Figure 1.** Child training phantom, full body with digital analysis of CPR quality.

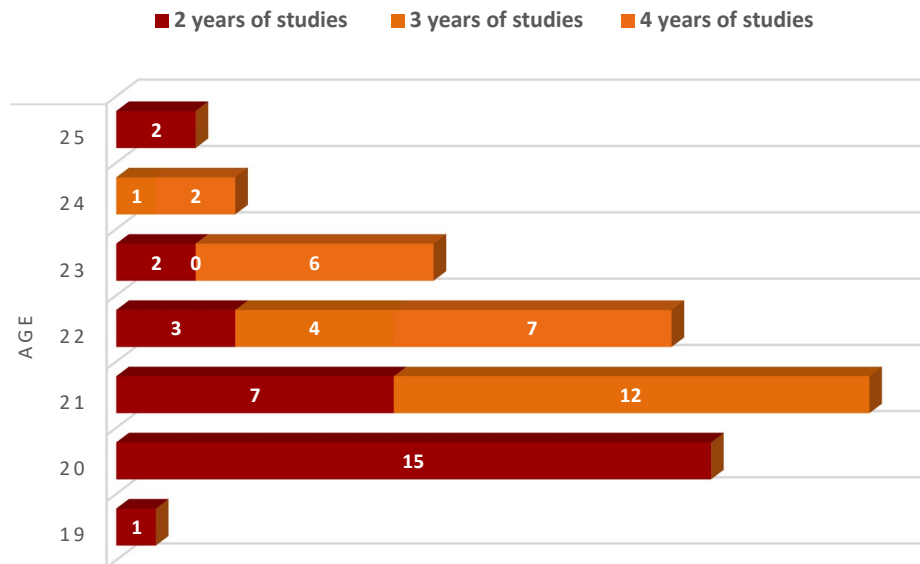
For the purpose study, the results were analysed of a theoretical and practical test covering the principles of first aid for children. For statistical analysis, we used the normality of distribution tests, descriptive statistics and the Chi2 test. The significance level was assumed at  $p < 0.05$ .

## RESULTS

### Profile of respondents

The study included as many as 63 students of early childhood and pre-school pedagogy; all individuals tested were female. The vast majority were second-year female students ( $n=31$ , representing 49% of the total), while third-year female students were recorded at 17 (27%) and fourth-year 15 (24%). The largest number of respondents were in the 20-22 age bracket ( $n=48$ ; 76%), followed by the 23-25 age bracket ( $n=13$ ; 21%). In contrast, only one person was 31 years old at the time of the survey. The mean age of the respondents was 21.63 (SD  $\pm$  1.77) years (Figure 2).

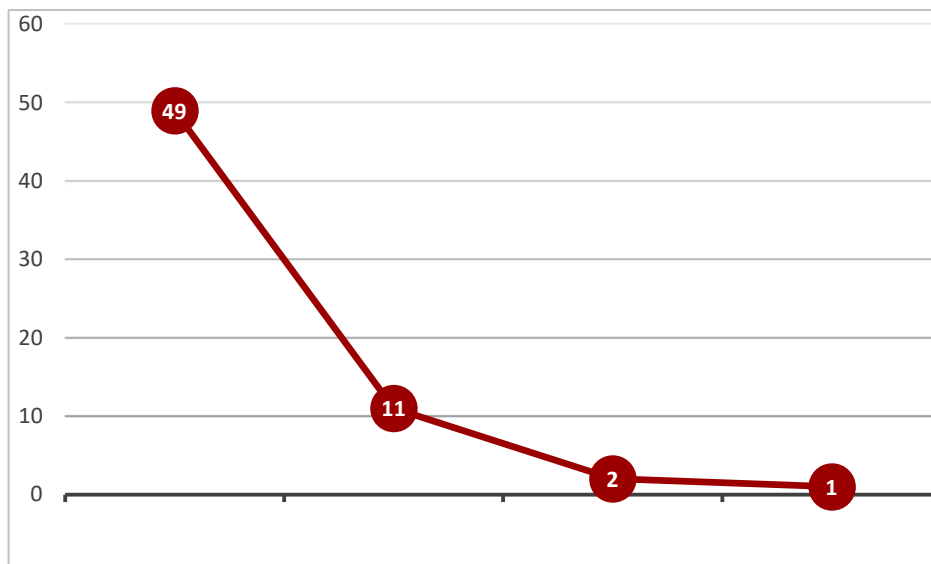
The survey questionnaire shows that remotely 52.4% of the students took their first aid classes at university ( $n=33$ ), while 47.6% ( $n=30$ ) did it onsite. When asked about working at an educational establishment requiring a first aid course, 8 respondents answered in the affirmative (13%) and 55 answered in the negative (87%); 43% of respondents said they had taken a first aid course outside the university ( $n=27$ ).



**Figure 2.** Breakdown of respondents by age.

### Self-assessment of the study group

Of all respondents, 77.8% rated their own knowledge of first aid in children as "good" (n=49). A detailed summary of the study group's self-assessment is shown in Figure 3.



**Figure 3.** Self-assessment of respondents' knowledge of first aid in children.

48 respondents (76.2%) indicated that they claim to have knowledge of what an AED is, while 34 respondents know how to use an AED (54%). Of the 27 who had taken a first aid course outside the university, as many as 22 students (81.5%) answered both questions in the affirmative.

### Substantive test results

The respondents were asked to answer 23 questions about first aid. To the following question: "What should be done during the assessment of the heart rhythm by AED?" the correct answer was indicated by 57 respondents, representing 90.5% of the total, while the wrong answer or no was marked by 6 students (9.5%). Of all respondents (n=51), 81% correctly answered the question related to the telephone number used to call the emergency medical team, while 19% gave an incorrect answer (n=12). The question "What information should be given when calling the emergency number?" was answered correctly by 84.1% of respondents (n=53) and incorrectly by 15.9% (n=10). The question related to the general technique for assessing breathing was correctly identified by as many as 63 (100%) of the respondents, but the correct answer related to the timing of the assessment of breathing in an unconscious child was only given by 79.4% (n=50). The diagnosis of cardiac arrest when the child was not breathing properly was only indicated by 42 respondents (66.7%). A detailed summary of the knowledge test results is shown in Table 1.

**Table 1.** Summary of substantive test results.

Scope of the question	Correct answer	p value
<b>AED</b>		
<i>Action to be performed during the assessment of heart rhythm by AED</i>	57 (90.5%)	<b>0.000</b>
<b>EMERGENCY MEDICAL TEAM</b>		
<i>Emergency Medical Service call number</i>	51 (81%)	<b>0.000</b>
<i>Information to be provided when calling the emergency number</i>	53 (84.1%)	<b>0.000</b>
<b>BREATHING IN CHILDREN</b>		
<i>Timing of assessment of breathing in an unconscious child</i>	50 (79.4%)	<b>0.000</b>
<i>What to do if your child is not breathing</i>	42 (66.7%)	<b>0.000</b>
<i>Steps to be taken when assessing a child's breathing</i>	63 (100%)	<b>0.000</b>
<b>SUDDEN CARDIAC ARREST IN CHILDREN</b>		
<i>Rate of chest compression in a child</i>	27 (42.9%)	0.109
<i>Method of chest compression for a 6-year-old child</i>	57 (90.5%)	<b>0.000</b>
<i>Ratio of chest compressions to breaths</i>	49 (77.8%)	<b>0.000</b>
<i>Most common cause of cardiac arrest in a child</i>	60 (95.2%)	<b>0.000</b>
<b>UNCONSCIOUS CHILD</b>		
<i>Unconscious child, sequence of treatment</i>	43 (68.3%)	<b>0.000</b>
<i>Placing the child in a safe position</i>	61 (96.8%)	<b>0.000</b>
<b>CHOKING OF THE CHILD</b>		
<i>Action to be taken when a child is choking</i>	53 (84.1%)	<b>0.000</b>
<b>SEIZURE IN A CHILD</b>		
<i>Action to be taken first</i>	58 (92%)	<b>0.000</b>

The survey found that the greatest number of respondents scored 11-12 on the Child First Aid test (n=38, representing 60.3% of the total). Those with a score of 8-10 came second (n=15; 23.8%), while students with 13-14 scores came third (n=10; 15.9%). The mean score achieved by the subjects on the theory test was M=11.49 out of a possible 14 points (SD ± 1.243). Students who took an additional first aid course outside the university have a comparable level of knowledge compared to ones who did not declare having received training outside the university curriculum (M=11.5 points; SD±1.10 vs. M=11.5 points; SD±1.32). In turn, students learning first aid remotely had less theoretical knowledge (M=11.3 points; SD±1.33 vs. M=11.7; SD±1.07) compared to ones taking classroom-based classes.

### Results of the practical test

The scenario of the practical task concerned a seizure in a 7-year-old boy. After the boy's seizures had stopped, he suffered sudden cardiac arrest. While CPR was being performed, there was a return of vital functions, which was signalled by the casualty coughing. In total, subjects could score a maximum of 15 points for the practical task. Virtually one in three respondents (n=17; 27%) scored only 0-5 points on the practical task, while the highest score in the 11-15 point range was achieved by only four students (6.3%). None of the respondents scored 14 and 15 points. The average points scored by students on the practical task was M=6.73 out of a possible 15 points (SD±2.73). Detailed data is shown in figure number 6. The least frequent of all activities were the reassessment of vital functions (n=9;14.3%) and the assessment of voice response (n=13; 20.6%). In contrast, the most common activities performed by the respondents were the recognition of cardiac arrest (n=52; 82.5%) and placing the victim in the safe position (n=52; 82.5%). Table 2 shows the distribution of results for the activities assessed in the practical task.

**Table 2.** Summary of the results of the practical task.

ACTIVITY ASSESSED	COMPLETED [n] (%)	p value
SAFETY ASSESSMENT	20 (31.7%)	<b>0.000</b>
VOICE RESPONSE ASSESSMENT	13 (20.6%)	<b>0.000</b>
ASSESSMENT OF REACTIONS TO TOUCH	17 (27%)	<b>0.000</b>
PROPER AIRWAY CLEARANCE	36 (57.1%)	0.109
BREATH ASSESSMENT ACCORDING TO THE 3xP RULE	32 (50.8%)	0.859
CORRECT TIMING OF BREATH ASSESSMENT	47 (74.6%)	<b>0.000</b>
DIAGNOSIS OF CARDIAC ARREST	52 (82.5%)	<b>0.000</b>
TAKING 5 BREATHS	19 (30.2%)	<b>0.000</b>
COMPRESSIONS IN A 15:2 SEQUENCE	28 (44.4%)	0.212
PERFORMING CHEST COMPRESSIONS CORRECTLY	20 (31.7%)	<b>0.000</b>
CORRECT ZRM CALL NUMBER	46 (73%)	<b>0.000</b>
CORRECT ORDER OF DATA	18 (28.6%)	<b>0.000</b>
REASSESSMENT OF VITAL FUNCTIONS	9 (14.3%)	<b>0.000</b>
SAFE POSITION ON THE SIDE	52 (82.5%)	<b>0.000</b>
MONITORING OF VITAL SIGNS EVERY 1 MINUTE	15 (23.8%)	<b>0.000</b>

The average effectiveness of the individual resuscitation measures was checked on the basis of the study. The mean quality of the compressions performed was  $M=28.59\%$  ( $SD\pm 30.41$ ). The mean quality of breaths taken was  $M= 17.7\%$  ( $SD\pm 17.70$ ). The mean quality of chest compression was  $M=20.29\%$  ( $SD\pm 27.98$ ). Students who took a first aid course outside the university are characterised by greater practical skills compared to ones who did not declare having received additional training outside the university curriculum ( $M=7.4$  points;  $SD\pm 2.58$  vs.  $M=6.22$  points;  $SD\pm 2.69$ ). The group of individuals claiming to have attended first aid classes remotely showed lower practical skills ( $M= 6.5$ ;  $SD\pm 2.40$  vs.  $M=6.9$ ;  $SD\pm 2.90$ ) compared to ones taking onsite classes.

## DISCUSSION

The authors are of the opinion that pedagogy students, taking into account the profession they will pursue in the future, should have proper knowledge and practical skills in first aid. Future educators must have the ability to deal with situations that are dangerous for the child, in particular emergencies that threaten life and health. Following the survey, it may be concluded that the right course of action would be to implement periodic first aid training for educators, by a person who is qualified and authorised to conduct out (e.g. once a year). It should also be noted that a student undergoing professional training at an educational establishment has the same duty to provide first aid as a teacher [13].

Receiving first aid training on a regular basis is vital to effectively help people in need and even save lives. Such training helps remove fear and consolidate the skills already acquired. Prehospital cardiac arrest is the cause of approximately 350,000 deaths per year in Europe. Survival rates for people with SCA in the pre-hospital setting are low and the chance of ROSC (return of spontaneous circulation) is negligible. However, rapid recognition of SCA by witnesses to the event and timely implementation of CPR increases the survival rate of such individuals. This is why witnesses to an incident play a key role in the survival of a person with SCA. It is important to remember that the most effective help is provided through people with the right skills, a willingness to help and confidence in their own abilities [14,15]. The research shows that having theoretical knowledge does not translate into practical skills. This is supported by the fact that as many as 43 of all the respondents in the theoretical test marked the assessment of their own safety as one of the first and most important activities during first aid (68.2% of respondents). In contrast, only 20 students (31.7%) assessed their own safety in the practical task. In the theoretical test, when asked how to perform chest compressions on a child aged 6 years, 57 out of 63 students (90.5%) marked the correct answer, whereas in the practical task, only 20 students (31.7%) opted for one-handed compressions. 42 respondents (66.7%) knew that if a child was breathless, 5 breaths should be taken, while only 19 (30.15) put this knowledge to practical use.

The above thesis is also supported by a study by Abelairs-Gomez C., et al. on teachers' and parents' knowledge of first aid. A total of 470 people participated in the survey (177 teachers, 242 parents and 51 teachers who were also parents). 57% of the respondents ( $n=268$ ) declared that they had knowledge of first aid, while only 66.8% of the respondents ( $n=179$ ) stated that their knowledge was at an



"acceptable" level. More than half of all the respondents (54.9%; n=258) declared optimal knowledge of first aid for an unconscious 6-year-old child. This response was correlated by the researchers with actual first aid knowledge ( $\chi^2 = 125.745$ ,  $P < .001$ ; Cramer's  $V = 0.517$ ,  $P < .001$ ). Only 4 respondents (1.6%) correctly sequenced how to perform BLS (Basic Life Support) and 44 people (17.1%) later admitted ignorance of how to correctly sequence BLS. 174 (37%) declared that they knew how to perform CPR. In contrast, the question on the appropriate ratio of compressions to ventilation was answered correctly by only 33 of 174 respondents (19%), while the correct depth and frequency of chest compressions in a 6-year-old child was marked by only 17 respondents (9.8%). In total, only six respondents answered both questions correctly (3.4%) [16]. In the present study, more than half of the people (n=33; 52.4%) took their first aid classes at university remotely. Learning CPR online is severely limited and requires specialised teaching tools implemented as e-learning [17]. The ERC 2021 guidelines clearly indicate that teaching first aid should involve teaching proper chest compressions as well as the use of an AED [10]. The study showed that students learning first aid remotely have less theoretical and practical knowledge compared to those ones taking full-time classes. The online CPR education technique used proved ineffective in this case.

The results of the study show that the level of first aid knowledge among pedagogy students is low. It would seem appropriate to change the system of education on this subject in order to achieve an improvement in results, e.g. by enabling students to receive cyclical training in first aid. A similar conclusion was also reached by E. Nowak and M. Pierza based on their own study. Conducting regular training would help students improve their knowledge and practical skills, resulting in less stress during an actual emergency situation [18]. The work of Bakalarski P. suggests that in-service school educators are significantly better at providing first aid knowledge and skills to adults than to children, confirming the urgent need to develop systemic in-service training solutions among teachers [19].

**Limitations of the study** – a larger sample is recommended for future research covering the topic of first aid for children. This will allow more data to be taken and the problem to be investigated in detail. The study did not compare the level of students' knowledge and skills in adult first aid. The development of a comprehensive professional development programme requires a broader framing of the problem and further research identifying the most effective methods of teaching first aid to teachers.

## CONCLUSIONS

The level of theoretical knowledge and practical skills of pedagogy students is clearly insufficient to provide effective first aid to children, despite a fairly high self-assessment in the study group. Having analysed the results of the survey, it seems fair to highlight significant differences in the level of knowledge and skills among students taking onsite and remote first aid classes. Taking an additional first aid course among the respondents has a negligible impact on the level of knowledge. Having the theoretical knowledge of selected topics through the subjects does not translate into practical skills. There is a need for systemic improvement in first aid teaching methods for future teachers.

## SUPPLEMENTARY INFORMATION

**Funding:** No fund was received related to this study.

**Institutional Review Statement:** The study was conducted according to the guidelines of the Declaration of Helsinki.

**Informed Consent Statement:** Not applicable

**Data Availability Statement:** The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

**Conflicts of Interest:** The authors declare no conflicts of interest.

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