

Evaluation of a 2-day First Aid Course Including Basic Resuscitation With 1,268 Primary School Children Aged 6–13 Years – A Multicenter Intervention Study



RESEARCH



PHILIPP HUMBSCH

ROBERT GINTROWICZ

ANIKA DIETRICH

JOHANNA WECKWERTH

CARMEN SCHULTZE-BERNDT

ANNE NASERT

RAFAEL DOLABELLA

JOSEPHINA KEHLERT

KIONA C. KEIL

KONRAD BOHM

SIMONA SCHMÖCHE

KATJA ICKE

THOMAS KEIL

*Author affiliations can be found in the back matter of this article

CORRESPONDING AUTHOR:

Philipp Humbsch

Gubener Straße 31a, 15230
Frankfurt (Oder), Germany

philipp.humbsch@charite.de

ABSTRACT

Background: In Germany, current school-based first aid training recommendations do not include children under 13 years. Our aim was therefore to evaluate a primary school-based first aid course for children aged 6–13 years.

Methods: Our 2-day course (4 hours per day) for primary schools in the German rural state Brandenburg included basic elements of scene safety, compression bandages, recovery position, and resuscitation. The evaluation of specific knowledge and skills took place 1-day post-course.

Results: Among the 1,268 included children (median age 9y, 49% girls) from six primary schools, 25% had previously attended first aid courses. Most children knew emergency phone number(s) pre-course. Afterward, this knowledge improved by 15% in the 6–7-year age group (reaching 80%) whereas it remained at 90% in children aged 8–13 years.

After the course, about 80% of the 8–13-year-old children (40% in 6–7-year age group) answered at least one resuscitation question correctly. In the practical skill assessments, about 80% of the 8–13-year-old children (60% in the 6–7-year age group) chose a correct or almost-correct chest compression rate during resuscitation. The correct depth of compression was achieved by about 80% (10–13 years), 60% (8–9 years), and 40% (6–7 years). Three-quarters successfully put another child in the recovery position; more than two-thirds applied a compression bandage appropriately.

Conclusions: A 2-day course in a primary school setting showed considerable improvement in first aid and resuscitation skills of children aged 6–13 years. Future studies should examine these effects' sustainability and the appropriate timing for refresher courses.

KEYWORDS:

elementary school; primary school; first aid; resuscitation; lay training; school children; school students; basic life support; classroom; bleeding control; compression bandage; recovery position; stable side position; CP, Bystander CPR; lay resuscitation

TO CITE THIS ARTICLE:

Humbsch, P., Gintrowicz, R., Dietrich, A., Weckwerth, J., Schultze-Berndt, C., Nasert, A., Dolabella, R., Kehlert, J., Keil, K. C., Bohm, K., Schmöche, S., Icke, K., & Keil, T. (2023). Evaluation of a 2-day First Aid Course Including Basic Resuscitation With 1,268 Primary School Children Aged 6–13 Years – A Multicenter Intervention Study. *International Journal of First Aid Education*, 6(1), 1–15. DOI: <https://doi.org/10.25894/ijfae.6.1.11>

ZUSAMMENFASSUNG

Hintergrund: In Deutschland umfassen die aktuellen schulbasierten Erste-Hilfe-Schulungsempfehlungen keine Kinder unter 13 Jahren. Unser Ziel war es daher, einen Erste-Hilfe-Kurs für Grundschulen zu evaluieren.

Material und Methode: Unser zweitägiger Kurs (4 Stunden pro Tag) für Grundschulen im Bundesland Brandenburg umfasste Basiselemente der eigenen Sicherheit am Unfallort, Kompressionsverbände, stabile Seitenlage und Wiederbelebung. Nach der Basiserhebung kurz vor Schulungsbeginn fand die Evaluation spezifischer Kenntnisse (mit Fragebogen) und Fertigkeiten einen Tag nach dem Kurs statt.

Ergebnisse Unter den 1.268 eingeschlossenen Kindern (Altersmedian 9 Jahre, 49% Mädchen) von sechs Grundschulen hatten 25% bereits früher an einem Erste-Hilfe-Kurs teilgenommen. Die meisten Kinder kannten vor dem Kurs bereits die Notrufnummer(n). Danach verbesserte sich dieses Wissen um 15% und erreichte 80% in der Altersgruppe der 6-7-Jährigen, während es bei älteren Kindern (8-13 Jahre) bei 90% blieb. Nach dem Kurs beantworteten 40% der 6-7-Jährigen und etwa 80% der 8-13-jährigen Kinder mindestens eine Frage zur Reanimation richtig. Bei den Bewertungen der praktischen Fertigkeiten wählten 60% der 6-7-Jährigen und etwa 80% der 8-13-jährigen Kinder während der Wiederbelebung die korrekte oder nahezu korrekte Rate der Kompression des Brustkorbs aus. Die richtige Kompressionstiefe wurde von 40% (6-7 Jahre), 60% (8-9 Jahre) und etwa 80% (10-13 Jahre) erreicht. Drei Viertel der Teilnehmenden setzten erfolgreich ein anderes Kind in die Stabile Seitenlage; mehr als zwei Drittel legten einen Kompressionsverband angemessen an.

Schlussfolgerungen Ein zweitägiger Kurs in der Grundschule führte in allen Altersgruppen von 6-13 Jahren zu einer deutlichen Verbesserung ihrer Kenntnisse in Erster-Hilfe und Fähigkeiten bei der Wiederbelebung. Zukünftige Studien sollten die Nachhaltigkeit dieser Effekte und den geeigneten Zeitpunkt für Auffrischkurse untersuchen.

Schlüsselwörter: Grundschule, Erste Hilfe, Wiederbelebung, Laienschulung, Schulkinder, Schüler, Basisreanimation, Klassenzimmer, Blutungsstillung, Kompressionsverband, Stabile Seitenlage, Wiederbelebung, Laien-Wiederbelebung

STRESZCZENIE

Tło Obecne zalecenia dotyczące szkolenia z pierwszej pomocy w niemieckich szkołach nie obejmują dzieci poniżej 13 roku życia. Naszym celem było zatem ocenienie kursu pierwszej pomocy dla dzieci w wieku od 6 do 13 lat prowadzonego w szkole podstawowej.

Metody Nasz dwudniowy kurs (4 godziny dziennie) dla szkół podstawowych na obszarach wiejskich w niemieckim kraju związkowym Brandenburgia obejmował podstawowe elementy bezpieczeństwa w miejscu zdarzenia, bandażowanie uciskowe, pozycję bezpieczną i resuscytację. Ocena konkretnych umiejętności i wiedzy odbyła się dzień po zakończeniu kursu.

Wyniki Wśród 1268 uwzględnionych dzieci (średni wiek 9 lat, 49% dziewczyn) z sześciu szkół podstawowych, 25% uczestniczyło wcześniej w kursach pierwszej pomocy. Większość dzieci przed kursem znała już numer(y) alarmowy. Po kursie wiedza ta poprawiła się o 15% w grupie wiekowej 6-7 lat (osiągając 80%), podczas gdy w grupie wiekowej 8-13 lat pozostała na poziomie 90%. Po kursie około 80% dzieci w wieku od 8 do 13 lat (40% w grupie wiekowej 6-7 lat) poprawnie odpowiedziało na co najmniej jedno pytanie dotyczące resuscytacji. W ocenach praktycznych umiejętności, około 80% dzieci w wieku od 8 do 13 lat (60% w grupie wiekowej 6-7 lat) wybrało właściwe lub prawie właściwe tempo ucisków klatki piersiowej podczas resuscytacji. Prawidłowa głębokość ucisków była osiągana przez około 80% (w wieku od 10 do 13 lat), 60% (w wieku od 8 do 9 lat) i 40% (w wieku od 6 do 7 lat). Trzy czwarte dzieci skutecznie ułożyło inne dziecko w pozycji bezpiecznej, a ponad dwie trzecie odpowiednio zastosowało bandaż uciskowy.

Wnioski Dwudniowy kurs przeprowadzony w szkole podstawowej wykazał znaczną poprawę umiejętności pierwszej pomocy i resuscytacji u dzieci w wieku od 6 do 13 lat. W przyszłych badaniach należy zbadać trwałość tych efektów oraz odpowiedni czas na odświeżenie wiedzy pozyskanej na kursach.

Słowa kluczowe: szkoła podstawowa, pierwsza pomoc, resuscytacja, szkolenie dla laików, dzieci szkolne, uczniowie

Although the number of bystander cardiopulmonary resuscitation attempts by laypeople in Germany has improved, it has been stagnating in recent years at around 40% of cardiac arrest cases (Fischer et al., 2020). This is considerably lower than in Scandinavian countries with rates of 60%–80% (Fischer et al., 2020; Gräsner et al., 2011). Individuals who are living in low-density areas have a lower chance of surviving cardiac arrest (Yasunaga et al., 2011). In German rural states like Brandenburg, ambulance services need up to 15 minutes to arrive at the emergency scene. This represents a risk for irreversible brain damage that may occur already after 3–5 minutes without resuscitation. Encouraging and training lay people may fill this gap (Böttiger & Van Aken, 2015).

In countries like the U.S., resuscitation courses are a mandatory part of the school curriculum and may have contributed to higher bystander resuscitation rates (Cave et al., 2011). Teenagers who are trained in resuscitation may also motivate their parents and thus act as multipliers (Böttiger & Van Aken, 2015; Corrado et al., 2011). Since 2014, schools in Germany are supposed to offer annual 2-hour school-based resuscitation training starting in grade 7, when most children are aged 12–14 years; however, this recommendation has rarely been implemented (Böttiger & Van Aken, 2015; Müller-Jung, 2014). Banfai et al. (2017) suggested that even children younger than 12 years were able to learn basic life support taught in a 3-day course.

Therefore, we developed a 2-day first aid course for German primary schools taught in grades 1 to 6 when children are 6–13 years old. We aimed to evaluate age-specific post-course practical skills as well as their pre- and post-course willingness to help and theoretical knowledge including emergency phone numbers, compression bandage, general bleeding control, recovery position, and basic resuscitation skills.

METHODS

STUDY SETTING AND DESIGN

The present study took place in Brandenburg, a large German territorial state, which surrounds the capital state of Berlin. The study was part of the initiative “Jeder kann ein Held sein” [“Everyone can be a Hero”], which was started by medical students and paramedics of the honorary volunteer organization Pèpinière in Germany. Its aim has been to improve schoolchildren’s education and practical training in basic first aid and resuscitation.

We included six primary schools that were on a list provided by the Brandenburg school authority from across the state on a first-come, first-served basis. The training program was delivered during regular school hours, thus all children had to be present in the classroom.

However, participation in practical first aid exercises and in role-play activities was voluntary.

In a pretest study, we evaluated the feasibility of the newly developed first aid program in one primary school and its acceptance among children, parents, and teachers. The program was highly accepted by children and parents, while recommendations by teachers led to the inclusion of more practical methods, especially for children aged 6–8 years.

Ethical approval for the evaluation was obtained from the review board of the Charité – Universitätsmedizin Berlin, Berlin, Germany (application number: EA2/123/18).

STUDY PARTICIPANTS

From six primary schools in Brandenburg, we included all present grade 1–6 students, ranging from age 6–13 years. We also included children with insufficient German language skills (from immigrant or asylum-seeking families). Children who missed the baseline assessment on the first day were excluded from the evaluation. The number of children per classroom was similar across the six schools. In the first two grades, there were about 15–22 children (mostly aged 6–7 years) in each classroom, whereas in grades 3 to 6 the number was higher with about 22–28 children.

FIRST AID TRAINING PROGRAM FOR PRIMARY SCHOOL CHILDREN

The standardized 2-day program was taught in the students’ classrooms while the teachers were present. The course took place during regular primary school days, which last between 4–6 hours in German public primary schools. Younger primary school students aged 6–8 years old usually do not have lectures for more than 4 hours (each is 45 minutes long). The course lasted 4 hours per day including regular breaks. Grades 3 to 6 (i.e., children aged 8–13 years) have usually up to 6 hours per day. After the 4 hours of the first aid course, they discussed general health-related topics with their teachers during the fifth and sixth hours in school.

The module-based lesson plan of our first aid course is presented in Table 1. The interactive problem-based learning-oriented modules focused on four main areas of first aid: scene safety-protection measures, general bleeding control, and compression bandage application (Figure 1), recovery position, and resuscitation in a standardized curriculum (Table 1). The modules included many practical exercises and role-play/case studies, considering the different age groups of the children.

For the 2 days, the instructors had to follow a standardized module-based lesson plan with detailed learning goals. Each instructor had a standardized box containing various first aid training materials. It included bandages, a high-visibility waistcoat, a safety triangle, disposable medical exam gloves, at least three

cardiopulmonary resuscitation (CPR) manikins, a blanket for practicing the recovery position, disinfection, and a model of a head to demonstrate how to tilt the head.

As recommended in guidelines of first aid education for children (De Buck et al., 2020; Global First Aid Reference Center, 2020) the instructors engaged the children to come up with their own scenarios, used age-appropriate role-plays but also informed the students on the importance to help in case of need and on a very basic level about physiology, but totally avoided any over-medicalized terms or medical language. The instructors only used age-appropriate language, which was adapted to individual children’s experiences. Our curriculum was based on and aligned with those from two established rescue organizations, the German Red Cross, and the *Arbeiter-Samariter-Bund* [Workers’ Samaritan Federation], a large German aid and rescue organization.

As the focus of our evaluation was to assess the benefits of first aid in primary school students of any age, we also included children aged 6 and 7 years, although they are not specifically included in recommendations by International First Aid, Resuscitation and Education

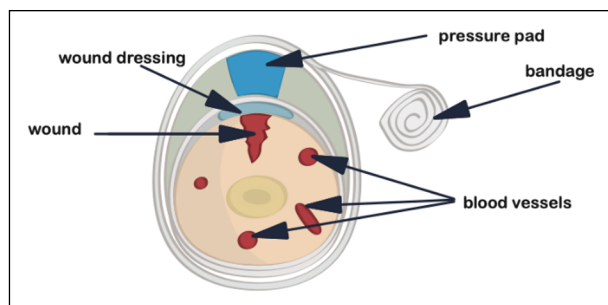


Figure 1 Simplified Illustration of Applying a Compression Bandage.

Guidelines of the Federation of Red Cross and Red Crescent Societies in 2020. (Global First Aid Reference Center, 2020).

The content of the course was taught in an age-specific fashion. For children aged 6–7 years, we kept the explanations as simple as possible and focused on practicing with a playful approach. In children aged 8–13 years, age-specific more advanced explanations (e.g., regarding the physiology of important organs) were included. Songs and manikins were used throughout all age groups. De Buck and colleagues’ recent guidelines with recommendations for the most appropriate age-specific teaching methods were published in 2020, after our study. Fortunately, we found many of their recommended elements that we also used in our training course, such as games and songs for the younger children and case studies and role-plays for the older children (De Buck et al., 2020; Global First Aid Reference Center, 2020).

For the resuscitation training, we used the cardiopulmonary resuscitation exercise manikin “Mini-Anne” (by Laerdal Medical, Stavanger, Norway). We had a total of 50 Mini-Annes, which did not provide feedback (for electronic recording). The manikins were used for teaching as well as for the post-course practical skill assessments, which were evaluated through observation by the instructors. Mini-Anne has a click mechanism that we deactivated on purpose during the course and during the evaluation of practical skills to minimize disappointment due to physical strengths.

INSTRUCTORS

In the present study, we had three main instructors with several years of working and teaching experience with rescue organizations (PH, RG, AN), who planned and coordinated the courses. They selected, trained, and supervised a pool of 20 instructors for the present project.

	FIRST AID COURSE DAY 1	FIRST AID COURSE DAY 2	POST-INTERVENTION ASSESSMENT DAY
First Lesson	Baseline Assessment of Pre-Intervention Knowledge Scene Safety Emergency Call	Resuscitation	Evaluation of Post-Intervention Knowledge
Break	10 min	10 min	10 min
Second Lesson	Scene Safety Emergency Call	Resuscitation	Evaluation of Post-Intervention Skills: <i>Resuscitation</i>
Break	20 min	20 min	20 min
Third Lesson	Recovery Position	General Bleeding Control and Compression Bandage	Evaluation of Post-Intervention Skills: <i>Recovery Position</i>
Break	10 min	10 min	10 min
Fourth Lesson	Recovery Position	General Bleeding Control and Compression Bandage	Evaluation of Post-Intervention Skills: <i>Compression Bandage</i>

Table 1 Lesson plan of a 2-day First Aid Course Including Basic Resuscitation for Primary School Children With Additional Information on the Time Points of Assessment for the Evaluation.

All instructors were advanced medical students and nurses who were specially trained in basic life support and first aid and/or were certified emergency medical assistants (paramedics). They worked for the project on a voluntary basis without any payment. According to the number of classes in each school, the number of instructors varied. In the larger primary schools (C, D and E) up to twelve instructors were conducting the training. A core team of eight to 10 instructors taught in all six schools of this project, whereas the remaining were substitutes for those who had other obligations on the day of the course or were sick.

The week or the evening before participating for the first time in the project, the new instructors were informed in a group setting or on an individual basis by one of the three main instructors about the module-based lesson plan (including hand-outs), the specific goals and core elements of each module including mnemonics and other specific tips (Table 1). In addition, instructors sat in and assisted during a first aid course taught to primary school students by another instructor before they started to teach themselves.

For this project, all course modules were taught by at least one instructor in each class, always in the presence of the class teacher, as the course took place during regular school hours. On all days, at least two of the three main instructors were present in the schools. On the morning of the first day, one hour before the first lesson started, the main instructors met in the school with all instructors and the teachers to organize the agenda for the next two days and the evaluation on the third day. During the course, the main instructors were always available for giving advice if required by the other instructors. During the scheduled breaks, all instructors came together in the central coordination room that was provided by each school and discussed possible questions that may have come up in the classroom.

EVALUATION OF KNOWLEDGE

The baseline (i.e., pre-intervention) knowledge assessment was conducted using a questionnaire with standardized questions and basic socio-demographic questions. It took place in the classroom on the first day of the course before the first lesson started. We assessed the post-intervention knowledge evaluation on day three (i.e., the next day after the course) in the classroom before the practical skills evaluation started. The age-specific questions were generally simple and according to the students reading and writing skills.

CHILDREN AGED 6–7 YEARS (GRADES 1–2)

The baseline questionnaire for this age group assessed basic demographic information (age in years, gender identity, and the language spoken at home: “only German,” “mostly German,” or “mostly non-German”). The pre-intervention knowledge evaluation examined

the knowledge of the emergency number (free text field), willingness to help others who are in an emergency (in four categories: “I would help everybody,” “I would help only someone I know,” “I would not help at all,” or “I am not sure”), and whether they had attended any prior form of first aid training (yes/no). The post-intervention knowledge evaluation included seven main questions. In addition to the baseline questions on an emergency number and willingness to help others in an emergency, we asked the children what module of the course they liked most (free text field). The assessment of their knowledge of basic resuscitation methods included compression depth (correct answers in free text fields included “4–6 cm,” “4 cm depth,” “1/3 depth-ratio,” “as deep as possible,” or “until cracking in manikin”), hand placement (marking the middle of the chest in the drawing of a person), and compressions per minute (correct answers in free text fields included “100–120 per min,” “2 per sec,” “a song with 4/4 beats (120 beats/minutes),” or “very fast”; the latter only until the age of 9 years) according to the current European Resuscitation Council (ERC) guidelines at the time (Olasveengen et al., 2021).

For this age group, an instructor read each question aloud. If 6-year-old students had difficulties in spelling, the teacher assisted them throughout the evaluation.

CHILDREN AGED 8–13 YEARS (GRADES 3–6)

The pre-intervention evaluation and questionnaires of this age group included 10 questions. Apart from age (in years), gender identity, the language spoken at home (only “German,” “mostly German,” or “mostly non-German”), previous first aid courses (yes/no), and knowledge of the emergency number (free text field) the students were asked about the willingness to help others in an emergency (“I would help everybody,” “I would help only someone I know,” “I would not help at all,” or “I am not sure”). Students answered questions concerning general knowledge of self-assessed first aid skills including compression bandage (“Do you know how to put on a compression bandage?” by yes/no), and recovery position (“Do you know how to put someone in the recovery position?” by yes/no).

Furthermore, we asked about previous knowledge of resuscitation including the compression point (i.e., hand placement by marking the middle of the chest in the drawing of a person), compression depth (correct answers in free text fields included “4–6 cm,” “4 cm depth,” “1/3 depth-ratio,” “as deep as possible,” or “until cracking in manikin”; the latter two only until age 9 years. And the rate of chest compression (correct answers in free text fields included “100–120 per min,” “2 per sec,” “a song with 4/4 beats (120 beats/minutes),” or “very fast”; the latter only until the age of 9 years.

The post-intervention knowledge evaluation with 10 questions included assessments of what students liked about the course, willingness to help others (“I would help

everybody,” “I would help only someone I know,” “I would not help at all,” or “I am not sure”), and knowledge of the emergency number (free text field). Short descriptions of emergency scenarios followed. The cases dealt with bandaging, recovery position, and resuscitation methods. Students had to answer in free text fields with keywords or a sentence. The last four questions were the same as in the pre-intervention evaluation assessing knowledge of resuscitation methods.

PRACTICAL SKILL ASSESSMENTS

On the third day, students were evaluated in terms of their practical skills at various stations. The three main instructors of the project (PH, RG, and AN) explained the assessment criteria for each exercise to the individual instructors beforehand, pointed out the importance of always giving positive and if necessary constructive corrective feedback to the children (after the exercise was over) and supervised the instructors during the assessments.

The instructors assessed the recovery position, compression bandage application, and resuscitation methods using a standardized form. The performance in the task “compression bandage” was assessed on a 4-point Likert scale with (i) correct (i.e., tight), (ii) technique mostly correct, (iii) insufficient, or (iv) not done (e.g., if a child felt unwell, refused to participate in the evaluation of this exercise, or was excluded by the teachers for a matter unrelated to the intervention).

The performances in the task “recovery position” were assessed on a 4-point Likert scale with (i) correctly conducted with all components, (ii) mostly correct, (iii) insufficient, and (iv) not done (e.g., if a child felt unwell, refused to participate in the evaluation of this exercise, or was excluded by the teacher for a matter unrelated to the intervention).

The assessment of the resuscitation exercise was done visually by the evaluator who recorded the depth and rate of chest compression (both on a 4-point Likert scale for compression depth: (I) compression sufficient (which was defined as 5–6cm), (ii) compression depth close to sufficient, (iii) compression depth insufficient and (iv) not done). For compression rate: (I) sufficient (defined as 100–120/min), (ii) mostly sufficient, (iii) insufficient, and (iv) not done (e.g., if a child felt unwell, refused to participate in the evaluation of this exercise, or was excluded by the teacher for a matter unrelated to the intervention).

STATISTICAL METHODS

Our evaluation of the first aid training program followed an exploratory analysis approach rather than testing specific primary and secondary hypotheses. No formal level of statistical significance was set. The distribution of age as a continuous variable was

described by median, interquartile range, minimum and maximum, whereas distributions of categorical basic sociodemographic variables (gender identity, main language spoken at home, and previous participation in a first aid course) were reported using absolute and relative frequencies (percentages). The latter was reported with corresponding 95% confidence intervals (95%-CI) as a measure of statistical uncertainty.

The main analyses were conducted after stratification in 2-year age categories (6–7, 8–9, 10–11, 12–13 years) using absolute and relative frequencies; the latter as percentages with the corresponding 95%-CIs based on bootstrapping technique (statistical software IBM SPSS Statistics 27). We compared the outcome variables “willingness to help” and “students’ knowledge of first aid including emergency number(s) and elements of resuscitation” before and after the 2-day course. The outcome variables assessing practical skills (i.e., compression bandage, recovery position, and resuscitation parameters) were only assessed post-course.

RESULTS

BASIC CHARACTERISTICS OF STUDY PARTICIPANTS

In six primary schools in the state of Brandenburg, 1,340 students with an age range of 6–13 years participated in the first aid courses. Of them, 1,268 reported their age on the questionnaires and were included in the age-specific analyses. About 16% of the students did not speak German at home (alone or in addition to German). In one school, over half of the children had some previous first aid training, whereas in all other participating schools this experience ranged from 11%–39% (see individual confidence intervals, [Table 2](#)). To examine if this may have had an effect, we conducted additional analyses stratified by school. They showed that the schools with a higher percentage of children reporting previous first aid training did not perform better regarding knowledge and skills than schools with a lower percentage (data not shown).

EMERGENCY NUMBER

Most of the students already knew the emergency number(s) prior to the course ([Figure 1](#)). This proportion increased considerably after the course only in children aged 6–7 years but remained at around 90% in those aged 8–13 years ([Figure 2](#)).

WILLINGNESS TO HELP

Prior to the course, 56% to 73% of the children of different age groups would have helped everyone in

PRIMARY SCHOOL	A	B	C	D	E	F	TOTAL
Students (N)	228	91	284	311	291	135	1,340
Gender Identity (male)	51%	39%	49%	51%	56%	51%	51%
Age (N = 1,268*)							
Median	9y	8y	9y	9y	10y	8y	9y
Interquartile range	4y	2y	3y	3y	3y	3y	4y
Min/Max	6-13y	6-11y	6-13y	6-12y	6-13y	6-12y	6-13y
Language at home (N = 1,276**)							
Only German	78%	96%	87%	85%	78%	91%	84%
Mostly German	13%	5%	10%	12%	17%	9%	12%
Mostly non-German	9%	0%	3%	4%	5%	0%	4%
Missing (n/N)	14/228	3/91	7/284	14/311	24/291	2/135	64/1340
Previous first aid course	55%	24%	18%	15%	19%	31%	25%
[95%CI in %]	[49-62]	[16-33]	[13-22]	[11-19]	[15-24]	[23-39]	[23-27]

Table 2 Basic Characteristics of Study Participants stratified by Primary School.

Note: Rounded percentages may not add up to 100%. 95%CI = 95% confidence interval. N = number. Y = years. * 72 children did not report their age. ** 64 children did not report the language spoken at home.

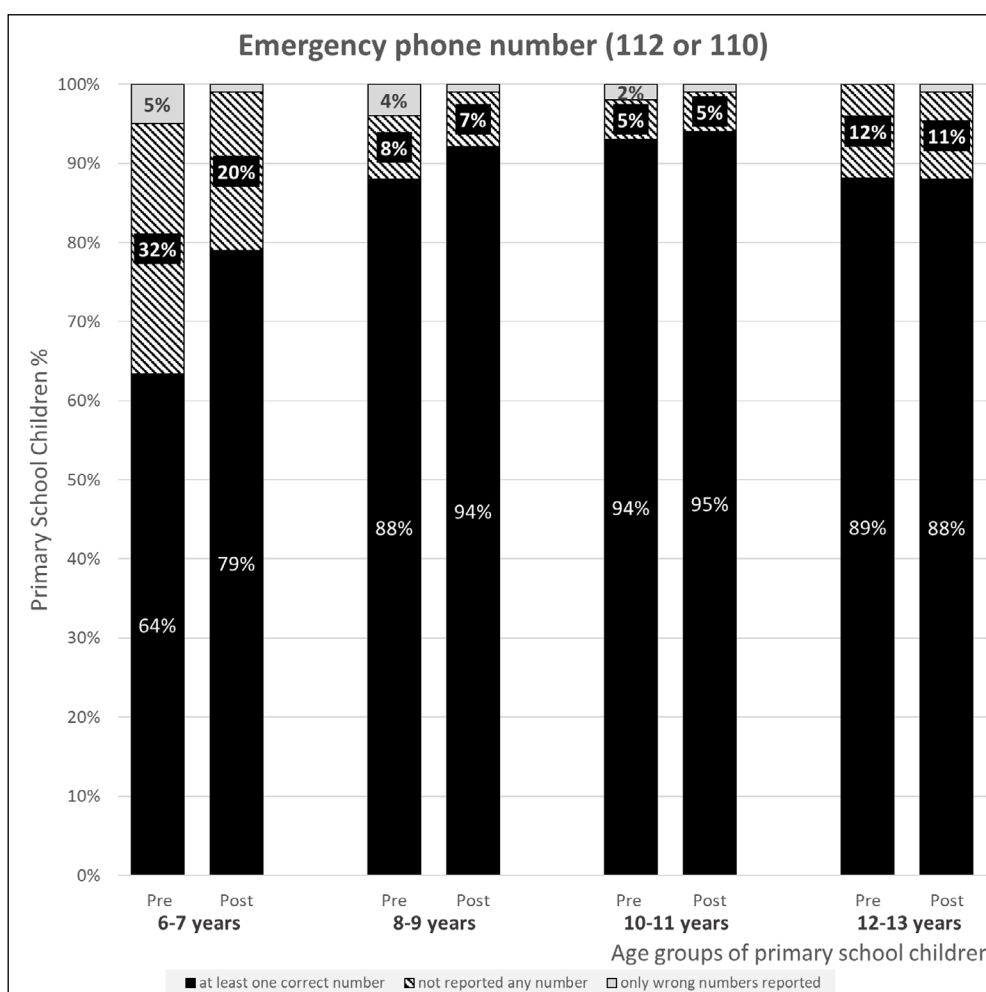


Figure 2 Emergency Phone Number Knowledge Before/After (Pre/Post) a 2-day First Aid Course in Primary Schools in the German State of Brandenburg with 1,268 Children.

Note: Percentages of primary school children aged 6-13 years reporting the correct emergency number(s) – i.e., 112 and/or police number 110 – before (pre) and after (post) a 2-day first aid course in primary schools in the State of Brandenburg (Germany).

an emergency (not only persons they have known before). After the course, the proportion of those helping everyone in an emergency increased further in all age groups, particularly in the two older age groups (Figure 3, Table 3).

SELF-REPORTED KNOWLEDGE OF COMPRESSION BANDAGE, RECOVERY POSITION, AND RESUSCITATION

Before the course, only 13%–15% of the children aged 8–13 years reported knowing how to do a compression

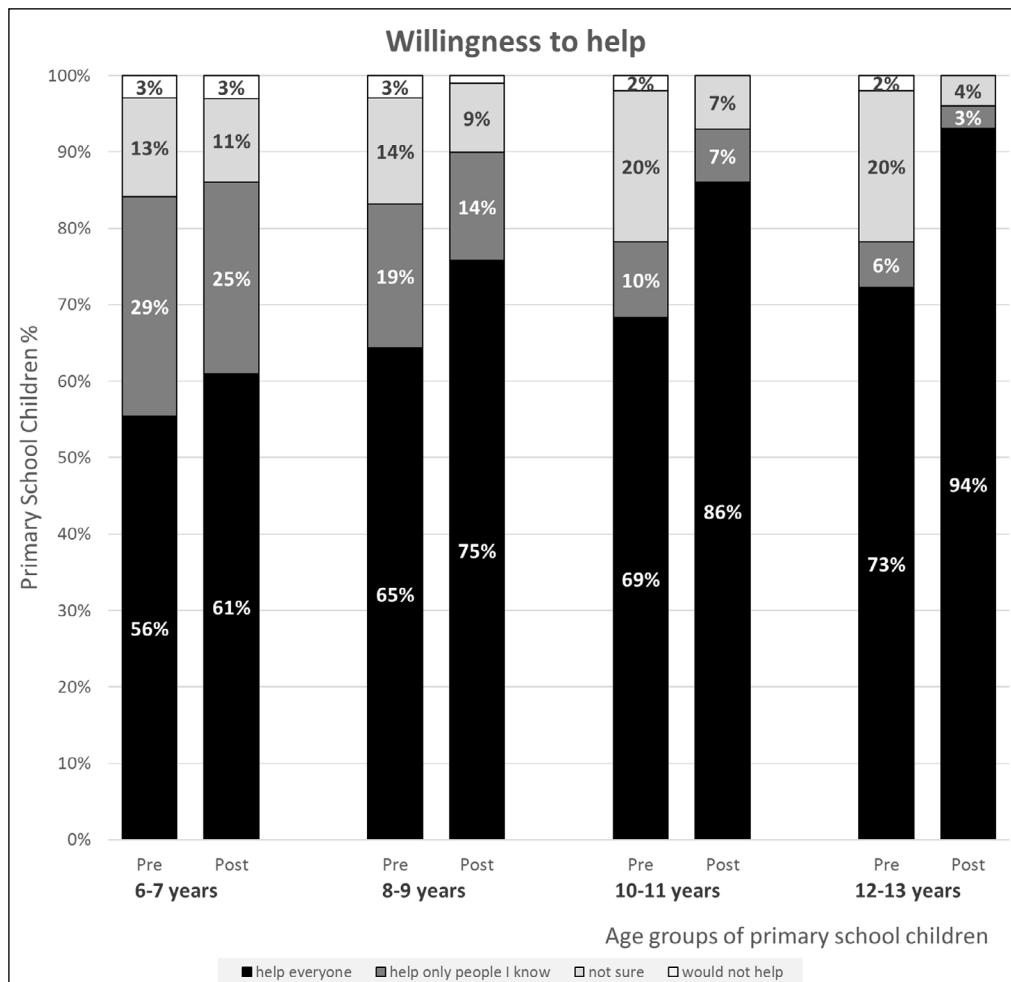


Figure 3 Self-Reported Willingness to Help in an Emergency Before/After (Pre/Post) a 2-day First Aid Course in Primary Schools in the German State of Brandenburg with 1,268 Children.

Note: The 95% confidence intervals corresponding to the presented percentages are reported in Table 3.

AGE GROUPS	6-7 YEARS		8-9 YEARS		10-11 YEARS		12-13 YEARS	
N (1,268 in total)	341		387		419		121	
Time points of assessment	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Willingness to help in an emergency case								
Would help everybody [95%CI in %]	56% [51-61]	61% [56-66]	65% [60-70]	75% [71-79]	69% [64-73]	86% [82-89]	73% [65-81]	94% [88-98]
Would help only someone I know [95%CI in %]	29% [24-34]	25% [21-30]	19% [15-23]	14% [11-18]	10% [7-13]	7% [5-10]	6% [3-13]	3% [1-8]
Would not help at all [95%CI in %]	3% [2-6]	3% [2-6]	3% [2-5]	1% [0-3]	2% [1-4]	0% [0-1]	2% [1-7]	0% [0-3]
I am not sure [95%CI in %]	13% [10-17]	11% [8-15]	14% [11-18]	9% [6-12]	20% [16-24]	7% [5-10]	20% [14-29]	4% [1-9]

Table 3 Willingness to Help Before (Pre) and After (Post) a First Aid Course in Primary Schools in the German State of Brandenburg with 1,268 Children.

bandage. The proportion of those claiming to know how to put someone in the recovery position ranged from 19%–30%, whereas for resuscitation techniques this proportion ranged from 14%–18% (Table 4).

ASSESSMENT OF RESUSCITATION KNOWLEDGE BEFORE AND AFTER THE COURSE

Before the course, very few children had any resuscitation knowledge regarding correct hand placement, correct depth, and rate of chest compression. After the training course, the post-intervention evaluation assessment showed strong improvements in all resuscitation parameters, particularly in the three older age groups.

Most of the children aged 8–12 years answered basic resuscitation questions correctly (Figure 4).

PRACTICAL SKILLS

After the course, the assessment of practical skills showed that overall, about three-quarters of participating children were able to apply a compression bandage correctly or almost correctly. On average, the performances seemed best in the 8–11-year-old children comparing the point estimates with those of the other children (Table 5).

About three-quarters or more of all children performed the recovery position correctly or almost

AGE GROUPS	6–7 YEARS	8–9 YEARS	10–11 YEARS	12–13 YEARS
Do you know how to put on a compression bandage?				
Number of students	n.e.	319	410	118
Yes	n.e.	14%	15%	13%
[95%CI in %]	n.e.	[10–17]	[11–18]	[7–19]
Do you know how to put someone in the recovery position?				
Number of students	n.e.	323	411	119
Yes	n.e.	19%	27%	30%
[95%CI in %]	n.e.	[14–23]	[22–31]	[22–39]
Do you know how to resuscitate someone?				
Number of students	n.e.	326	413	120
Yes	n.e.	14%	15%	18%
[95%CI in %]	n.e.	[10–18]	[11–18]	[12–25]

Table 4 Students’ Self-reported General Knowledge of First Aid Skills Before the First Aid Training Course.

Note: 95%CI = 95% confidence interval. n.e. = not evaluated (to keep the pre-intervention knowledge evaluation questionnaire assessment short and simple for the 6–7-year-old students).

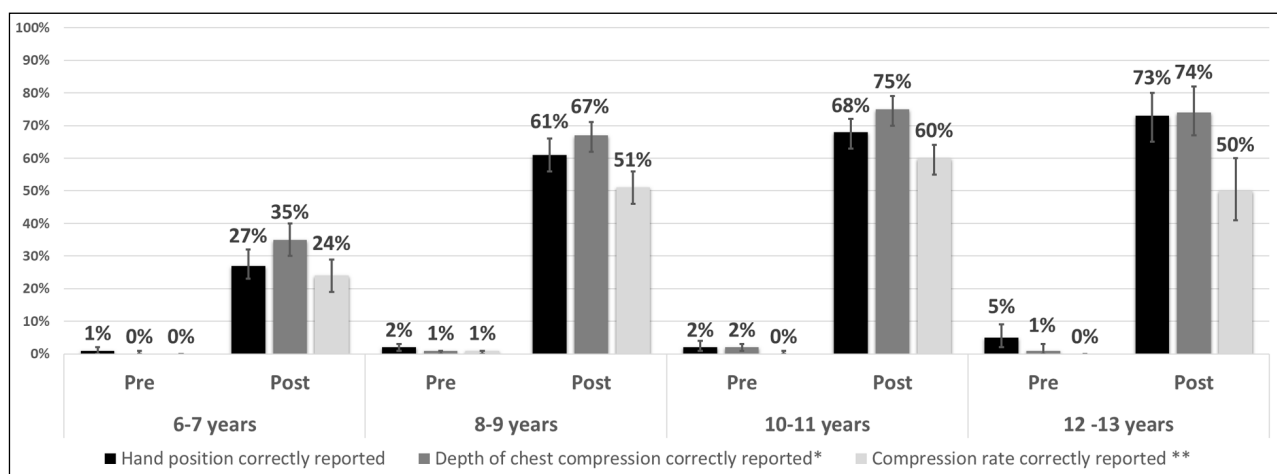


Figure 4 Basic Resuscitation Knowledge Before/After (Pre/Post) a 2-day First Aid Course in Primary Schools in the German State of Brandenburg with 1,268 Children.

Note: * For depth of chest compression (grey middle bar) correct answers included “4–6 cm”; “4 cm depth”; “1/3 depth-ratio”; “as deep as possible”; “until cracking in manikin” (the latter two only until age 9 years). ** For rate of compression (light grey right bar) correct answers included “100–120 per min”; “2 per sec”; “a song with 4/4 beats (120 beats/minutes)”; “very fast” (the latter only until the age of 9 years).

AGE GROUPS	6–7 YEARS	8–9 YEARS	10–11 YEARS	12–13 YEARS
Compression bandage (skill assessed by trainer)				
Students, present (missing), N	286 (55)	366 (21)	398 (21)	108 (13)
Correct (i.e. tight) [95%CI in %]	19% [15–24]	32% [27–37]	36% [31–41]	24% [16–33]
Technique mostly correct [95%CI in %]	55% [49–61]	48% [43–53]	45% [40–50]	50% [40–60]
Insufficient [95%CI in %]	25% [20–31]	19% [15–24]	18% [14–22]	25% [17–34]
Not done * [95%CI in %]	2% [1–5]	1% [0–3]	1% [0–3]	1% [0–7]
Recovery position (assessed by trainer)				
Students, present (missing), N	311 (30)	366 (21)	397 (22)	107 (14)
Correctly conducted, with all components [95%CI in %]	20% [16–25]	24% [20–29]	33% [29–38]	20% [13–29]
Mostly correct (person lies stable on his/her side) [95%CI in %]	59% [53–65]	57% [52–62]	56% [51–61]	70% [60–79]
Insufficient [95%CI in %]	21% [17–26]	19% [15–24]	11% [8–15]	10% [5–18]
Not done * [95%CI in %]	1% [0–3]	0% [0–1]	0% [0–1]	0% [0–1]
Depth of chest compression during resuscitation (assessed by trainer)				
Students, present (missing), N	256 (85)	318 (69)	329 (90)	80 (41)
Compression depth sufficient (approx. 5–6 cm) [95%CI in %]	15% [11–20]	21% [17–26]	32% [27–38]	36% [26–48]
Compression depth close to sufficient [95%CI in %]	28% [23–34]	43% [38–49]	47% [42–53]	44% [34–57]
Compression depth insufficient [95%CI in %]	57% [51–63]	36% [31–42]	21% [17–26]	20% [12–30]
Rate of compression during resuscitation (assessed by trainer)				
Students, present (missing), N	257 (84)	318 (69)	329 (90)	80 (41)
Sufficient (100–120 compressions per minute) [95%CI in %]	26% [21–32]	36% [31–42]	46% [41–52]	46% [35–58]
Mostly sufficient [95%CI in %]	35% [29–41]	45% [40–51]	39% [34–45]	35% [25–46]
Insufficient [95%CI in %]	39% [33–46]	20% [16–25]	15% [12–20]	19% [12–30]

Table 5 Practical Skills After a 2-day First Aid Training Course in Primary Schools in the German State of Brandenburg aged 6–13 years. Note: * “Not done” was recorded by the evaluator e.g., if a child felt unwell, refused to participate in the evaluation of this exercise, or was excluded by the teachers for a matter unrelated to the intervention.

correctly. There were no considerable differences between the age groups (Table 5). The proportion of students who performed a “sufficient or close to sufficient compression depth” increased by age, whereas the “compression rate during resuscitation” was assessed as sufficient or close to sufficient in about 80% of the children aged 8–13 years compared to about 60% in the 6–7-year-olds (Table 5).

DISCUSSION

MAIN FINDINGS

Although most primary school students already knew at least one emergency number, the participation in the first aid course increased this proportion to almost 80% (students aged 6–7 years) and around 90% (8–13 years). The attitude to help in the case of an emergency

increased slightly after the first aid course in students aged 6–7 years, whereas we saw much stronger increases in those aged 8–13 years.

Most students aged 8–13 years showed appropriate first aid knowledge and practical skills including basic resuscitation techniques after the 2-day training course, whereas first aid knowledge improved to a lesser extent in those aged 6–7 years. Among the latter, over 50% performed the exercise “compression bandage” and “recovery position” successfully in the final practical skill assessments, whereas less than half were able to demonstrate sufficient/almost-sufficient basic resuscitation skills.

COMPARISON WITH PREVIOUS STUDIES

Earlier studies included smaller samples of kindergarten and primary school children than our study with over 1200 children aged 6–13 years (Banfai et al., 2017; Bollig et al., 2009; Bollig et al., 2011; Calicchia et al., 2016; Fleischhackl et al., 2009; Lubrano et al., 2005; Calicchia et al., 2016). A previous study that evaluated first aid and resuscitation instructions including very young school children was conducted by Austrian emergency physicians who studied 47 students aged 6–7 years. Most children knew an emergency number, were able to perform the recovery position, and used a defibrillator after their newly developed 1-week program. However, the effects regarding the care of burn injuries and cardiopulmonary resuscitation were only mediocre. Finally, 82% of all parents considered their children capable of reacting properly in emergency situations (Uray et al., 2003).

A 3-day course, comparable to our 2-day program, was evaluated in over 500 children aged 7–14 years in Hungary. Their findings were confirmed by our results showing considerable gains in knowledge and practical skills in all age groups. However, we did not see such a strong age gradient in all assessments as in the Hungarian study (Banfai et al., 2017). In our post-course assessments, the knowledge and skills of the students aged 6–7 years were not as good as those in the older student groups. However, those aged 8–9 years performed sometimes on a quite comparable level to students aged 10–13 years.

In some practical assessments, the 10–11-year-old students seemed to have performed better than those aged 12–13 years (Table 5). It has been speculated by some teachers that this may be due to puberty and lack of concentration. However, overlapping 95%-confidence intervals between these two age groups did not indicate clear differences (e.g., among the 10–11-year-old students the application of a compression bandage was correctly or almost correctly performed by 81% [77%–85%] compared to 74% [65%–82%] among the 12–13-year-old ones). Similarly, the recovery position was correctly or almost correctly performed by 89%

[86%–92%] and 90% [83%–95%] of the 10–11- and 12–13-year-old students, respectively (Table 5). Larger samples of 12–13-year-old students than in our study would be necessary to examine possible differences in this preadolescent age period.

In the past, studies with primary school children were mostly not as comprehensive as our study regarding the first aid topics and skills covered (Lubrano et al., 2005). Previous studies often focused only on CPR (Bohn et al., 2012; Li et al., 2018; Lukas et al., 2016) whereas we also taught and evaluated basic first aid skills such as general behavior including scene safety, applying the recovery position and compression bandages. Fleischhackl et al. (2009) reported that 86% of included students with a mean age of 13 years (range 9–18 years) performed CPR correctly but did not report age-specific results. In comparison to Fleischhackl and colleagues, we found a slightly lower percentage with about 80% correctly or almost correctly performing chest compression for children aged 10–13 years. For the age group 8–9 years, this percentage was considerably lower with one-third performing chest compression insufficiently (Table 5).

The age of students is determining the effectiveness of a first aid course, especially their practical resuscitation skills (Banfai et al., 2017; Plant & Taylor, 2013; Bohn et al., 2012). For physical reasons, very young students were not able to perform CPR as well as teenagers or adults in terms of “push hard and fast.” However, starting to teach these techniques before puberty, even in the first school years, may improve self-confidence, motivation, and skills to help them later in life (Banfai et al., 2017; Bohn et al., 2012).

A British study showed that students aged 9–12 years chose the correct hand placement and the correct compression rate during CPR, however, they did not achieve the correct depth of chest compressions as adults usually do (Jones et al., 2007). This was confirmed by an Austrian study with 8–13-year-old children. Nevertheless, over 98% of all 322 children participating in that study had fun and interest in the training and 90% of all age groups wanted to continue to receive resuscitation training in the future (Weidenauer et al., 2018). A German study with 1,022 participating 10–17-year-old students found that the necessary force to compress the chest in accordance with the ERC guidelines can only be applied by children aged 12–13 years and older (Rücker et al., 2010).

On the contrary, two studies found some evidence that 10-year-old children may be able to understand and/or perform chest compressions with adequate depth of pressure (Lukas et al., 2016; Abelairas-Gómez et al., 2014). The evaluation of 10–15-year-old children showed that many were able to improve their practical skills in basic life support, however, the majority were not able to perform CPR as well as adults (Abelairas-Gómez et al., 2014). Our results suggested that students aged

8–13 years might gain similar levels of resuscitation knowledge by a single session in comparison to older students. This is further evidence for recommending mandatory age-specific first aid lessons including basic life support beginning in early primary school age.

The participation of children in first aid courses and especially resuscitation exercises regardless of the effectiveness of the training can also increase the general willingness to help in an emergency, as two Japanese studies have shown (Hori et al., 2016; Kitamura et al., 2016). Similarly in our study, the willingness to help increased among all students after the course, especially among the older children. We did not assess the reasons why some children (i.e., ranging from 0%–3% depending on the age group) were still not willing or were unsure to help (Table 4). It may be due to strict parental advice to stay away from strangers or being afraid to cause more harm while helping the person in an emergency as suggested in a study from Croatia with 12–15-year-old youths (Petrić et al., 2013). Studies including also qualitative methods should examine this further. Furthermore, first aid courses may also contribute to the early promotion of general health literacy in primary school children (Böttiger & Van Aken, 2015; Beck et al., 2016; Bitzer & Sørensen, 2018).

STRENGTHS AND LIMITATIONS

The strengths of our study include its large sample spanning across 6 years of primary school age, including students from 6–13 years, and comprehensive assessments of their pre-/post-intervention attitudes, knowledge, and practical skills related to not only CPR but also general first aid.

Several limitations must be noted regarding our study. Firstly, we did not include primary schools from cities and more urban populations. Since we conducted our study in rural regions and small towns in the large territorial state of Brandenburg, our results may be considered representative only for the regions where the study took place and perhaps other non-urban areas in North-Eastern Germany, but not for the whole country. Secondly, we did not have a comparison group in terms of control schools. However, we used the students themselves as a control group, by comparing before-and-after assessments of knowledge and attitudes with identical standardized questions. Thus, we cannot fully exclude possible influences before and during the 2-day course including first aid techniques appearing on TV/internet, through parental interaction, or elsewhere in the community. However, during the short time period of 2 days, we consider this as a marginal influence.

Thirdly, we conducted the whole project with our own means and had no external funding, thus lacking resources to hire a single evaluator for the assessment

of practical skills in all schools. Instead, we relied on a core team of experienced volunteer instructors, who have been specially trained and used the standardized evaluation form with subjective rating scales for each exercise to minimize measurement bias. We cannot exclude a potential evaluator's effect but found no indication for it when looking at the school-specific results, which did not differ considerably among the schools (data not shown). Fourthly, from our study only using instructors with a medical background, we cannot draw conclusions about the effects of teachers training primary school students in first aid. However, there is evidence that teachers perform just as well as or even better in teaching first aid in schools than medical professionals (Bohn et al., 2012).

CONCLUSIONS

Our study showed that primary school students of all ages benefit from a 2-day first aid course. Especially those aged 8–13 years were able to improve their knowledge as well as their practical first aid skills demonstrating successfully the recovery position and application of compression bandages on fellow students, as well as resuscitation procedures on manikins. The youngest students, aged 6–7 years, also improved their first aid knowledge but to a lesser extent than their older peers.

Compared to the current recommendations to start resuscitation training in German schools at grade 7 (corresponding to age 12–13 years) our results clearly showed that such training will also be very beneficial for students younger than 12 years.

Previous recommendations already pointed out the importance of refresher training for children and young teenagers (Bánfai et al., 2019). Future evaluations are needed to examine the long-term benefit of first aid courses in primary schools and at what time refresher courses are required. We aim to conduct a follow-up after 2 years in the participating schools of the present study evaluating how sustainable their acquired knowledge and skills will be.

Future studies on children under 8 years of age should consider including teachers and pedagogic scientists to develop better age-specific programs for students aged 6–7 years. Future age-specific research should also focus on children's attitudes and their willingness to help in an emergency (e.g., using mixed-methods approaches).

From a public health perspective, long-term and broad-scale population-based assessments are required to examine if school-based first aid courses will lead to more knowledgeable and self-confident adult bystanders (by both the students themselves and their parents through multiplier effects) and may eventually increase the number of bystander CPR.

ACKNOWLEDGEMENTS

We are very grateful to all staff and children of the schools that participated in this study. We also thank all members of the Pépinière charity as well as volunteers from the local German rescue services, civil protection units, voluntary working firefighters and members of the federal agency for technical relief (Germany) for their contributions and participation as trainers and supporters in the first aid courses.

FUNDING INFORMATION

The present study was conducted with own funding.

PH, RG, AD, JW, CSB, AN, RD, JK, KCK, and KB are working on a voluntary basis for the charitable organization Pépinière INP.

PH and KB are founders of the Pépinière Foundation.

RG, AD and JK received a medical student research grant by the Pépinière foundation and Ministry of Science, Research and Culture of the State of Brandenburg for the project presented here (RG and AD) and for another school-based first aid research project (JK).

SSC, KI, and TK have no conflicts of interest to disclose.


COMPETING INTERESTS


The authors have no competing interests to declare.


PUBLISHER'S NOTE

This article was originally published displaying the submission date as 26 February 2023 and the acceptance date as 05 March 2023. This metadata was incorrect due to the article being added to the OJS3 system after a migration to a new publisher when it had already been through the review process. As of 05 October 2023, the data has been corrected to display the correct submission and acceptance dates.

AUTHOR AFFILIATIONS

Philipp Humbsch  orcid.org/0000-0002-0414-1287
Institute of Social Medicine, Epidemiology and Health Economics, Charité – Universitätsmedizin Berlin, Berlin, Germany; Pépinière INP gGmbH Frankfurt (Oder), Germany; Pépinière Foundation, Frankfurt (Oder), Germany

Robert Gintrowicz  orcid.org/0000-0002-2972-6943
Institute of Social Medicine, Epidemiology and Health Economics, Charité – Universitätsmedizin Berlin, Berlin, Germany; Pépinière INP gGmbH Frankfurt (Oder), Germany

Anika Dietrich  orcid.org/0000-0002-7556-8587
Institute of Social Medicine, Epidemiology and Health Economics, Charité – Universitätsmedizin Berlin, Berlin, Germany; Pépinière INP gGmbH Frankfurt (Oder), Germany

Johanna Weckwerth

Pépinière INP gGmbH Frankfurt (Oder), Germany

Carmen Schultze-Berndt

Pépinière INP gGmbH Frankfurt (Oder), Germany

Anne Nasert

Pépinière INP gGmbH Frankfurt (Oder), Germany

Rafael Dolabella

Pépinière INP gGmbH Frankfurt (Oder), Germany

Josephina Kehlert  orcid.org/0000-0003-2685-164X

Institute of Social Medicine, Epidemiology and Health Economics, Charité – Universitätsmedizin Berlin, Berlin, Germany; Pépinière INP gGmbH Frankfurt (Oder), Germany

Kiona C. Keil

Institute of Social Medicine, Epidemiology and Health Economics, Charité – Universitätsmedizin Berlin, Berlin, Germany

Konrad Bohm

Pépinière INP gGmbH Frankfurt (Oder), Germany; Pépinière Foundation, Frankfurt (Oder), Germany

Simona Schmöche

Johann Wolfgang von Goethe Primary School, Eisenhüttenstadt, Germany

Katja Icke  orcid.org/0000-0002-4170-8430

Institute of Social Medicine, Epidemiology and Health Economics, Charité – Universitätsmedizin Berlin, Berlin, Germany

Thomas Keil  orcid.org/0000-0002-9108-3360

Institute of Social Medicine, Epidemiology and Health Economics, Charité – Universitätsmedizin Berlin, Berlin, Germany; Institute for Clinical Epidemiology and Biometry, University of Würzburg, Würzburg, Germany; State Institute of Health I, Bavarian Health and Food Safety Authority, Erlangen, Germany

REFERENCES

Abelairas-Gómez, C., Rodríguez-Núñez, A., Casillas-Cabana, M., Romo-Perez, V., & Barcala Furelos, R. (2014).

Schoolchildren as life savers: At what age do they become strong enough? *Resuscitation*, 85, 814–819. DOI: <https://doi.org/10.1016/j.resuscitation.2014.03.001>

Bánfai, B., Pandur, A., Schiszler, B., Pek, E., Radnai, B., Csonka, H., & Betlehem, J. (2019). 'The (second) year of first aid':

A 15-month follow-up after a 3-day first aid programme. *Emergency Medicine Journal*, 36(11), 666–669. DOI: <https://doi.org/10.1136/emermed-2018-208110>

Banfai, B., Pek, E., Pandur, A., Csonka, H., & Betlehem, J.

(2017). "The year of first aid": Effectiveness of a 3-day first aid programme for 7–14-year-old primary school children. *Emergency Medicine Journal*, 34(8), 526–532. DOI: <https://doi.org/10.1136/emermed-2016-206284>

Beck, S., Ruhnke, B., Issleib, M., Daubmann, A., Harendza, S., & Zöllner, C. (2016). Analyses of inter-rater reliability

between professionals, medical students and trained school children as assessors of basic life support skills. *BMC Medical Education*, 16(1), 263. DOI: <https://doi.org/10.1186/s12909-016-0788-9>

Bitzer, E. M., & Sørensen, K. (2018). Health Literacy [Gesundheitskompetenz—Health Literacy] In German. *Gesundheitswesen (Bundesverband Der Ärzte Des*

- Öffentlichen Gesundheitsdienstes (Germany)*), 80(8–09), 754–766. DOI: <https://doi.org/10.1055/a-0664-0395>
- Bohn, A., Van Aken, H. K., Möllhoff, T., Wienzek, H., Kimmeyer, P., Wild, E., Döpker, S., Lukas, R. P., & Weber, T. P.** (2012). Teaching resuscitation in schools: Annual tuition by trained teachers is effective starting at age 10. A four-year prospective cohort study. *Resuscitation*, 83(5), 619–625. DOI: <https://doi.org/10.1016/j.resuscitation.2012.01.020>
- Bollig, G., Myklebust, A. G., & Østringen, K.** (2011). Effects of first aid training in the kindergarten—A pilot study. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, 19, 13. DOI: <https://doi.org/10.1186/1757-7241-19-13>
- Bollig, G., Wahl, H. A., & Svendsen, M. V.** (2009). Primary school children are able to perform basic life-saving first aid measures. *Resuscitation*, 80(6), 689–692. DOI: <https://doi.org/10.1016/j.resuscitation.2009.03.012>
- Böttiger, B. W., & Van Aken, H.** (2015). Kids save lives—Training school children in cardiopulmonary resuscitation worldwide is now endorsed by the World Health Organization (WHO). *Resuscitation*, 94, A5–7. DOI: <https://doi.org/10.1016/j.resuscitation.2015.07.005>
- Calicchia, S., Cangiano, G., Capanna, S., De Rosa, M., & Papaleo, B.** (2016). Teaching Life-Saving Manoeuvres in Primary School. *BioMed Research International*, 2016, Article 2647235. DOI: <https://doi.org/10.1155/2016/2647235>
- Cave, D. M., Aufderheide, T. P., Beeson, J., Ellison, A., Gregory, A., Hazinski, M. F., Hiratzka, L. F., Lurie, K. G., Morrison, L. J., Mosesso, V. N., Nadkarni, V., Potts, J., Samson, R. A., Sayre, M. R., Schexnayder, S. M., American Heart Association Emergency Cardiovascular Care Committee, Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation, Council on Cardiovascular Diseases in the Young, Council on Cardiovascular Nursing, & Council on Clinical Cardiology, and Advocacy Coordinating Committee.** (2011). Importance and implementation of training in cardiopulmonary resuscitation and automated external defibrillation in schools: A science advisory from the American Heart Association. *Circulation*, 123(6), 691–706. DOI: <https://doi.org/10.1161/CIR.0b013e31820b5328>
- Corrado, G., Rovelli, E., Beretta, S., Santarone, M., & Ferrari, G.** (2011). Cardiopulmonary resuscitation training in high-school adolescents by distributing personal manikins. The Como-Cuore experience in the area of Como, Italy. *Journal of Cardiovascular Medicine*, 12(4), 249–254. DOI: <https://doi.org/10.2459/JCM.0b013e31828341027d>
- De Buck, E., Laermans, J., Vanhove, A.-C., Dockx, K., Vandekerckhove, P., & Geduld, H.** (2020). An educational pathway and teaching materials for first aid training of children in sub-Saharan Africa based on the best available evidence. *BMC Public Health*, 20(1), 836. DOI: <https://doi.org/10.1186/s12889-020-08857-5>
- Fischer, M., Wnent, J., Gräsner, J.-T., Seewald, S., Brenner, S., Jantzen, T., Bein, B., Bohn, A., Ristau, P., & die teilnehmenden Rettungsdienste am Deutschen Reanimationsregister.** (2020). *Öffentlicher Jahresbericht 2019 des Deutschen Reanimationsregisters: Außerklinische Reanimation 2019 [Public Annual Report 2019 of the German Resuscitation Registry: Pre-Hospital Resuscitation 2019]*. Deutsches Reanimationsregister. <https://www.reanimationsregister.de/downloads/oeffentliche-jahresberichte/rettungsdienst/168-oeffentlicher-jahresbericht-2019/file.html>
- Fleischhackl, R., Nuernberger, A., Sterz, F., Schoenberg, C., Urso, T., Habart, T., Mittlboeck, M., & Chandra-Strobos, N.** (2009). School children sufficiently apply life supporting first aid: A prospective investigation. *Critical Care*, 13(4), R127. DOI: <https://doi.org/10.1186/cc7984>
- Global First Aid Reference Center.** (2020). *First aid education for children* https://www.globalfirstaidcentre.org/wp-content/uploads/2021/02/EN_GFARC_GUIDELINES_2020.pdf
- Gräsner, J. T., Herlitz, J., Koster, R. W., Rosell-Ortiz, F., Stamatakis, L., & Bossaert, L.** (2011). Quality management in resuscitation—Towards a European cardiac arrest registry (EuReCa). *Resuscitation*, 82(8), 989–994. DOI: <https://doi.org/10.1016/j.resuscitation.2011.02.047>
- Hori, S., Suzuki, M., Yamazaki, M., Aikawa, N., & Yamazaki, H.** (2016). Cardiopulmonary Resuscitation training in schools: A comparison of trainee satisfaction among different age groups. *The Keio Journal of Medicine*, 65(3), 49–56. DOI: <https://doi.org/10.2302/kjm.2015-0009-OA>
- Jones, I., Whitfield, R., Colquhoun, M., Chamberlain, D., Vetter, N., & Newcombe, R.** (2007). At what age can schoolchildren provide effective chest compressions? An observational study from the Heartstart UK schools training programme. *BMJ: British Medical Journal*, 334(7605), 1201. DOI: <https://doi.org/10.1136/bmj.39167.459028.DE>
- Kitamura, T., Nishiyama, C., Murakami, Y., Yonezawa, T., Nakai, S., Hamanishi, M., Marukawa, S., Sakamoto, T., & Iwami, T.** (2016). Compression-only CPR training in elementary schools and student attitude toward CPR. *Pediatrics International: Official Journal of the Japan Pediatric Society*, 58(8), 698–704. DOI: <https://doi.org/10.1111/ped.12881>
- Li, H., Shen, X., Xu, X., Wang, Y., Chu, L., Zhao, J., Wang, Y., Wang, H., Xie, G., Cheng, B., Ye, H., Sun, Y., & Fang, X.** (2018). Bystander cardiopulmonary resuscitation training in primary and secondary school children in China and the impact of neighborhood socioeconomic status: A prospective controlled trial. *Medicine*, 97(40), e12673. DOI: <https://doi.org/10.1097/MD.00000000000012673>
- Lubrano, R., Romero, S., Scoppi, P., Cocchi, G., Baroncini, S., Elli, M., Turbacci, M., Scateni, S., Travasso, E., Benedetti, R., Cristaldi, S., & Moscatelli, R.** (2005). How to become an under 11 rescuer: A practical method to teach first aid to primary schoolchildren. *Resuscitation*, 64(3), 303–307. DOI: <https://doi.org/10.1016/j.resuscitation.2004.09.004>
- Lukas, R.-P., Van Aken, H., Möllhoff, T., Weber, T., Rammert, M., Wild, E., & Bohn, A.** (2016). Kids save

lives: A six-year longitudinal study of schoolchildren learning cardiopulmonary resuscitation: Who should do the teaching and will the effects last? *Resuscitation*, 101, 35–40. DOI: <https://doi.org/10.1016/j.resuscitation.2016.01.028>

Müller-Jung, J. (2014, June 30). Kultusminister-Beschluss: Wiederbelebung wird Schulstoff [Minister of Education and Cultural Affairs: Resuscitation becomes a teaching unit] In German. *FAZ.NET*. <https://www.faz.net/aktuell/gesellschaft/gesundheit/wiederbelebung-wird-schulstoff-13018801.html>

Olasveengen, T. M., Semeraro, F., Ristagno, G., Castren, M., Handley, A., Kuzovlev, A., Monsieurs, K. G., Raffay, V., Smyth, M., Soar, J., Svavarsdottir, H., & Perkins, G. D. (2021). European Resuscitation Council Guidelines 2021: Basic Life Support. *Resuscitation*, 161, 98–114. DOI: <https://doi.org/10.1016/j.resuscitation.2021.02.009>

Petrić, J., Malički, M., Marković, D., & Meštrović, J. (2013). Students' and parents' attitudes toward basic life support training in primary schools. *Croatian Medical Journal*, 54(4), 376–380. DOI: <https://doi.org/10.3325/cmj.2013.54.376>

Plant, N., & Taylor, K. (2013). How best to teach CPR to school children: A systematic review. *Resuscitation*, 84(4), 415–421. DOI: <https://doi.org/10.1016/j.resuscitation.2012.12.008>

Rücker, G., Schubert, J., Scheeren, T., & Nöldge-Schomburg, G. (2010, March 19). Wiederbelebungsinstruktion bei Schülern:

Ab der siebten Klasse sinnvoll [Resuscitation lessons in schools: Reasonable for students grade 7 and older]. In German. *Dtsch Arztebl* 2010; 107(11): A 492–3. <https://www.aerzteblatt.de/archiv/70015/Wiederbelebungsinstruktion-bei-Schuelern-Ab-der-siebten-Klasse-sinnvoll>

Uray, T., Lunzer, A., Ochsenhofer, A., Thanikkel, L., Zingerle, R., Lillie, P., Brandl, E., & Sterz, F. (2003). Feasibility of life-supporting first-aid (LSFA) training as a mandatory subject in primary schools. *Resuscitation*, 59(2), 211–220. DOI: [https://doi.org/10.1016/S0300-9572\(03\)00233-8](https://doi.org/10.1016/S0300-9572(03)00233-8)

Weidenauer, D., Hamp, T., Schriefl, C., Hlaubek, C., Gattinger, M., Krammel, M., Winnisch, M., Weidenauer, A., Mundigler, G., Lang, I., Schreiber, W., Sterz, F., Herkner, H., & Domanovits, H. (2018). The impact of cardiopulmonary resuscitation (CPR) manikin chest stiffness on motivation and CPR performance measures in children undergoing CPR training—A prospective, randomized, single-blind, controlled trial. *PLOS ONE*, 13(8), Article e0202430. DOI: <https://doi.org/10.1371/journal.pone.0202430>

Yasunaga, H., Miyata, H., Horiguchi, H., Tanabe, S., Akahane, M., Ogawa, T., Koike, S., & Imamura, T. (2011). Population density, call-response interval, and survival of out-of-hospital cardiac arrest. *International Journal of Health Geographics*, 10, 26. DOI: <https://doi.org/10.1186/1476-072X-10-26>

TO CITE THIS ARTICLE:

Humbsch, P., Gintrowicz, R., Dietrich, A., Weckwerth, J., Schultze-Berndt, C., Nasert, A., Dolabella, R., Kehlert, J., Keil, K. C., Bohm, K., Schmöche, S., Icke, K., & Keil, T. (2023). Evaluation of a 2-day First Aid Course Including Basic Resuscitation With 1,268 Primary School Children Aged 6–13 Years – A Multicenter Intervention Study. *International Journal of First Aid Education*, 6(1), 1–15. DOI: <https://doi.org/10.25894/ijfae.6.1.11>

Submitted: 19 November 2022

Accepted: 04 March 2023

Published: 22 March 2023

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