BMJ Open

School teachers are able to teach first aid to children younger than 6 years: randomized study.

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2014-005848
Article Type:	Research
Date Submitted by the Author:	03-Jun-2014
Complete List of Authors:	AMMIRATI, Christine; University Hospital of Amiens, Active Teaching and Health Simulation Training Center (CPA-SimUSanté©) GAGNAYRE, Rémi; University Paris 13, Sorbonne Paris Cité, Laboratory Education and Health Practices, EA3412 AMSALLEM, Carole; University Hospital of Amiens, Active Teaching and Health Simulation Training Center (CPA-SimUSanté©) NEMITZ, Bernard; University Hospital of Amiens, Active Teaching and Health Simulation Training Center (CPA-SimUSanté©) GIGNON, Maxime; Active Teaching and Health Simulation Training Center (CPA-SimUSanté©), ; University Paris 13, Sorbonne Paris Cité, Laboratory Education and Health Practices, EA3412 , France, Laboratory Education and Health Practices, EA3412
Primary Subject Heading:	Public health
Secondary Subject Heading:	Emergency medicine, Medical education and training, Public health
Keywords:	EDUCATION & TRAINING (see Medical Education & Training), Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PRIMARY CARE, PUBLIC HEALTH

School teachers are able to teach first aid to children younger than 6 years: randomized study.

Short title: Emergency first aid training for children

Christine Ammirati[a, b, c], Rémi Gagnayre[b], Carole Amsallem[a, c], Bernard Némitz[a], Maxime Gignon[b, c, d]

[a] Emergency Medicine Department, University Hospital of Amiens, France

[b] University Paris 13, Sorbonne Paris Cité, Laboratory Education and Health Practices, EA3412 Bobigny, France

[c] Active Teaching and Health Simulation Training Center (CPA-SimUSanté©), Amiens, France

[d] Public Health department, University Hospital of Amiens, France

Contributorship Statement

CA: conception of the work, analyse, draft, revising it critically for important intellectual content and final approval

RG : conception of the work, analyse, draft, revising it critically for important intellectual content and final approval

CA : interpretation of data, revising critically for important intellectual contentand final approval

BN : interpretation of data, revising critically for important intellectual contentand final approval

MG : interpretation of data, draft, revising it critically for important intellectual content and final approval

Address correspondence to:

Pr. Christine AMMIRATI, MD, PhD

Professor

CHU d'Amiens

Service de médecine d'urgence

Place Victor Pauchet

F-80000 Amiens

Phone: +33 3 22 66 84 60

Fax: +33 3 22 66 87 13

E-mail: christine.ammirati@chu-amiens.fr

Keywords: Education, Child, Preschool, Educational Measurement, first aid, Schools.

Word count : 2 605

ABSTRACT

BACKGROUND. Emergency medicine societies recommend teaching first aid at school. This study was designed to assess the skills acquired by very young children (< 6 years) trained by their own teachers at nursery school. **METHODS.** This prospective randomized study assessed the effect of training under the age of 6 years (cohort C1) compared with a group of age-matched untrained children (cohort C2). School teachers of cohort C1 were trained by emergency medical teams to perform basic first aid. The test involved observing and describing three pictures and use of the phone to call the medical emergency center. Assessment of each child was based on nine criteria, and was performed by teachers 2 months after completion of first aid training. **RESULTS.** 285 pupils: 140 trained and 145 untrained. For all criteria, the majority of trained pupils gave the expected answers and reacted appropriately in assessing the situation and alerting emergency services (55.7−89.3% according to the questions). Comparison of the two groups revealed a significantly greater

ability of trained pupils to describe an emergency situation ($p<0.005$) and raise the alert ($p<0.0001$). **CONCLUSIONS.** This study shows the ability of very young children to assimilate basic skills as taught by their own school teachers.

Keywords: Education, Child, Preschool, Educational Measurement, first aid, Schools.

"Strengths and limitations of this study"

- Emergency medicine societies recommend teaching first aid at school but conclusions cannot be drawn about which first-aid training courses or programmes are most effective or the age at which training can be most effectively provided. This study was designed to assess the skills acquired by very young children (< 6 years) trained by their own teachers at nursery school.
- Our study demonstrated that first aid programs given to very young children may improve their ability to assess and describe an emergency medical situation and alert the emergency medical call centre.
- This study supports the current general implementation of this training course in all French schools. This program is now compulsory and begins with children aged 4 to 6 years.
- Any correlation between the simulation used here and how children would react in a real life emergency can not be known

INTRODUCTION

In a medical emergency, it is essential for the first witness to raise the alert and provide emergency first aid as soon as possible. Many experts now recommend training children as early as primary school to ensure that these skills are deeply and permanently ingrained. Emergency medicine societies recommend teaching first aid at school so that every citizen knows how to perform first aid appropriately and raise emergency alerts at the earliest possible time. [1-5] A recent systematic review highlighted that conclusions cannot be drawn about which first-aid training courses or programmes are most effective or the age at which training can be most effectively provided. [6]

To date, studies on emergency first aid training at school have focused on children aged 6 years or older, often trained by first aid instructors. [7-19] This report presents the results of a pilot study involving children aged 6 years or younger who were trained in first aid by their own teacher without the presence of first aid instructors. This study, carried out in this department (560,000 inhabitants), was supervised by the University Hospital emergency medicine department, teachers of national education system, and a University research unit specialized in health education.

METHODS

A program was initially developed to train teachers in basic first aid to deal with an emergency situation. The most common emergency situations occurring in elementary schools were used to design this program. In this department, 2,200 out of a total of 3,300 elementary school teachers have been trained by emergency medical teams, assisted by health professionals from the Ministry of Education since 2002. During a 6-hour training session, the teachers learned when to alert the medical call center and how to act when faced with trauma,

burns, bleeding, a choking victim, or an unconscious person. After training, the teachers had to integrate specific skills into various subjects of the curriculum, depending on the learning pace of the class. The children's psychological, cognitive, and moral development was taken into account when setting up the course. The principle of the course is to plan a yearly increase in complexity, allowing the revision of acquired skills and the learning of new skills. [20-22] Young children in nursery schools should be able to recognize an "unusual" situation and alert the medical emergency call centre. To do so, they need to dial the emergency medical number (Phone: 15, SAMU in France), describe what they have observed, and name the various parts of the human body. Children aged between 6 and 8 years must be able to alert the SAMU by precisely locating the event. They must be able to describe injuries and perform simple tasks to deal with a burn, a bleeding wound or trauma. Children aged between 9 and 11 years must be able to recognize an unconscious patient, determine the presence of breathing and place the unconscious person on the side. They learn how to assist a person who is choking and perform chest compression and defibrillation in the case of cardiac arrest in secondary education. The progression of the child's abilities during the curriculum was assessed in our department. The aims of this first study were to assess the abilities of very young children trained in the nursery by their own teacher and to compare these results with those of age-matched untrained children.

Participants

In nursery schools in this area, some children were trained by their teachers, while others were not, because their teachers did not wish to train them or were not trained themselves. This study was accepted by the department section of the Ministry of Education. This department section of the Ministry of Education designated part of the department to participate in this study (80 schools, n= 1,360 pupils). Eighteen classes comprising 315 pupils were randomly selected: nine classes of trained pupils and nine classes of untrained pupils. The untrained

pupils had never received any first aid education. The families gave their consent to this study.

Instrumentation

The children's ability to observe pictures, and then to use a telephone to give an alert were assessed. Three pictures showed three different situations, one of which did not require alerting the SAMU:

- A boy who has fallen off a stepladder and who is holding his leg (Figure 1).
- A young girl crying because she has broken her doll (Figure 2).
- A young boy who has injured his hand while peeling an apple (Figure 3).

The following questions were asked in relation to each picture to test the pupil's ability to observe, and decide whether or not to raise an alert. The questions were: "*What is happening?"* and *"You are alone with him (her), nobody is here to help you, what would you do?"* The answers were classified into two categories: "expected answer" (with key-words or synonyms) or "other answer".

The expected answer in relation to the first picture was: *"He has fallen over, his leg hurts"*. The expected answer in relation to the second picture was: *"She has broken her doll and is crying"* and the expected answer in relation to the third photograph was *"He has cut himself, he is bleeding"*. The child was required to *"alert the SAMU"* for the first and third situations The teacher then tested the pupil's ability to alert the SAMU in relation to the third picture. The teacher gave the children access to a standard landline telephone, playing the role of the SAMU emergency doctor. The teacher's instructions were**:** *"You see, he has cut himself, he is bleeding. You are alone at home with him, the SAMU must be alerted, do it!"* The assessment of the child's reaction was binary: did or did not. The three criteria were;

- using the telephone;
- introducing himself, explaining where he is;

- describing the situation.

The pictures had been previously tested on two classes (not included in this study).

Procedure

In order to obtain the most objective results possible, written instructions were given and discussed individually with each teacher approximately 2, 3 months after completion of first aid training. Each pupil was assessed by his/her own teacher.

Data Analysis

To ensure anonymous grids, the results were collected by Ministry of Education staff. The researchers did not have access to personal data from children. Only fully completed assessments were analyzed. Data were presented as percentages with 95% confidence intervals (95% CI). Statistical analysis of the results was performed using a Chi-square test (significance level: p <0.05). analyses were performed using the Statistical Package for the Social Sciences (version 11.0, SPSS, Inc).

RESULTS

For the overall analysis, 315 pupils were prospectively evaluated, 285 with complete grids were included: 140 trained children (cohort C1) and 145 untrained children (cohort C2) (Figure 4). The sex ratio (male/female) was 0.94 and the mean age was 5.4 years.

Only 68 children in cohort C2 were tested for their use of the telephone, as some teachers decided not to complete this assessment, which they considered to be time-consuming and fastidious.

Children's ability to observe pictures, describe the situation and raise the alert (Table 1).

The majority of trained pupils was able to describe the three pictures and gave the expected answers (67.9%, 71.4% and 75.7%, respectively). The ability to observe and describe the

situation was significantly higher in cohort C1 for the three pictures ($p<0.001$ for the first and second pictures and $p<0.01$ for the third picture).

Table 1. Results: Children's ability to observe pictures

Exercise	Question	C1 cohort % of expected answers (n=140)	C2 cohort % of expected answers (n=145)	Odds ratio	*p*
Photograph 1	What is going on? *He has fallen over, his leg hurts*	67.9% (95)	45.5% (66)	2.5	<0.001
	You are alone at home, what do you do? *I call the SAMU*	62.1% (87)	8.3% (12)	18.2	<0.0001
Photograph 2	What is going on? *She has broken her doll and is crying*	71.4% (100)	41.4% (60)	3.5	<0.0001
	You are alone at home, what do you do? *I do not call the SAMU*	75% (105)	75.9% (110)	-	0.24 NS
Photograph 3	What is going on? *He has cut himself, he is bleeding*	75.7% (106)	60.0% (87)	2.8	0.01
	You are alone at home, what do you do? *I call the SAMU*	66.4% (93)	13.8% (20)	12.4	<0.0001

When the SAMU had to be alerted, the majority of trained pupils were willing to raise the alert.

A marked difference was observed between the two cohorts in terms of alerting the SAMU, which was significantly higher in cohort C1 ($p<0.0001$). In relation to the first picture, 61.9% of children in cohort C2 were willing to help the injured child after the picture had been explained to them, but did not know who to alert (73.8% for the third picture). Note that 23% of pupils in cohort C1 and 43.8% of pupils in cohort C2 misinterpreted picture 2 and the intention to act was not significantly different between the two groups (to help or comfort the girl) (Table 1).

Simulation exercise with a telephone using the third picture.

This exercise involved the 140 trained children of cohort C1 and 68 children of the cohort C2. Overall, 55.7% pupils of cohort C1 knew how to use the telephone correctly and how to call the SAMU (vs. 17.7% of children in cohort C2; $p <0.0001$) (Table 2), and 82.1% of children in cohort C1 gave their first name, last name and personal address (vs. 33.8% of C2; $p <0.0001$) (Table 2). Lastly, 89.3% of children in cohort C1 correctly described the situation using the keywords “cut”,” hand”, “blood” (vs. 75% of C2; $p <0.01$) (Table 2).

Table 2. Results: Simulation exercise with a telephone

Exercise	Criteria	C1 cohort % of expected answers (n=140)	C2 cohort % of expected answers (n=68)	Odds ratio	*p*
Use of the telephone	1 - Using the telephone	55.7% (78)	17.7% (12)	5.9	<0.0001
	2 - Introducing oneself, Explaining the location	82.1% (115)	33.8% (23)	9	<0.0001
	3 - Describing the situation	89.3% (125)	75% (51)	2.8	0.01

DISCUSSION

For all criteria, the majority of trained pupils gave expected answers and presented an appropriate reaction to the situation by recognizing the medical problem and appropriately raising the alert. Comparison of the two cohorts revealed significant differences in terms of the ability of pupils to describe an emergency situation and raise the alert.

Observation capacity

The situation shown in each picture had not been previously raised or discussed in class. The teachers were not aware of the assessment methods used and therefore could not have prepared their pupils beforehand. A significant difference was observed between the two

cohorts, reflecting the existence of cognitive links between the test situations. The vast majority of trained pupils spontaneously gave expected answers without prompting from their teacher, making this result even more relevant. The results related to the non-emergency situation (young girl with a broken doll) showed that the observation capacity of trained pupils was significantly better than that of untrained pupils. The teachers of the trained cohort may have more generally emphasized observation capacities, as an emergency call to the SAMU (or to an adult) required an oral description of the situation. It is difficult to define this aspect from these results alone: it would be interesting to test these capacities with other assessments comprising less obvious situations.

Intention to alert the SAMU

A marked significant difference was observed between the two cohorts in the two situations in which the SAMU had to be alerted. This study can be compared with Bollig's study in which the same ability was assessed. [19] Despite the obvious willingness of untrained children to help, they did not know which number to dial or what role the SAMU played. It is noteworthy that trained pupils did not associate the picture of a broken doll with the need to alert emergency services as they were able to differentiate the various situations.

Ability to raise the alert

Overall, trained pupils felt more confident than their untrained counterparts. Although two-thirds of trained pupils intended to call the SAMU in a medical emergency situation, only about one half of them really knew how to call the SAMU with a landline. However, as a result of age-related psychological and cognitive maturity, the child's comprehension and the intention to take a particular action may not be automatically linked.

This difference between intention and ability to act shows that learning methods must be based on real-life situations and must be regularly revised.

Integrating a first aid course in the curriculum

It was considered important for teachers to learn first aid in so that they can subsequently teach first aid to their pupils at school as part of the class' "daily life education". In contrast with first aid training provided by external instructors, teachers know their pupils. They can plan emergency first aid training along with other topics and assess the children in different ways. Finally, the teachers' active part in "role-playing games", placing the child in a situation for which he/she is responsible for somebody else's health, appears to be a more efficient method to acquire complex skills.

Limitations

Our study has bias. Only 48% of the untrained children (C2) were tested on their use of the telephone. The main bias is the fact that some teachers acted outwith the study protocol leading to incomplete data capture for some aspects of the study. It highlights the difficulties of working with teachers who are sometimes unwilling to comply with study protocols.

Although the instructions were explained to all teachers, they may presented differences in terms of their evaluation and interpretation of these instructions. The pictures had been previously tested on two classes, but interpretation of the pictures may nevertheless have been biased. As this study was based exclusively on pictures, it would be interesting to include the observation of videos or "role-playing games". A size difference was also observed between the two cohorts for the last exercise.

As this is the first assessment of its kind, we limited ourselves to a global assessment and did not take into account variables such as gender, class atmosphere, or family background.

Finally, there are limitations of simulations. Any correlation between the simulation used here and how children would react in a real life emergency can not be known.

Prospects

In collaboration with the Ministry of Education, we discussed the possibility of increasing the complexity of the exercises on a yearly basis, which would enable revision of acquired skills and learning of new skills. [22] Assessment of pupils at the end of elementary school and in secondary school will be the subject of other studies in our department.

To adapt this training to the children's psychological and physical development, pupils at the end of elementary school were taught which behavior to adopt when faced with an unconscious person who is still breathing [Table 3]. Cardiac arrest was not addressed until high school in line with Bollig's propositions. [19] In order to meet public health requirements, emergency first-aid training is now a compulsory part of the national curriculum in France. Today, all trainee school teachers must learn basic first aid to be applied in the class and to be taught to their pupils. More than 9,875,000 school children ranging from 4-year-old nursery school pupils to end of secondary school teenagers about 14 to 15 years of age have received this first aid training. This program is called is "*apprendre à porter secours*" ("learn how to help") and pupils can obtain a "basic-life saving diploma" at the end of secondary school.

Table 3 Skills/Age in the French curriculum

	Nursery school	Primary school		Secondary school	
Skills/ Age	Age 4 - 6 years	Age 6 - 8 years	Age 8 – 11 years	Age 11 – 12 years	Age 12 – 15 years
Alert - Recognize an emergency medical situation - Stay in a safe place - Tell an adult - Alert an emergency medical center					
Trauma - Recognize a burn - Place the burned part under running water - Recognize an injury to the head, limb or spine - Avoid mobilization of the injured part - Recognize bleeding - Stop bleeding					
Consciousness					

- Recognize an unconscious person - Turn on the side					
Breathing - Look, listen and feel for breathing					
- Assist the person who is choking - Perform mouth to mouth*					
Circulation - Recognize a cardiac arrest - Administer chest compressions - Use automatic external defibrillator					

	Skill introduced
	Skill reinforced
	Skill acquired

IMPLICATIONS

The challenge of enabling everyone to give life-saving first aid when faced with a medical emergency implies that everyone should be trained at some point in their life. The complexity of the training suggests that it should be started as early as possible in the educational curriculum.

The public health aim is that every pupil can learn first aid. To achieve this objective, school teachers must first acquire appropriate emergency skills in the classroom. The present study concerned children aged 6 years or younger attending nursery school, trained by their own teachers. It demonstrated that first aid programs given to very young children may improve their ability to assess and describe an emergency medical situation and alert the emergency medical call centre as necessary. The results of trained pupils were significantly better than those of untrained pupils. Furthermore, these untrained children did not appear to acquire these skills outside of school. These preliminary results demonstrate the advantages of integrating this first aid course into the national curriculum, mainly provided by teachers themselves. Since 2006, the assessments carried out by our team support the current general implementation of this training course in all French schools. This program is now compulsory and begins with children aged 4 to 6 years.

Acknowledgments

The authors are very grateful to Mrs Kerneur and Mrs Lagarde for their very helpful contribution to this research program (Ministry of National Education, France) and M. Jean-Michel Mercieca (Amiens University hospital) for his help.

Conflicts of Interest

The authors have indicated they have no financial and personal relationships with other people or organisations that could inappropriately influence this article.

Funding

None

Abbreviations: SAMU - Service d'aide médicale urgente; 95% CI - 95% confidence interval

REFERENCES

1. Guidelines for basic life support. A statement by the Basic Life Support Working Party of the European Resuscitation Council, 1992. *Resuscitation.* 1992;24:103-110.
2. American Academy of Pediatrics Committee on School Health. Basic life support training school. *Pediatrics.* 1993;91:158-159.
3. Lester CA, Weston CF, Donnelly PD, et al. The need for wider dissemination of CPR skills: are schools the answer? *Resuscitation.* 1994;28:233-237.
4. Eisenburger P, Safar P. Life supporting first aid training of the public--review and recommendations. *Resuscitation.* 1999;41:3-18.
5. Education in resuscitation: An ILCOR symposium: Utstein Abbey, Stavanger Norway.: June 2001. *Circulation* 2003; 108:2575-2594.
6. He Z1, Wynn P, Kendrick D. Non-resuscitative first-aid training for children and laypeople: a systematic review. *Emerg Med J.* 2013; 18. doi: 10.1136/emermed-2013-202389.
7. Lind B. Teaching resuscitation in primary schools. *Anaesthesist.* 1973;22:464-465.
8. Berkebile P, Benson D, Ersoz C, et al. Public education in heart-lung resuscitation. Evaluation of three self-training methods in teenagers. Proceedings of the National Conference on Standards for Cardiopulmonary Resuscitation and Emergency Cardiac Care. Dallas, TX: *American Heart Association;* 1975:13-23.
9. Vanderschmidt H, Burnap TK, Thwaites JK. Evaluation of a cardiopulmonary resuscitation course for secondary schools. *Med Care.* 1975;13:763-774.
10. Gardiner AW. Teaching first aid to children. *Br Med J.* 1977;2:1088.
11. Plotnikoff R. Retention of expired air resuscitation skills of sixth class students. *Environ Health Rev.* 1986;18:35-49.

12. Plotnikoff R, Moore PJ. Retention of cardiopulmonary resuscitation knowledge and skills by 11- and 12-year-old children. *Med J Aust.* 1989;150:296-302.

13. Lester C, Donnelly P, Weston C, et al. Teaching schoolchildren cardiopulmonary resuscitation. *Resuscitation.* 1996;31:33-38.

14. Lewis RM, Fulstow R, Smith GB. The teaching of cardiopulmonary resuscitation in schools in Hampshire. *Resuscitation.* 1997;35:27-31.

15. Bernardo LM, Doyle C, Bryn S. Basic emergency lifesaving skills (BELS): a framework for teaching skills to children and adolescents. *Int J Trauma Nurs.* 2002;8:48-50.

16. Uray T, Lunzer A, Ochsenhofer A, et al. Feasibility of life-supporting first aid (LSFA) training as a mandatory subject in primary schools. *Resuscitation.* 2003;59:211-220.

17. Lubrano R, Romero S, Scoppi P, et al. How to become an under 11 rescuers: a practical method to teach first aid to primary schoolchildren. *Resuscitation.* 2005;64:303-307.

18. Thurston M. Emergency life support training for school children: exploring local implementation and outcomes of the Heartstart UK School Programme within the context of the National Healthy School Standard. *Centre for Public Health Research, University of Chester, externally commissioned research reports,* 2005:1-86.

19. Bollig G, Walh H A, Svendsen MV. Primary school children are able to perform basic life-saving first aid measures, Resuscitation, 2009;80:689–692.

20. Kohlberg L. Moral stages and Moralization: The Cognitive-developmental Approach. In: Lickona T, eds. *Moral development and behavior: Theory, research, and social issues*. New-York, NY: Holt, Rinehart & Winston 1976:31-53.

21. Smith PL, Ragan TJ. Strategies for psychomotor skill learning. In: *Instructional Design*. 3rd ed. Chap. 15, Hoboken, NJ:Wiley 2005:276-283.

22. Bruner J. The process of education, Cambridge, MA: Harvard University Press 1960.

Photo 1 :

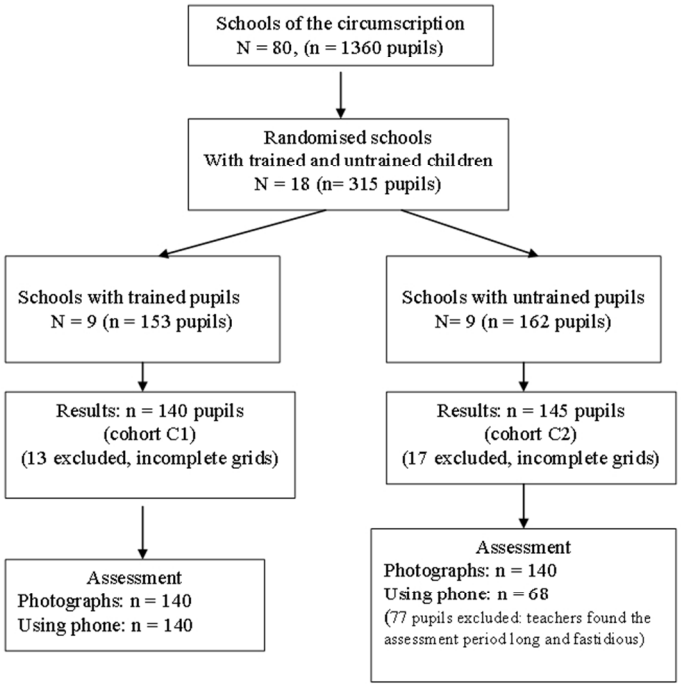
254x190mm (96 x 96 DPI)

Photo 2 :

254x190mm (96 x 96 DPI)

Photo 3 :

254x190mm (96 x 96 DPI)



254x190mm (96 x 96 DPI)

BMJ Open

Are schoolteachers able to teach first aid to children younger than 6 years?

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2014-005848.R1
Article Type:	Research
Date Submitted by the Author:	01-Aug-2014
Complete List of Authors:	AMMIRATI, Christine; University Hospital of Amiens, Active Teaching and Health Simulation Training Center (CPA-SimUSanté©) GAGNAYRE, Rémi; University Paris 13, Sorbonne Paris Cité, Laboratory Education and Health Practices, EA3412 AMSALLEM, Carole; University Hospital of Amiens, Active Teaching and Health Simulation Training Center (CPA-SimUSanté©) NEMITZ, Bernard; University Hospital of Amiens, Active Teaching and Health Simulation Training Center (CPA-SimUSanté©) GIGNON, Maxime; Active Teaching and Health Simulation Training Center (CPA-SimUSanté©), ; University Paris 13, Sorbonne Paris Cité, Laboratory Education and Health Practices, EA3412 , France, Laboratory Education and Health Practices, EA3412
Primary Subject Heading:	Public health
Secondary Subject Heading:	Emergency medicine, Medical education and training, Public health
Keywords:	EDUCATION & TRAINING (see Medical Education & Training), Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PRIMARY CARE, PUBLIC HEALTH

Are schoolteachers able to teach first aid to children younger than 6 years?

Short title: Emergency first aid training for children

Christine Ammirati[a, b, c], Rémi Gagnayre[b], Carole Amsallem[a, c], Bernard Némitz[a], Maxime Gignon[b, c, d]

[a] Emergency Medicine Department, University Hospital of Amiens, France

[b] University Paris 13, Sorbonne Paris Cité, Laboratory Education and Health Practices, EA3412 Bobigny, France

[c] Active Teaching and Health Simulation Training Centre (CPA-SimUSanté©), Amiens, France

[d] Public Health department, University Hospital of Amiens, France

Address correspondence to:

Prof. Christine AMMIRATI, MD, PhD

Professor

CHU d'Amiens

Service de médecine d'urgence

Place Victor Pauchet

F-80000 Amiens

Phone: +33 3 22 66 84 60

Fax: +33 3 22 66 87 13

E-mail: christine.ammirati@chu-amiens.fr

Keywords: Education, Child, Preschool, Educational Measurement, first aid, Schools.

Word count: 3 725

ABSTRACT

Objectives. This study was designed to assess the knowledge acquired by very young children (< 6 years) trained by their own teachers at nursery school. This comparative study assessed the effect of training before the age of 6 years compared with a group of age-matched untrained children.

Setting. Some schoolteachers were trained by emergency medical teams to perform basic first aid.

Participants. Eighteen classes comprising 315 pupils were randomly selected: nine classes of trained pupils (cohort C1) and nine classes of untrained pupils (cohort C2).

Primary and secondary outcome measures. The test involved observing and describing three pictures and using the phone to call the medical emergency centre. Assessment of each child was based on nine criteria, and was performed by the teacher 2 months after completion of first aid training.

Results. This study concerned 285 pupils: 140 trained and 145 untrained. The majority of trained pupils gave the expected answers for all criteria and reacted appropriately by assessing the situation and alerting emergency services (55.7–89.3% according to the questions). Comparison of the two groups revealed a significantly greater ability of trained pupils to describe an emergency situation ($p<0.005$) and raise the alert ($p<0.0001$).

Conclusions. This study shows the ability of very young children to assimilate basic skills as taught by their own schoolteachers.

"Strengths and limitations of this study"

- This study was designed to assess the knowledge and the ability to analyse situations acquired by very young children (< 6 years) trained by their own teachers at nursery school.
- This study demonstrated that first aid programmes for very young children can improve their ability to assess and describe a medical emergency situation and alert the medical emergency centre.
- As required by the French national education system, randomisation was performed *post hoc* by the Ministry of Education and the children's performance was assessed by their own teachers.
- No correlation can be established between the simulation used in this study and the way in which children would react in a real life emergency situation.

INTRODUCTION

In France, all trainee schoolteachers must learn basic first aid to be applied in the classroom and to be taught to their pupils. More than 9,875,000 school children ranging from 4-year-old nursery schoolchildren to end of secondary school teenagers, about 14 to 15 years of age, should receive this first aid training. This programme is called "*apprendre à porter secours*" ("learn how to help") and pupils can obtain a "basic-life saving diploma" at the end of secondary school. In a medical emergency, it is essential for the first witness to raise the alert and provide emergency first aid as soon as possible. First aid has been defined as help given to any "sick or injured person until professional help arrives". [1] The challenge of enabling everyone to provide life-saving first aid when faced with a medical emergency implies that everyone should be trained at some point in their life. The construction of knowledge and skills that can be easily mobilized in a medical emergency situation suggests that this training should be started as early as possible in the educational curriculum. The public health goal is that every pupil should learn first aid, as laypersons play an important role in saving lives in emergency situations. Many experts now recommend training children starting at primary school to ensure that these skills are deeply and permanently ingrained. Emergency medicine societies recommend teaching first aid at school so that every citizen knows how to perform first aid appropriately and raise emergency alerts at the earliest possible time. [2-6] Children can provide first aid measures and save lives by recognizing life-threatening emergency situations and by making an emergency call. [7] A young child may be the only person present in the event of an emergency and first aid education should therefore be started as early as feasible.

The age and weight of schoolchildren are significant factors determining the quality of cardiopulmonary resuscitation [8], as the depth of chest compression correlates with physical factors such as weight, Body Mass Index and height. [9] Abelairas-Gómez et al. showed that

thirteen years was the minimum age at which children are able to achieve a minimum CPR quality similar to that achieved by adults. [10] Young children who are not yet physically able to compress the chest can nevertheless be taught how to perform appropriate first aid, and can therefore . be the first link of the Chain of Survival by calling for help. [11]

Published studies on emergency first aid training at school have focused on children aged 6 years or older, often trained by first aid instructors. [12-24] A recent systematic review highlighted that no conclusions can be drawn concerning the most effective first-aid training courses or programmes or the age at which training can be most effectively provided. [25] It is important to assess the effectiveness of standardised first-aid training as a basis for policy development and provision of first-aid training. More evidence is required to determine the most appropriate types of training according to the child's age, taking into account the child's psychomotor development and degree of autonomy.

Very limited scientific literature is available concerning children under the age of 6 years. Studies on emergency first aid training at school have focused on children often trained by first aid instructors, while few studies have assessed emergency first aid training at school provided by teachers themselves.

However, there are a number arguments in favour of training provided by teachers, [26-29] as they know their pupils and their representations and can work on the basis of their previous knowledge and experience. Teachers are familiar with each child's sensitivity and can measure the emotional charge associated with emergency situations. The teacher establishes a relationship of trust with the child and can use situations experienced in the classroom as a pretext for learning and enhancing knowledge. The teacher is familiar with the required curriculum and skills. The teacher is a mentor, and the child is able to imitate the teacher's first aid skills.

The aims of this preliminary study were to assess the knowledge and abilities of very young children trained in the nursery by their own teacher and to compare the results with those of age-matched untrained children.

METHODS

This study, carried out in the Somme department (560,000 inhabitants), was supervised by the University Hospital emergency medicine department, national education teachers, and a University research unit specialised in health education. This study took place in "real life." Due to the importance of public health issue, we were required to adapt our research methodology to the national education system's educational, legal and ethical constraints.

Intervention

Training of teachers.

A programme was initially developed to train teachers in basic first aid to deal with an emergency situation. The most common emergency situations occurring in elementary schools were used to design this programme. In the Somme department, 2,200 of all 3,300 elementary schoolteachers have been trained by emergency medical teams, assisted by Ministry of Education health professionals since 2002. During a 6-hour training session, the teachers learned when to alert the medical call centre and how to act when faced with trauma, burns, bleeding, a choking victim, or an unconscious person. Teachers received first aid training to improve their prior knowledge and then worked on educational applications in the context of nursery schools. This training was conducted by emergency medical teams and education specialists, assisted by Ministry of Education health professionals.

Training of children by teachers.

After training, the teachers had to integrate specific skills into various subjects of the curriculum, depending on the learning pace of the class. The children's psychological, cognitive, and moral development was taken into account when setting up the course. The principle of the course is to plan a yearly increase in complexity, allowing the revision of acquired skills and the learning of new skills. [27-31] Young children in nursery schools should be able to recognize an "unusual" situation and alert the medical emergency call centre. To do so, they need to dial the emergency medical number (Phone: 15, SAMU in France), describe what they have observed, and name the various parts of the human body. Children aged between 6 and 8 years must be able to alert the SAMU by precisely locating the event. They must be able to describe injuries and perform simple tasks to deal with a burn, a bleeding wound or trauma. Children aged between 9 and 11 years must be able to recognize an unconscious patient, determine the presence of breathing and place the unconscious person on the side. They learn how to assist a person who is choking and perform chest compression and defibrillation in the case of cardiac arrest in secondary education. The progression of the child's abilities during the curriculum was assessed in the Somme department.

Teachers have introduced first aid knowledge and skills into the curriculum, suitable to the child's stage of psychological, cognitive, and emotional development, as recommended by experts in the education of young children. For example, when teaching basic anatomy, teachers addressed the issue of how to deal with trauma. The number of hours of training therefore cannot be assessed in the context of this educational approach adapted to young children.

Participants

Due to the requirements of the national education system, in nursery schools in this area, some children were trained by their teachers, while others were not, because their teachers did not wish to train them or were not trained themselves. This study was approved by the regional section of the Ministry of Education, which designated part of the region to participate in this study (80 schools, n=1,360 pupils). Eighteen classes comprising 315 pupils were randomly selected: nine classes of trained pupils and nine classes of untrained pupils (Figure 1). The untrained pupils had never received any first aid education. The families gave their consent to this study.

Instrumentation

The children's ability to observe pictures, and then to use a telephone to raise an alert were assessed. Three pictures illustrated three different situations, one of which did not require alerting the SAMU:

- A boy who has fallen off a stepladder and who is holding his leg (Figure 2).
- A young girl crying because she has broken her doll (Figure 3).
- A young boy who has injured his hand while peeling an apple (Figure 4).

Assessment of each child was based on nine criteria, and was performed by the teacher 2 months after completion of first aid training. These nine criteria consisted of answers to the following questions testing the child's ability to observe each picture and decide whether or not to raise an alert: "*What is happening?"* and *"You are alone with him (her), nobody is here to help you, what would you do?"* The answers were classified into two categories: "expected answer" (with key-words or synonyms) or "other answer".

The expected answer in relation to the first picture was: *"He has fallen over, his leg hurts"*. The expected answer in relation to the second picture was: *"She has broken her doll and is crying"* and the expected answer in relation to the third photograph was *"He has cut himself,*

he is bleeding". The child was required to *"alert the SAMU"* for the first and third situations The teacher then tested the pupil's ability to alert the SAMU in relation to the third picture. The teacher gave the children access to a standard landline telephone, playing the role of the SAMU emergency doctor. When the child did not use the telephone spontaneously, the teacher encouraged the child to do so. The teacher's instructions were**:** *"You see, he has cut himself, he is bleeding. You are alone at home with him, the SAMU must be alerted, do it!"*

The assessment of the child's reaction was binary: did or did not. The three criteria were;

- using the telephone;
- introducing himself, explaining where he is;
- describing the situation.

The pictures had been previously tested on two classes (not included in this study).

Procedure

The national education system required each child to be assessed by his/her own teacher because children of this age are not usually assessed, especially by an unknown adult not part of the classroom. In order to obtain the most objective results possible, written instructions were given and discussed individually with each teacher approximately 2 months after completion of first aid training.

Data Analysis

To ensure anonymous grids, the results were collected by Ministry of Education staff. For reasons of confidentiality required by the national education system, the researchers did not have access to personal data from children. Only fully completed assessments were analyzed. Data were presented as percentages with 95% confidence intervals (95% CI). Statistical analysis of the results was performed using a Chi-square test (significance level: p <0.05). analyses were performed using the Statistical Package for the Social Sciences (version 11.0, SPSS, Inc).

RESULTS

For the overall analysis, 315 pupils were prospectively evaluated, 285 with complete grids were included: 140 trained children (cohort C1) and 145 untrained children (cohort C2) (Figure 1). The sex ratio (male/female) was 0.94 and the mean age was 5.4 years.

Only 68 children in cohort C2 were tested for their use of the telephone, as some teachers decided not to complete this assessment, which they considered to be time-consuming and fastidious.

Children's ability to observe pictures, describe the situation and raise the alert (Table 1).

The majority of trained pupils were able to describe the three pictures and gave the expected answers (67.9%, 71.4% and 75.7%, respectively). The ability to observe and describe the situation was significantly higher in cohort C1 for the three pictures ($p<0.001$ for the first and second pictures and $p<0.01$ for the third picture).

Table 1. Results: Children's ability to observe pictures

Exercise	**Question** & *- Expected answers*	**C1 cohort % of expected answers (n=140)**	**C2 cohort % of expected answers (n=145)**	**Odds ratio**	***P value***
Photograph 1	What is going on? *- He has fallen over, his leg hurts (criterion 1)*	67.9% (95)	45.5% (66)	2.5	<0.001

	You are alone at home, what do you do? *-I call the SAMU (criterion 2)*	62.1% (87)	8.3% (12)	18.2	<0.0001
Photograph 2	What is going on? *- She has broken her doll and is crying (criterion 3)*	71.4% (100)	41.4% (60)	3.5	<0.0001
	You are alone at home, what do you do? *- I do not call the SAMU (criterion 4)*	75% (105)	75.9% (110)	-	0.24
Photograph 3	What is going on? *- He has cut himself, he is bleeding (criterion 5)*	75.7% (106)	60.0% (87)	2.8	0.01
	You are alone at home, what do you do? *- I call the SAMU (criterion 6)*	66.4% (93)	13.8% (20)	12.4	<0.0001

When the SAMU had to be alerted, the majority of trained pupils were willing to raise the alert.

A marked difference was observed between the two cohorts in terms of alerting the SAMU, which was significantly higher in cohort C1 ($p<0.0001$). In relation to the first picture, 61.9%

of children in cohort C2 were willing to help the injured child after the picture had been explained to them, but did not know who to alert (73.8% for the third picture). Note that 23% of pupils in cohort C1 and 43.8% of pupils in cohort C2 misinterpreted picture 2 and the intention to act was not significantly different between the two groups (to help or comfort the girl) (Table 1).

Simulation exercise with a telephone using the third picture.

This exercise involved the 140 trained children of cohort C1 and 68 children of the cohort C2. Overall, 55.7% pupils of cohort C1 knew how to use the telephone correctly and how to call the SAMU (vs. 17.7% of children in cohort C2; $p < 0.0001$) (Table 2), and 82.1% of children in cohort C1 gave their first name, last name and personal address (vs. 33.8% of C2; $p < 0.0001$) (Table 2). Lastly, 89.3% of children in cohort C1 correctly described the situation using the keywords “cut”,” hand”, “blood” (vs. 75% of C2; $p < 0.01$) (Table 2).

Table 2. Results: Simulation exercise with a telephone

Exercise	Criteria	C1 cohort % of expected answers (n=140)	C2 cohort % of expected answers (n=68)	Odds ratio	*p*
Use of the phone	1 - Using the telephone *(criterion 7)*	55.7% (78)	17.7% (12)	5.9	<0.0001
	2 - Introducing oneself, Explaining the location*(criterion 8)*	82.1% (115)	33.8% (23)	9	<0.0001
	3 - Describing the situation*(criterion 9)*	89.3% (125)	75% (51)	2.8	0.01

DISCUSSION

For all criteria, the majority of trained pupils gave expected answers and presented an appropriate reaction to the situation by recognizing the medical problem and appropriately raising the alert. Comparison of the two cohorts revealed significant differences in terms of the ability of pupils to describe an emergency situation and raise the alert.

Observation capacity

The situation shown in each picture had not been previously raised or discussed in class. The teachers were not aware of the assessment methods used and therefore could not have prepared their pupils beforehand. A significant difference was observed between the two cohorts, reflecting the existence of cognitive links between the test situations. The vast majority of trained pupils spontaneously gave expected answers without prompting from their teacher, making this result even more relevant. The results related to the non-emergency

situation (young girl with a broken doll) showed that the observation capacity of trained pupils was significantly better than that of untrained pupils. The teachers of the trained cohort may have more generally emphasized observation capacities, as an emergency call to the SAMU (or to an adult) required an oral description of the situation. It is difficult to define this aspect from these results alone: it would be interesting to test these capacities with other assessments comprising less obvious situations.

The situations described in the pictures focused on trauma and injuries, which correspond to common situations encountered by children. [32-34] Many emergencies in western countries deal with acute emergencies in the field of internal medicine (heart attack, stroke, etc.) but, education experts from the Ministry of Education thought that it would be too emotionally disturbing for a young child to be faced with an adult in a life-threatening situation and therefore proposed that young children should act out situations involving injured children.

Intention to alert the SAMU

A highly significant difference was observed between the two cohorts in the two situations in which the SAMU had to be alerted. This study can be compared with Bollig's study in which the same ability was assessed. [24] Despite the obvious willingness of untrained children to help, they did not know which number to dial or what role the SAMU played. It is noteworthy that trained pupils did not associate the picture of a broken doll with the need to alert emergency services as they were able to differentiate the various situations.

Ability to raise the alert

Overall, trained pupils felt more confident than their untrained counterparts. Although two-thirds of trained pupils intended to call the SAMU in a medical emergency situation, only about one half of them really knew how to call the SAMU with a landline. However, as a

result of age-related psychological and cognitive maturity, the child's comprehension and the intention to take a particular action may not be automatically linked.

This difference between intention and ability to act shows that learning methods must be based on real-life situations and must be regularly revised.

Integrating a first aid course in the curriculum

In a pilot study of 10 children, Bollig et al. showed that kindergarten children aged 4-5 years can learn basic first aid with training provided by a first aid instructor and kindergarten teachers. [30] The results of the present study support training by teachers themselves. It was considered important for teachers to learn first aid in order to be subsequently able to teach first aid to their pupils at school as part of "daily life education". In contrast with first aid training provided by external instructors, teachers know their pupils. They can plan emergency first aid training along with other topics and assess the children in different ways. Finally, the teachers' active participation in "role-playing games", placing the child in a situation in which he/she is responsible for somebody else's health, appears to be a more efficient method to acquire complex skills, according to the concept of situated learning. [31]

Teacher training lasted 6 hours. Our experience and an unpublished evaluation suggest that a 6-hour training course is sufficient. Teachers have satisfactory prior first aid knowledge and are trained in science education. This 6-hour training upgraded their knowledge and helped them to integrate first aid training in the curriculum. The effectiveness of this training needs to be evaluated and further studies are required to define the optimal design.

Limitations

This study has several limitations. Randomisation was not performed before setting up the study, but was performed *post hoc* by the Ministry of Education, at their request for ethical reasons, as the Ministry of Education refused the idea of predefining two groups with and without first aid training. A consensus therefore had to be found to randomly select classes

receiving and not receiving first aid training. Assessment of the children's performance by their own teachers could constitute a bias in favour of the trained group. As explained in the Methods section, the national education system required each child to be assessed by his/her own teacher because children of this age are not usually assessed, especially by an unknown adult not part of the classroom. It would be interesting to investigate differences between schoolteacher and first aid instructor interventions during a limited training period, as teachers integrate specific skills into various subjects of the curriculum, depending on the learning pace of the class. In addition, some teachers decided not to perform this assessment, which they considered to be "time-consuming and fastidious". This study was conducted under "real life" conditions. We had to adapt our research methodology to the educational, legal and ethical requirements of the French national education system.

Our study presents a number of biases. Use of the telephone was tested in only 48% of untrained children (C2) . The main bias is that some teachers failed to comply with the study protocol, leading to incomplete data collection for certain aspects of the study, highlighting the difficulties of working with teachers who are sometimes unwilling to comply with study protocols.

Although the instructions were explained to all teachers, evaluation and interpretation of these instructions may have differed between teachers. The pictures had been previously tested on two classes, but interpretation of the pictures may nevertheless have been biased. As this study was based exclusively on pictures, it would be interesting to include the observation of videos or "role-playing games". A size difference was also observed between the two cohorts for the last exercise.

As this is the first assessment of its kind, we confined ourselves to a global assessment and did not take into account variables such as gender, class atmosphere, or family background.

The child's knowledge and ability to analyse a situation from photographs were assessed. For practical reasons, as this assessment was performed by the teacher in each classroom, although it may have been preferable to assess the acquired skills in a role play situation, as performed by several authors. [24, 30] It could be difficult to ensure similar and reproducible scenarios in each school. Photographs were designed by teachers themselves and had been previously tested on a sample of 50 children not included in the present study. Another possibility would be to evaluate children in the context of a video or serious game.

Finally, simulations present a number of limitations. No correlation can be established between the simulation used in this study and the way in which children would react in a real life emergency situation.

Prospects

In collaboration with the Ministry of Education, we discussed the possibility of increasing the complexity of the exercises on a yearly basis, which would enable revision of acquired skills and learning of new skills. [25] Assessment of pupils at the end of elementary school and in secondary school will be the subject of other studies in our research unit.

To adapt this training to the children's psychological and physical development, pupils at the end of elementary school were taught which behaviour to adopt when faced with an unconscious person who is still breathing [Table 3]. Cardiac arrest was not addressed until high school in line with Bollig's propositions. [24, 35-36] In order to meet public health requirements, emergency first-aid training is now a compulsory part of the national curriculum in France.

Table 3 Skills / Age in the French curriculum

	Nursery school	Primary school		Secondary school	
Skills/ Age	Age 4 - 6 years	Age 6 - 8 years	Age 8 – 11 years	Age 11 – 12 years	Age 12 – 15 years
Alert - Recognize an emergency medical situation - Stay in a safe place - Tell an adult - Alert an emergency medical centre					
Trauma - Recognize a burn - Place the burned part under running water - Recognize an injury to the head, limb or spine - Avoid mobilization of the injured part - Recognize bleeding - Stop bleeding					
Consciousness					

- Recognize an unconscious person - Turn on the side					
Breathing - Look, listen and feel for breathing - Assist the person who is choking - Perform mouth to mouth*					
Circulation - Recognize a cardiac arrest - Administer chest compressions - Use automatic external defibrillator					

	Skill introduced
	Skill reinforced
	Skill acquired

IMPLICATIONS

The challenge of enabling everyone to give life-saving first aid when faced with a medical emergency implies that everyone should be trained at some point in their life. The complexity of the training suggests that this training should be started as early as possible in the educational curriculum.

The public health goal is that every pupil should learn first aid. To achieve this objective, schoolteachers must first acquire appropriate emergency skills in the classroom. The present study concerned children aged 6 years or younger attending nursery school, trained by their own teachers. It demonstrated that first aid programmes given to very young children may improve their ability to assess and describe a medical emergency situation and alert the medical emergency call centre as necessary. The results of trained pupils were significantly better than those of untrained pupils.

These preliminary results demonstrate the advantages of integrating this first aid course into the national curriculum, mainly provided by teachers themselves. Since 2006, the assessments carried out by our team support the current general implementation of this training course in all French schools. This programme is now compulsory starting at the age of 4 to 6 years.

Acknowledgements

The authors are very grateful to Mrs Kerneur and Mrs Lagarde (Ministry of National Education, France) for their very helpful contribution to this research and Mr. Jean-Michel Mercieca (Amiens University hospital) for his help.

Contributorship Statement

CA: conception of the work, analyse, draft, revising it critically for important intellectual content and final approval

RG: conception of the work, analyse, draft, revising it critically for important intellectual content and final approval

CA: interpretation of data, revising critically for important intellectual content and final approval

BN: interpretation of data, revising critically for important intellectual content and final approval

MG: interpretation of data, draft, revising it critically for important intellectual content and final approval

Competing interests

The authors have indicated they have no financial and personal relationships with other people or organisations that could inappropriately influence this article.

Funding

None

Data sharing

No additional data available

Abbreviations: SAMU - Service d'aide médicale urgente; 95% CI - 95% confidence interval

REFERENCES

1. IFRC. International first aid and resuscitation guidelines 2011. Geneva: International Federation of Red Cross and Red Crescent Societies, 2011.
2. Guidelines for basic life support. A statement by the Basic Life Support Working Party of the European Resuscitation Council, 1992. *Resuscitation.* 1992;24:103-110.
3. American Academy of Pediatrics Committee on School Health. Basic life support training school. *Pediatrics.* 1993;91:158-159.
4. Lester CA, Weston CF, Donnelly PD, et al. The need for wider dissemination of CPR skills: are schools the answer? *Resuscitation.* 1994;28:233-237.
5. Eisenburger P, Safar P. Life supporting first aid training of the public--review and recommendations. *Resuscitation.* 1999;41:3-18.
6. Education in resuscitation: An ILCOR symposium: Utstein Abbey, Stavanger Norway. June 2001. *Circulation* 2003;108:2575-2594.
7. C. Amsallem, C. Ammirati, M. Gignon, et al. Appel d'un enfant: rôle de la régulation médicale. In. Urgences 2011, Société Française de Médecine d'Urgences, 2011:1035-44.
8. Jones I, Whitfield R, Colquhoun M, et al. At what age can schoolchildren provide effective chest compressions? An observational study from the Heartstart UK schools training programme. *BMJ* 2007;334(7605):1201.
9. Plant N, Taylor K. How best to teach CPR to schoolchildren: a systematic review. *Resuscitation* 2013;84(4):415-21. doi: 10.1016/j.resuscitation.2012.12.008.
10. Abelairas-Gómez C, Rodríguez-Núñez A, Casillas-Cabana M, et al. Schoolchildren as life savers: at what age do they become strong enough? *Resuscitation* 2014;85(6):814-9. doi: 10.1016/j.resuscitation.2014.03.001.

11. Koster RW, Baubin MA, Bossaert LL, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 2. Adult basic life support and use of automated external defibrillators. Resuscitation. 2010;81(10):1277-92. doi: 10.1016/j.resuscitation.2010.08.009.
12. Lind B. Teaching resuscitation in primary schools. *Anaesthesist* 1973;22:464-465.
13. Berkebile P, Benson D, Ersoz C, et al. Public education in heart-lung resuscitation. Evaluation of three self-training methods in teenagers. Proceedings of the National Conference on Standards for Cardiopulmonary Resuscitation and Emergency Cardiac Care. Dallas, TX: *American Heart Association;* 1975:13-23.
14. Vanderschmidt H, Burnap TK, Thwaites JK. Evaluation of a cardiopulmonary resuscitation course for secondary schools. *Med Care.* 1975;13:763-774.
15. Gardiner AW. Teaching first aid to children. *Br Med J.* 1977;2:1088.
16. Plotnikoff R. Retention of expired air resuscitation skills of sixth class students. *Environ Health Rev.* 1986;18:35-49.
17. Plotnikoff R, Moore PJ. Retention of cardiopulmonary resuscitation knowledge and skills by 11- and 12-year-old children. *Med J Aust.* 1989;150:296-302.
18. Lester C, Donnelly P, Weston C, et al. Teaching schoolchildren cardiopulmonary resuscitation. *Resuscitation.* 1996;31:33-38.
19. Lewis RM, Fulstow R, Smith GB. The teaching of cardiopulmonary resuscitation in schools in Hampshire. *Resuscitation.* 1997;35:27-31.
20. Bernardo LM, Doyle C, Bryn S. Basic emergency lifesaving skills (BELS): a framework for teaching skills to children and adolescents. *Int J Trauma Nurs.* 2002;8:48-50.
21. Uray T, Lunzer A, Ochsenhofer A, et al. Feasibility of life-supporting first aid (LSFA) training as a mandatory subject in primary schools. *Resuscitation.* 2003;59:211-220.

22. Lubrano R, Romero S, Scoppi P, et al. How to become an under 11 rescuers: a practical method to teach first aid to primary schoolchildren. *Resuscitation.* 2005;64:303-307.

23. Thurston M. Emergency life support training for school children: exploring local implementation and outcomes of the Heartstart UK School Programme within the context of the National Healthy School Standard. *Centre for Public Health Research, University of Chester, externally commissioned research reports,* 2005:1-86.

24. Bollig G, Walh H A, Svendsen MV. Primary school children are able to perform basic life-saving first aid measures, *Resuscitation*, 2009;80:689–692.

25. He Z, Wynn P, Kendrick D. Non-resuscitative first-aid training for children and laypeople: a systematic review. *Emerg Med J.* 2013; 18. doi: 10.1136/emermed-2013-202389.

26. Tardif J. Pour un enseignement stratégique. L'apport de la psychologie cognitive. 2ème edition. Ed Logiques 1997.

27. Kohlberg L. Moral stages and Moralization: The Cognitive-developmental Approach. In: Lickona T, eds. *Moral development and behavior: Theory, research, and social issues*. New-York, NY: Holt, Rinehart & Winston 1976:31-53.

28. Smith PL, Ragan TJ. Strategies for psychomotor skill learning. In: *Instructional Design*. 3rd ed. Chap. 15, Hoboken, NJ:Wiley 2005:276-283.

29. Bruner J. The process of education, Cambridge, MA: Harvard University Press 1960.

30. Bollig G, Myklebust AG, Østringen K. Effects of first aid training in the kindergarten--a pilot study. Scand J Trauma Resusc Emerg Med. 2011 Feb 28;19:13. doi: 10.1186/1757-7241-19-13.

31. Lave J, Wenger E. Situated Learning: Legitimate Peripheral Participation. Cambridge University Press. 1991.

32. Enquête Permanente sur les accidents de la vie courante. Résultats 2012. Institut de Veille Sanitaire, Saint Denis, 2012. http://www.invs.sante.fr/content/download/83774/306579/version/1/file/TR13G263_%28resultats_Epac2012%29.pdf (accessed 10 July 2014).

33. Principales causes de décès des jeunes et des enfants en 2011. Institut national de la statistique et des études économiques, 2011. http://www.insee.fr/fr/themes/tableau.asp?ref_id=NATCCJ06206&reg_id=0 (accessed 10 july 2014).

34. Philippakis A1, Hemenway D, Alexe DM, et al. A quantification of preventable unintentional childhood injury mortality in the United States. Inj Prev. 2004 Apr;10(2):79-82.

35. Bollig G. First Aid and the family. In: Craft-Rosenberg M, Pehler SR. Encyclopaedia of Family Health, SAGE Publications, Thousand Oaks 2011.

36. Bollig G. First Aid Training in the Kindergarten: A Review of the Literature and Reflections from Practical Experience in Two Countries. NOVA Science Publishers New York 2013.

Figure legends

Figure 1: Flowchart

Figure 2: Photograph 1. A Boy Who Has Fallen Off a Stepladder and Is Holding His Leg

Figure 3: Photograph 2. A Young Girl Crying Because She Has Broken Her Doll.

Figure 4: Photograph 3. A Young Boy Who Has Injured His Hand While Peeling An Apple.

Are ~~S~~school ~~-~~teachers ~~are~~ able to teach first aid to children younger than 6 years? ~~A "real life" study.: randomized study.~~

Short title: Emergency first aid training for children

Christine Ammirati[a, b, c], Rémi Gagnayre[b], Carole Amsallem[a, c], ~~–~~ Bernard Némitz[a], Maxime Gignon[b, c, d]

[a] Emergency Medicine Department, University Hospital of Amiens, France

[b] University Paris 13, Sorbonne Paris Cité, Laboratory Education and Health Practices, EA3412 Bobigny, France

[c] Active Teaching and Health Simulation Training Centre~~r~~ (CPA-SimUSanté©), Amiens, France

[d] Public Health department, University Hospital of Amiens, France

~~**Contributorship Statement**~~

~~CA: conception of the work, analyse, draft, revising it critically for important intellectual content and final approval~~

~~RG :: conception of the work, analyse, draft, revising it critically for important intellectual content and final approval~~

~~CA :: interpretation of data, revising critically for important intellectual content and final approval~~

~~BN :: interpretation of data, revising critically for important intellectual content and final approval~~

~~MG :: interpretation of data, draft, revising it critically for important intellectual content and final approval~~

Address correspondence to:

Prof. Christine AMMIRATI, MD, PhD

Formatted: French (France)

Professor

CHU d'Amiens

Service de médecine d'urgence

Place Victor Pauchet

F-80000 Amiens

Phone: +33 3 22 66 84 60

Fax: +33 3 22 66 87 13

E-mail: christine.ammirati@chu-amiens.fr

Keywords: Education, Child, Preschool, Educational Measurement, first aid, Schools.

Word count~~:~~: ~~2~~ 3 725~~605~~

ABSTRACT

Objectives~~BACKGROUND~~. ~~Emergency medicine societies recommend teaching first aid at school.~~ This study was designed to assess the knowledge ~~skills~~ acquired by very young children (< 6 years) trained by their own teachers at nursery school. This comparative study assessed the effect of training ~~under~~before the age of 6 years compared with a group of age-matched untrained children. **Setting~~METHODS~~.** Some school~~–~~teachers were trained by emergency medical teams to perform basic first aid. **Participants.** ~~This prospective randomized study assessed the effect of training under the age of 6 years (cohort C1) compared with a group of age matched untrained children (cohort C2).~~ Eighteen classes comprising 315 pupils were randomly selected: nine classes of trained pupils (cohort C1) and nine classes of untrained pupils (cohort C2).~~–~~ **Primary and secondary outcome measures.** ~~School teachers of cohort C1 were trained by emergency medical teams to perform basic first aid.~~ The test involved observing and describing three pictures and ~~use of~~using the phone to

Formatted: French (France)

Formatted: Font: Bold

Formatted: Font: Bold

call the medical emergency centrecer. Assessment of each child was based on nine criteria, and was performed by the teachers 2 months after completion of first aid training. **ResultsESULTS.** This study concerned 285 pupils: 140 trained and 145 untrained. For all criteria, the The majority of trained pupils gave the expected answers for all criteria and reacted appropriately in by assessing the situation and alerting emergency services (55.7−89.3% according to the questions). Comparison of the two groups revealed a significantly greater ability of trained pupils to describe an emergency situation ($p<0.005$) and raise the alert ($p<0.0001$). **ConclusionsONCLUSIONS.** This study shows the ability of very young children to assimilate basic skills as taught by their own school teachers.

Keywords: Education, Child, Preschool, Educational Measurement, first aid, Schools.

"Strengths and limitations of this study"

- Emergency medicine societies recommend teaching first aid at school but conclusions cannot be drawn about which first aid training courses or programmes are most effective or the age at which training can be most effectively provided. This study was designed to assess the knowledge and the ability to analyzse situations skills acquired by very young children (< 6 years) trained by their own teachers at nursery school.
- Our This study demonstrated that first aid programprogrammes given tofor very young children may can improve their ability to assess and describe an emergency medical emergency situation and alert the emergency medical emergency call centre.
- Due to constraints imposedAs required by the French national education system, the randomizsation process was doneperformed *post hoc* by the Ministry of Education and the children's assessment of pupils' performance was doneassessed by their own teachers.

Formatted: Bullets and Numbering

- ~~This study supports the current general implementation of this training course in all French schools. This program is now compulsory and begins with children aged 4 to 6 years.~~
- ~~Any~~ No correlation can be established between the simulation used ~~here~~ in this study and ~~how~~ the way in which children would react in a real life emergency situation. ~~can not be known~~

INTRODUCTION

In ~~our country~~France, all trainee school-teachers must learn basic first aid to be applied in the classroom and to be taught to their pupils. More than 9,875,000 school children ranging from 4-year-old nursery schoolchildren ~~pupils~~ to end of secondary school teenagers, about 14 to 15 years of age, should ~~have~~ receive~~d~~ this first aid training. This ~~program~~programme is called ~~is~~ "*apprendre à porter secours*" ("learn how to help") and pupils can obtain a "basic-life saving diploma" at the end of secondary school. In a medical emergency, it is essential for the first witness to raise the alert and provide emergency first aid as soon as possible. First aid has been defined as help given to any "sick or injured person until professional help arrives". [1] The challenge of enabling everyone to ~~give~~provide life-saving first aid when faced with a medical emergency implies that everyone should be trained at some point in their life. The construction of knowledge and skills that can be easily mobilized in ~~emergency~~ a medical emergency situation ~~The complexity of the training~~ suggests that ~~it~~this training should be started as early as possible in the educational curriculum. The public health ~~aim~~goal is that every pupil ~~can~~should learn first aid, as l~~. L~~aypersons ~~are~~play an important ~~factor~~role in ~~for~~ saving lives in emergency situations. Many experts now recommend training children ~~as early as~~starting at primary school to ensure that these skills are deeply and permanently ingrained. Emergency medicine societies recommend teaching first aid at school so that every citizen knows how to perform first aid appropriately and raise emergency alerts at the earliest possible time. ~~.~~ [2~~1~~-6~~5~~] Children can ~~provided~~provide first aid measures ~~or~~and ~~saved~~save lives by recognizing life-threatening emergency situations and ~~giving~~by making an emergency call. [7] A young child ~~can~~may be the only person present in ~~case~~the event of an emergency and ~~that~~ first aid education ~~therefore~~ should therefore ~~start~~be started as early as feasible.

~~In~~The age and weight of schoolchildren~~, age and anthropometry~~ are significant factors determining the quality of cardiopulmonary resuscitation ~~quality factors.~~ [8] ~~In fact~~, as the

depth of chest compression ~~depth~~ correlates with physical factors such as ~~increasing~~ weight, Body Mass Index and height. [9] Abelairas-Gómez et ~~coll~~al. ~~have identified~~showed that thirteen years ~~is~~was the minimum age ~~to~~at which children are ~~be~~ able to achieve a minimum CPR quality similar to ~~the one~~that achieved by adults ~~possess~~. [10] Young children who are not yet physically able to compress the chest can ~~learn~~nevertheless be taught how to perform appropriate first aid, and can therefore ~~appropriately~~. ~~They can~~ be the first link of the Chain of Survival by calling for help. [11]

~~To date,~~Published studies on emergency first aid training at school have focused on children aged 6 years or older, often trained by first aid instructors. [12-24] A recent systematic review highlighted that no conclusions ~~cannot~~ can be drawn concerning the most effective ~~about which~~ first-aid training courses or programmes ~~are most effective~~ or the age at which training can be most effectively provided. [~~6~~25] It is important to assess the effectiveness of standardised first-aid training ~~to inform~~as a basis for policy development and provision of first-aid training. ~~We need m~~More evidence is required to determine the most appropriate types of training according to the child's ~~depending on the~~ age ~~of the children~~, taking into account the child's psychomotor development and ~~the~~ degree of autonomy ~~of children~~.

Very limited ~~The~~ scientific literature is ~~particularly weak~~available concerning ~~for~~ children under the age of ~~younger than~~ 6 years. Studies on emergency first aid training at school have focused on children often trained by first aid instructors, while few studies have assessed ~~There are few study on~~ emergency first aid training at school provided by teachers themselves.

However, there are a number ~~Yet there are many~~ arguments in favour of training provided by teachers, ~~-~~ [26-29] as t~~T~~hey know their pupils and their representations and can work ~~from~~on the basis of ~~-~~their previous knowledge and ~~their~~ experience. Teachers are familiar with each child's ~~He knows the~~ sensitivity ~~of each child~~ and can measure the emotional charge

associated with emergency situations~~emergencies and dramatize~~. The teacher establishes a relationship of trust ~~relationship~~ with the ~~student~~child and ~~. He~~ can use situations experienced in the classroom~~,~~ as a pretext for learning and ~~achievement~~enhancing ~~of~~ knowledge. The teacher ~~knows~~is familiar with the required curriculum ~~the curriculum~~ and skills ~~listed~~. The teacher is ~~the~~a mentor, and the child is able to imitate the teacher's first aid skills~~if he knows himself to rescue the action is "imitable"~~.

The aims of this preliminary ~~first~~ study were to assess the knowledge and abilities of very young children trained in the nursery by their own teacher and to compare ~~these~~the results with those of age-matched untrained children.

~~**To date, studies on emergency first aid training at school have focused on children aged 6 years or older, often trained by first aid instructors. [7-19] This report presents the results of a pilot study involving children aged 6 years or younger who were trained in first aid by their own teacher without the presence of first aid instructors. This study, carried out in this department (560,000 inhabitants), was supervised by the University Hospital emergency medicine department, teachers of national education system, and a University research unit specialized in health education.**~~

METHODS

This study, carried out in ~~this area~~the Somme department (560,000 inhabitants), was supervised by the University Hospital emergency medicine department, ~~teachers of~~ national education teachers~~system~~, and a University research unit specialis~~z~~ed in health education.

This study took place in "real life." Due to the importance of public health issue, ~~W~~we were

forcedrequired to adapt our research methodology to the national education system's educational, legal and ethical constraints of national education system.

Intervention

Training of teachers.

A programprogramme was initially developed to train teachers in basic first aid to deal with an emergency situation. The most common emergency situations occurring in elementary schools were used to design this programprogramme. In this areadepartmentthe Somme department, 2,200 out of a total ofof all 3,300 elementary school teachers have been trained by emergency medical teams, assisted by Ministry of Education health professionals from the Ministry of Education since 2002. During a 6-hour training session, the teachers learned when to alert the medical call centrcer and how to act when faced with trauma, burns, bleeding, a choking victim, or an unconscious person. Teachers received a contribution of knowledge on first aid training to supplementimprove their prior knowledge which were previously assessed. Thenand then they worked on educational and worked on educational applications in the context of the nursery schools. This training was conducted by emergency medical teams, and education specialists, and assisted by health professionals from the Ministry of Education health professionals.

Training of children by teachers.

After training, the teachers had to integrate specific skills into various subjects of the curriculum, depending on the learning pace of the class. The children's psychological, cognitive, and moral development was taken into account when setting up the course. The principle of the course is to plan a yearly increase in complexity, allowing the revision of acquired skills and the learning of new skills. [2027-2312] Young children in nursery schools

should be able to recognize an "unusual" situation and alert the medical emergency call centre. To do so, they need to dial the emergency medical number (Phone: 15, SAMU in France), describe what they have observed, and name the various parts of the human body. Children aged between 6 and 8 years must be able to alert the SAMU by precisely locating the event. They must be able to describe injuries and perform simple tasks to deal with a burn, a bleeding wound or trauma. Children aged between 9 and 11 years must be able to recognize an unconscious patient, determine the presence of breathing and place the unconscious person on the side. They learn how to assist a person who is choking and perform chest compression and defibrillation in the case of cardiac arrest in secondary education. The progression of the child's abilities during the curriculum was assessed in ~~our department area~~the Somme department.

~~To meet the young children's psychological, cognitive, and moral development, T~~teachers have ~~inserted~~introduced first aid ~~the~~ knowledge and skills ~~of first aid~~ into the curriculum, suitable to the child's stage of psychological, cognitive, and emotional development, as recommended by ~~according to~~ experts in the education of young children ~~pedagogy~~. For example, when ~~they taught basics of~~teaching basic anatomy, teachers ~~members, they have~~ addressed the issue of how to deal with trauma. ~~This~~The number of hours of training therefore cannot be assessed in the context of this ~~pedagogical~~educational approach ~~suitable for~~adapted to young children~~, do not allow us to quantify the number of hours of training~~. ~~The aims of this first study were to assess the abilities of very young children trained in the nursery by their own teacher and to compare these results with those of age-matched untrained children.~~

Participants

Due to the ~~constraints~~requirements of the national education system, i~~I~~n nursery schools in this area, some children were trained by their teachers, while others were not, because their

teachers did not wish to train them or were not trained themselves. This study was ~~accepted~~ approved by the ~~department~~ regional section of the Ministry of Education, which ~~. This regional department section of the Ministry of Education~~ designated part of the ~~department~~ ~~aera~~region to participate in this study (80 schools, n=~~–~~1,360 pupils). Eighteen classes comprising 315 pupils were randomly selected: nine classes of trained pupils and nine classes of untrained pupils (Figure 1). The untrained pupils had never received any first aid education. The families gave their consent to this study.

Instrumentation

The children's ability to observe pictures, and then to use a telephone to ~~give~~ raise an alert were assessed. Three pictures ~~showed~~ illustrated three different situations, one of which did not require alerting the SAMU:

- A boy who has fallen off a stepladder and who is holding his leg (Figure 2~~1~~).
- A young girl crying because she has broken her doll (Figure ~~2~~3).
- A young boy who has injured his hand while peeling an apple (Figure ~~3~~4).

Assessment of each child was based on nine criteria, and was performed by the teacher~~s~~ 2 months after completion of first aid training. These nine criteria consisted of answers to the following questions~~.~~ This~~e following questions were asked in relation~~ testing the child's ability to observe each picture and decide whether or not to raise an alert~~ to each picture to test the pupil's ability to observe, and decide whether or not to raise an alert. The questions were~~: "*What is happening?"* and *"You are alone with him (her), nobody is here to help you, what would you do?"* The answers were classified into two categories: "expected answer" (with key-words or synonyms) or "other answer".

The expected answer in relation to the first picture was: *"He has fallen over, his leg hurts"*. The expected answer in relation to the second picture was: *"She has broken her doll and is*

crying" and the expected answer in relation to the third photograph was *"He has cut himself, he is bleeding"*. The child was required to *"alert the SAMU"* for the first and third situations The teacher then tested the pupil's ability to alert the SAMU in relation to the third picture. The teacher gave the children access to a standard landline telephone, playing the role of the SAMU emergency doctor. ~~If~~When the child did not ~~do it~~use the telephone spontaneously, the teacher ~~played the role of facilitator~~encouraged the child to do so. The teacher's instructions were**:** *"You see, he has cut himself, he is bleeding. You are alone at home with him, the SAMU must be alerted, do it!"* The assessment of the child's reaction was binary: did or did not. The three criteria were;

- using the telephone;
- introducing himself, explaining where he is;
- describing the situation.

The pictures had been previously tested on two classes (not included in this study).

Procedure

The national education system ~~has imposed us that~~required each ~~pupil~~child to be ~~was~~ assessed by his/her own teacher because children of this age ~~do~~are not usually ~~be~~ assessed, especially ~~in particular~~ by an unknown adult not part of the classroom~~beyond class~~. In order to obtain the most objective results possible, written instructions were given and discussed individually with each teacher approximately ~~2, 3~~2 months after completion of first aid training. ~~Each pupil was assessed by his/her own teacher.~~

Data Analysis

To ensure anonymous grids, the results were collected by Ministry of Education staff. For reasons of confidentiality ~~imposed~~required by the national education system, ~~The~~the researchers did not have access to personal data from children. Only fully completed assessments were analyzed. Data were presented as percentages with 95% confidence

intervals (95% CI). Statistical analysis of the results was performed using a Chi-square test (significance level: p <0.05). analyses were performed using the Statistical Package for the Social Sciences (version 11.0, SPSS, Inc).

RESULTS

For the overall analysis, 315 pupils were prospectively evaluated, 285 with complete grids were included: 140 trained children (cohort C1) and 145 untrained children (cohort C2) (Figure 14). The sex ratio (male/female) was 0.94 and the mean age was 5.4 years.

Only 68 children in cohort C2 were tested for their use of the telephone, as some teachers decided not to complete this assessment, which they considered to be time-consuming and fastidious.

Children's ability to observe pictures, describe the situation and raise the alert (Table 1).

The majority of trained pupils ~~was~~ were able to describe the three pictures and gave the expected answers (67.9%, 71.4% and 75.7%, respectively). The ability to observe and describe the situation was significantly higher in cohort C1 for the three pictures (p<0.001 for the first and second pictures and p<0.01 for the third picture).

Table 1. Results: Children's ability to observe pictures

Exercise	Question & - *Expected answers*	C1 cohort % of expected answers (n=140)	C2 cohort % of expected answers (n=145)	Odds ratio	*P value*

Photograph 1	What is going on? - *He has fallen over, his leg hurts* (~~criteria~~criterion 1) You are alone at home, what do you do? - *I call the SAMU* (~~criteria~~criterion 2)	67.9% (95) 62.1% (87)	45.5% (66) 8.3% (12)	2.5 18.2	<0.001 <0.0001
Photograph 2	What is going on? - *She has broken her doll and is crying* (~~criteria~~criterion 3) You are alone at home, what do you do? - *I do not call the SAMU* (~~criteria~~criterion 4)	71.4% (100) 75% (105)	41.4% (60) 75.9% (110)	3.5 -	<0.0001 0.24 ~~NS~~
Photograph 3	What is going on? - *He has cut himself, he is bleeding* (~~criteria~~criterion 5) You are alone at home, what do you do? - -*I call the SAMU* (~~criteria~~criterion 6)	75.7% (106) 66.4% (93)	60.0% (87) 13.8% (20)	2.8 12.4	0.01 <0.0001

When the SAMU had to be alerted, the majority of trained pupils were willing to raise the alert.

A marked difference was observed between the two cohorts in terms of alerting the SAMU, which was significantly higher in cohort C1 ($p<0.0001$). In relation to the first picture, 61.9% of children in cohort C2 were willing to help the injured child after the picture had been explained to them, but did not know who to alert (73.8% for the third picture). Note that 23% of pupils in cohort C1 and 43.8% of pupils in cohort C2 misinterpreted picture 2 and the intention to act was not significantly different between the two groups (to help or comfort the girl) (Table 1).

Simulation exercise with a telephone using the third picture.

This exercise involved the 140 trained children of cohort C1 and 68 children of the cohort C2. Overall, 55.7% pupils of cohort C1 knew how to use the telephone correctly and how to call the SAMU (vs. 17.7% of children in cohort C2; $p <0.0001$) (Table 2), and 82.1% of children in cohort C1 gave their first name, last name and personal address (vs. 33.8% of C2; $p <0.0001$) (Table 2). Lastly, 89.3% of children in cohort C1 correctly described the situation using the keywords “cut”,” hand”, “blood” (vs. 75% of C2; $p <0.01$) (Table 2).

Table 2. Results: Simulation exercise with a telephone

Exercise	Criteria	C1 cohort % of expected answers (n=140)	C2 cohort % of expected answers (n=68)	Odds ratio	*p*
Use of the ~~tele~~phone	1 - Using the telephone *(~~criteria~~criterion 7)*	55.7% (78)	17.7% (12)	5.9	<0.0001
	2 - Introducing oneself, Explaining the location *(~~criteria~~criterion 8)*	82.1% (115)	33.8% (23)	9	<0.0001
	3 - Describing the situation *(~~criteria~~criterion 9)*	89.3% (125)	75% (51)	2.8	0.01

DISCUSSION

For all criteria, the majority of trained pupils gave expected answers and presented an appropriate reaction to the situation by recognizing the medical problem and appropriately raising the alert. Comparison of the two cohorts revealed significant differences in terms of the ability of pupils to describe an emergency situation and raise the alert.

Observation capacity

The situation shown in each picture had not been previously raised or discussed in class. The teachers were not aware of the assessment methods used and therefore could not have prepared their pupils beforehand. A significant difference was observed between the two

cohorts, reflecting the existence of cognitive links between the test situations. The vast majority of trained pupils spontaneously gave expected answers without prompting from their teacher, making this result even more relevant. The results related to the non-emergency situation (young girl with a broken doll) showed that the observation capacity of trained pupils was significantly better than that of untrained pupils. The teachers of the trained cohort may have more generally emphasized observation capacities, as an emergency call to the SAMU (or to an adult) required an oral description of the situation. It is difficult to define this aspect from these results alone: it would be interesting to test these capacities with other assessments comprising less obvious situations.

The situations described in the pictures focused on trauma and ~~hurt~~injuries, which correspond to ~~because there are~~ common situations ~~which~~encountered by children ~~are most confronted in their life~~. [~~INVS~~32-34] ~~+ INSEE + INJURY PREVENTION 2004;10:79-82] although m~~Many emergencies in western countries deal with acute emergencies in the field of internal medicine (heart attack, stroke, etc.) but, education experts from ~~th~~the Ministry of Education thought that it would be too emotionally disturbing ~~think it is too emotionnaly charged~~ for a young child to be ~~confronted~~faced with an adult ~~wh~~in a life-threatening situation and ~~ose health is in danger.~~ t~~T~~herefore~~,~~ ~~they~~ proposed that ~~these~~ young children ~~acted~~should act out situations ~~that~~involving injured children.

Intention to alert the SAMU

A ~~marked~~ highly significant difference was observed between the two cohorts in the two situations in which the SAMU had to be alerted. This study can be compared with Bollig's study in which the same ability was assessed. [~~19~~24] Despite the obvious willingness of untrained children to help, they did not know which number to dial or what role the SAMU played. It is noteworthy that trained pupils did not associate the picture of a broken doll with the need to alert emergency services as they were able to differentiate the various situations.

Ability to raise the alert

Overall, trained pupils felt more confident than their untrained counterparts. Although two-thirds of trained pupils intended to call the SAMU in a medical emergency situation, only about one half of them really knew how to call the SAMU with a landline. However, as a result of age-related psychological and cognitive maturity, the child's comprehension and the intention to take a particular action may not be automatically linked.

This difference between intention and ability to act shows that learning methods must be based on real-life situations and must be regularly revised.

Integrating a first aid course in the curriculum

In a pilot study of 10 children, Bollig et ~~coll~~al. showed that kindergarten children aged 4-5 years can learn basic first aid with ~~a~~ training ~~given~~provided by a first aid instructor and kindergarten teachers. [30] ~~Our~~The results of the present study ~~argues for~~support training by ~~the~~ teachers themselves. It was considered important for teachers to learn first aid in ~~so that~~order to be ~~they can~~ subsequently able to teach first aid to their pupils at school as part of ~~the class'~~ "daily life education". In contrast with first aid training provided by external instructors, teachers know their pupils. They can plan emergency first aid training along with other topics and assess the children in different ways. Finally, the teachers' active participation in "role-playing games", placing the child in a situation ~~for~~ in which he/she is responsible for somebody else's health, appears to be a more efficient method to acquire complex skills, according to the concept of situated learning.~~.~~ [31]

Teacher training lasted 6 hours. Our experience and an unpublished evaluation suggest that a 6-hour training course ~~leads us to believe that this time~~ is sufficient. Teachers have satisfactory prior first aid knowledge ~~on first aid~~ and are ~~particularly relevant~~trained in science education. This 6-~~-~~hour training ~~helped to~~ upgraded their knowledge and ~~work~~helped them ~~on~~to integrate first aid training ~~the pedagogical integration~~ in the curriculum. The

effectiveness of ~~An evaluation of~~ this training needs to be evaluated ~~would be beneficial to validate~~ and further studies are required to define ~~could help clarify~~ the optimal design.

Limitations

This study has several limitations. ~~The r~~Randomis~~z~~ation ~~process~~ was not performed before ~~study~~ setting up the study, but was ~~done~~performed *post hoc* by the Ministry of Education~~.~~, at their request for ethical ~~This was imposed us by the Ministry of Education for~~ reasons, as the Ministry of Education refused the idea of predefining two groups with and without first aid training ~~of pedagogical ethics. It was inconceivable to them to decide beforehand that some children would be trained and others not.~~ A consensus therefore had to be found to randomly select classes receiving and not receiving first aid training~~So we had to find a consensus to randomly selected classes from those trained and those untrained~~. ~~The a~~Assessment of the children's ~~pupils'~~ performance by their own teachers could constitute ~~be~~ a bias in favour of the trained group. As explained in the M~~m~~ethods section, the national education system required ~~has imposedprefered us that~~ each ~~pupil was~~child to be assessed by his/her own teacher because children of this age ~~do~~are not usually ~~be~~ assessed, especially ~~in particular~~ by an unknown adult not part of the classroom~~beyond class~~. It would be interesting to investigate differences between schoolteacher~~s~~ and first aid instructor~~'s~~ interventions during a limited ~~time~~ training period, as teachers ~~who~~ integrate specific skills into various subjects of the curriculum, depending on the learning pace of the class. ~~It would be interesting to investigate the difference between schoolteachers and first aid instructors as teachers.~~

In addition, ~~On top of that~~ some teachers decided not to ~~complete~~perform this assessment, which they considered to be "time-~~-~~consuming and fastidious". This study was conducted under ~~took place in~~ "real life~~.~~" conditions. We ~~were forced~~had to adapt our research

methodology to the educational, legal and ethical ~~constraints of~~ requirements of the French national education system.

Our study ~~has~~ presents a number of biases. Use of the telephone was tested in o~~O~~nly 48% of ~~the~~ untrained children (C2) ~~were tested on their use of the telephone~~. The main bias is ~~the fact~~ that some teachers ~~acted outwith~~ ffailed to comply with the study protocol, leading to incomplete data ~~capture~~ collection for ~~some~~ certain aspects of the study. ~~It~~ highlighting~~s~~ the difficulties of working with teachers who are sometimes unwilling to comply with study protocols.

Although the instructions were explained to all teachers, ~~they may presented differences in terms of their~~ evaluation and interpretation of these instructions may have differed between teachers. The pictures had been previously tested on two classes, but interpretation of the pictures may nevertheless have been biased. As this study was based exclusively on pictures, it would be interesting to include the observation of videos or "role-playing games". A size difference was also observed between the two cohorts for the last exercise.

As this is the first assessment of its kind, we ~~limited~~ confined ourselves to a global assessment and did not take into account variables such as gender, class atmosphere, or family background.

~~We evaluate the~~The child's knowledge and ability to analys~~z~~e a situation from photographs were assessed. ~~This method was chosen f~~For practical reasons, ~~to be carried out~~as this assessment was performed by the teacher~~s~~ in each classroom, although it may have been preferable to ~~. It would be betterdiscussed to~~ assess the acquired skills in a ~~scenario~~role play situation, as performed by several ~~like other~~ authors ~~did~~.

[24, 30] It could be difficult to ~~have~~ensure similar and reproducible ~~and similar~~ scenarios in each school. ~~The conception of p~~Photographs ~~was made~~were designed by teachers themselves. ~~Photographs were~~and had been previously tested on a sample of 50 children ~~who~~

were not included in thisthe present study. Another possibility mightwould be to evaluate children fromin the context of a video or serious game.

Finally, simulations there are present a number of limitations of simulations. No correlation can be established between the simulation used in this study and the way in which children would react in a real life emergency situationAny correlation between the simulation used here and how children would react in a real life emergency can not be known.

Prospects

In collaboration with the Ministry of Education, we discussed the possibility of increasing the complexity of the exercises on a yearly basis, which would enable revision of acquired skills and learning of new skills. [2225] Assessment of pupils at the end of elementary school and in secondary school will be the subject of other studies in our departmentresearch unit.

To adapt this training to the children's psychological and physical development, pupils at the end of elementary school were taught which behaviour to adopt when faced with an unconscious person who is still breathing [Table 3]. Cardiac arrest was not addressed until high school in line with Bollig's propositions. [1924, 35-36] In order to meet public health requirements, emergency first-aid training is now a compulsory part of the national curriculum in France. Today, all trainee school teachers must learn basic first aid to be applied in the class and to be taught to their pupils. More than 9,875,000 school children ranging from 4 year old nursery school pupils to end of secondary school teenagers about 14 to 15 years of age have received this first aid training. This program is called is "*apprendre à porter secours*" ("learn how to help") and pupils can obtain a "basic life saving diploma" at the end of secondary school.

Table 3 Skills / Age in the French curriculum

	Nursery school	Primary school		Secondary school	
Skills/ Age	Age 4 - 6 years	Age 6 - 8 years	Age 8 – 11 years	Age 11 – 12 years	Age 12 – 15 years
Alert - Recognize an emergency medical situation - Stay in a safe place - Tell an adult - Alert an emergency medical centrecer					
Trauma - Recognize a burn - Place the burned part under running water - Recognize an injury to the head, limb or spine - Avoid mobilization of the injured part - Recognize bleeding - Stop bleeding					
Consciousness					

- Recognize an unconscious person - Turn on the side					
Breathing - Look, listen and feel for breathing - Assist the person who is choking - Perform mouth to mouth*					
Circulation - Recognize a cardiac arrest - Administer chest compressions - Use automatic external defibrillator					

	Skill introduced
	Skill reinforced
	Skill acquired

IMPLICATIONS

The challenge of enabling everyone to give life-saving first aid when faced with a medical emergency implies that everyone should be trained at some point in their life. The complexity of the training suggests that ~~it~~ this training should be started as early as possible in the educational curriculum.

The public health ~~aim~~ goal is that every pupil ~~can~~ should learn first aid. To achieve this objective, school ~~–~~ teachers must first acquire appropriate emergency skills in the classroom. The present study concerned children aged 6 years or younger attending nursery school, trained by their own teachers. It demonstrated that first aid ~~program~~programmes given to very young children may improve their ability to assess and describe a~~n~~ ~~emergency~~ medical emergency situation and alert the ~~emergency~~ medical emergency call centre as necessary. The results of trained pupils were significantly better than those of untrained pupils. ~~Furthermore, these untrained children did not appear to acquire these skills outside of school.~~

These preliminary results demonstrate the advantages of integrating this first aid course into the national curriculum, mainly provided by teachers themselves. Since 2006, the assessments carried out by our team support the current general implementation of this training course in all French schools. This ~~program~~programme is now compulsory ~~and begins with children~~starting at the age~~d~~ of 4 to 6 years.

Acknowledgements

The authors are very grateful to Mrs Kerneur and Mrs Lagarde ~~for their very helpful contribution to this research program~~ (Ministry of National Education, France) for their very helpful contribution to this research and Mr. Jean-Michel Mercieca (Amiens University hospital) for his help.

Contributorship Statement

CA: conception of the work, analyse, draft, revising it critically for important intellectual content and final approval

RG: conception of the work, analyse, draft, revising it critically for important intellectual content and final approval

CA: interpretation of data, revising critically for important intellectual content and final approval

BN: interpretation of data, revising critically for important intellectual content and final approval

MG: interpretation of data, draft, revising it critically for important intellectual content and final approval

~~**Conflicts of Interest**~~

Competing interests

The authors have indicated they have no financial and personal relationships with other people or organisations that could inappropriately influence this article.

Funding

None

Data sharing

None

Figure legends

Figure 1: Flowchart

Figure 2: Photograph 1. A Boy Who Has Fallen Off a Stepladder and Is Holding His Leg

Figure 3: Photograph 2. A Young Girl Crying Because She Has Broken Her Doll.

Figure 4: Photograph 3. A Young Boy Who Has Injured His Hand While Peeling An Apple.

Abbreviations: SAMU - Service d'aide médicale urgente; 95% CI - 95% confidence interval

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: English (U.K.)

REFERENCES

1. IFRC. International first aid and resuscitation guidelines 2011. Geneva: International Federation of Red Cross and Red Crescent Societies, 2011.
2. Guidelines for basic life support. A statement by the Basic Life Support Working Party of the European Resuscitation Council, 1992. *Resuscitation.* 1992;24:103-110.
3. American Academy of Pediatrics Committee on School Health. Basic life support training school. *Pediatrics.* 1993;91:158-159.
4. Lester CA, Weston CF, Donnelly PD, et al. The need for wider dissemination of CPR skills: are schools the answer? *Resuscitation.* 1994;28:233-237.
5. Eisenburger P, Safar P. Life supporting first aid training of the public--review and recommendations. *Resuscitation.* 1999;41:3-18.
6. Education in resuscitation: An ILCOR symposium: Utstein Abbey, Stavanger Norway. June 2001. *Circulation* 2003;108:2575-2594.
7. C. Amsallem, C. Ammirati, M. Gignon, et al. Appel d'un enfant : rôle de la régulation médicale. In. Urgences 2011, Société Française de Médecine d'Urgences, 2011:1035-44.
8. Jones I, Whitfield R, Colquhoun M, et al. At what age can schoolchildren provide effective chest compressions? An observational study from the Heartstart UK schools training programme. *BMJ* 2007;334(7605):1201.
9. Plant N, Taylor K. How best to teach CPR to schoolchildren: a systematic review. *Resuscitation* 2013;84(4):415-21. doi: 10.1016/j.resuscitation.2012.12.008.
10. Abelairas-Gómez C, Rodríguez-Núñez A, Casillas-Cabana M, et al. Schoolchildren as life savers: at what age do they become strong enough? *Resuscitation* 2014;85(6):814-9. doi: 10.1016/j.resuscitation.2014.03.001.

Formatted: Bullets and Numbering
Formatted: Bullets and Numbering
Formatted: Bullets and Numbering
Formatted: French (France)
Formatted: Bullets and Numbering
Formatted: French (France)
Formatted: Bullets and Numbering

11. Koster RW, Baubin MA, Bossaert LL, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 2. Adult basic life support and use of automated external defibrillators. Resuscitation. 2010;81(10):1277-92. doi: 10.1016/j.resuscitation.2010.08.009.

~~He Z1, Wynn P, Kendrick D. Non-resuscitative first-aid training for children and laypeople: a systematic review. *Emerg Med J.* 2013; 18. doi: 10.1136/emermed-2013-202389.~~

~~8.~~12. Lind B. Teaching resuscitation in primary schools. *Anaesthesist.* 1973;22:464-465.

~~9.~~13. Berkebile P, Benson D, Ersoz C, et al. Public education in heart-lung resuscitation. Evaluation of three self-training methods in teenagers. Proceedings of the National Conference on Standards for Cardiopulmonary Resuscitation and Emergency Cardiac Care. Dallas, TX: *American Heart Association;* 1975:13-23.

~~10.~~14. Vanderschmidt H, Burnap TK, Thwaites JK. Evaluation of a cardiopulmonary resuscitation course for secondary schools. *Med Care.* 1975;13:763-774.

~~11.~~15. Gardiner AW. Teaching first aid to children. *Br Med J.* 1977;2:1088.

~~12.~~16. Plotnikoff R. Retention of expired air resuscitation skills of sixth class students. *Environ Health Rev.* 1986;18:35-49.

~~13.~~17. Plotnikoff R, Moore PJ. Retention of cardiopulmonary resuscitation knowledge and skills by 11- and 12-year-old children. *Med J Aust.* 1989;150:296-302.

~~14.~~18. Lester C, Donnelly P, Weston C, et al. Teaching schoolchildren cardiopulmonary resuscitation. *Resuscitation.* 1996;31:33-38.

~~15.~~19. Lewis RM, Fulstow R, Smith GB. The teaching of cardiopulmonary resuscitation in schools in Hampshire. *Resuscitation.* 1997;35:27-31.

Formatted: French (France)
Formatted: Bullets and Numbering
Formatted: Bullets and Numbering
Formatted: French (France)

~~16.~~20. Bernardo LM, Doyle C, Bryn S. Basic emergency lifesaving skills (BELS): a framework for teaching skills to children and adolescents. *Int J Trauma Nurs.* 2002;8:48-50.

~~17.~~21. Uray T, Lunzer A, Ochsenhofer A, et al. Feasibility of life-supporting first aid (LSFA) training as a mandatory subject in primary schools. *Resuscitation.* 2003;59:211-220.

~~18.~~22. Lubrano R, Romero S, Scoppi P, et al. How to become an under 11 rescuers: a practical method to teach first aid to primary schoolchildren. *Resuscitation.* 2005;64:303-307.

~~19.~~23. Thurston M. Emergency life support training for school children: exploring local implementation and outcomes of the Heartstart UK School Programme within the context of the National Healthy School Standard. *Centre for Public Health Research, University of Chester, externally commissioned research reports,* 2005:1-86.

~~20.~~24. Bollig G, Walh H A, Svendsen MV. Primary school children are able to perform basic life-saving first aid measures, *Resuscitation*, 2009;80:689–692.

25. He Z~~l~~, Wynn P, Kendrick D. Non-resuscitative first-aid training for children and laypeople: a systematic review. *Emerg Med J.* 2013; 18. doi: 10.1136/emermed-2013-202389.

26. Tardif J. Pour un enseignement stratégique. L'apport de la psychologie cognitive. 2ème edition. Ed Logiques 1997.

~~21.~~27. Kohlberg L. Moral stages and Moralization: The Cognitive-developmental Approach. In: Lickona T, eds. *Moral development and behavior: Theory, research, and social issues*. New-York, NY: Holt, Rinehart & Winston 1976:31-53.

Formatted: French (France)

Formatted: Bullets and Numbering

Formatted: French (France)

Formatted: Bullets and Numbering

Formatted: Bullets and Numbering

~~22.~~ Smith PL, Ragan TJ. Strategies for psychomotor skill learning. In: *Instructional Design*. 3rd ed. Chap. 15, Hoboken, NJ:Wiley 2005:276-283.

28.

~~23.~~29. Bruner J. The process of education, Cambridge, MA: Harvard University Press 1960.

30. Bollig G, Myklebust AG, Østringen K. Effects of first aid training in the kindergarten--a pilot study. Scand J Trauma Resusc Emerg Med. 2011 Feb 28;19:13. doi: 10.1186/1757-7241-19-13.

31. Lave J, Wenger E. Situated Learning: Legitimate Peripheral Participation. Cambridge University Press. 1991.

32. Enquête Permanente sur les accidents de la vie courante. Résultats 2012. Institut de Veille Sanitaire, Saint Denis, 2012. http://www.invs.sante.fr/content/download/83774/306579/version/1/file/TR13G263_%28resultats_Epac2012%29.pdf (accessed 10 July 2014).

33. Principales causes de décès des jeunes et des enfants en 2011. Institut national de la statistique et des études économiques, 2011. http://www.insee.fr/fr/themes/tableau.asp?ref_id=NATCCJ06206&reg_id=0 (accessed 10 july 2014).

34. Philippakis A1, Hemenway D, Alexe DM, et al. – A quantification of preventable unintentional childhood injury mortality in the United States. Inj Prev. 2004 Apr;10(2):79-82.

35. Bollig G. First Aid and the family. In: Craft-Rosenberg M, Pehler SR. Encyclopaedia of Family Health, SAGE Publications, Thousand Oaks 2011.

Formatted: Bullets and Numbering

Formatted: Bullets and Numbering

Formatted: Bullets and Numbering

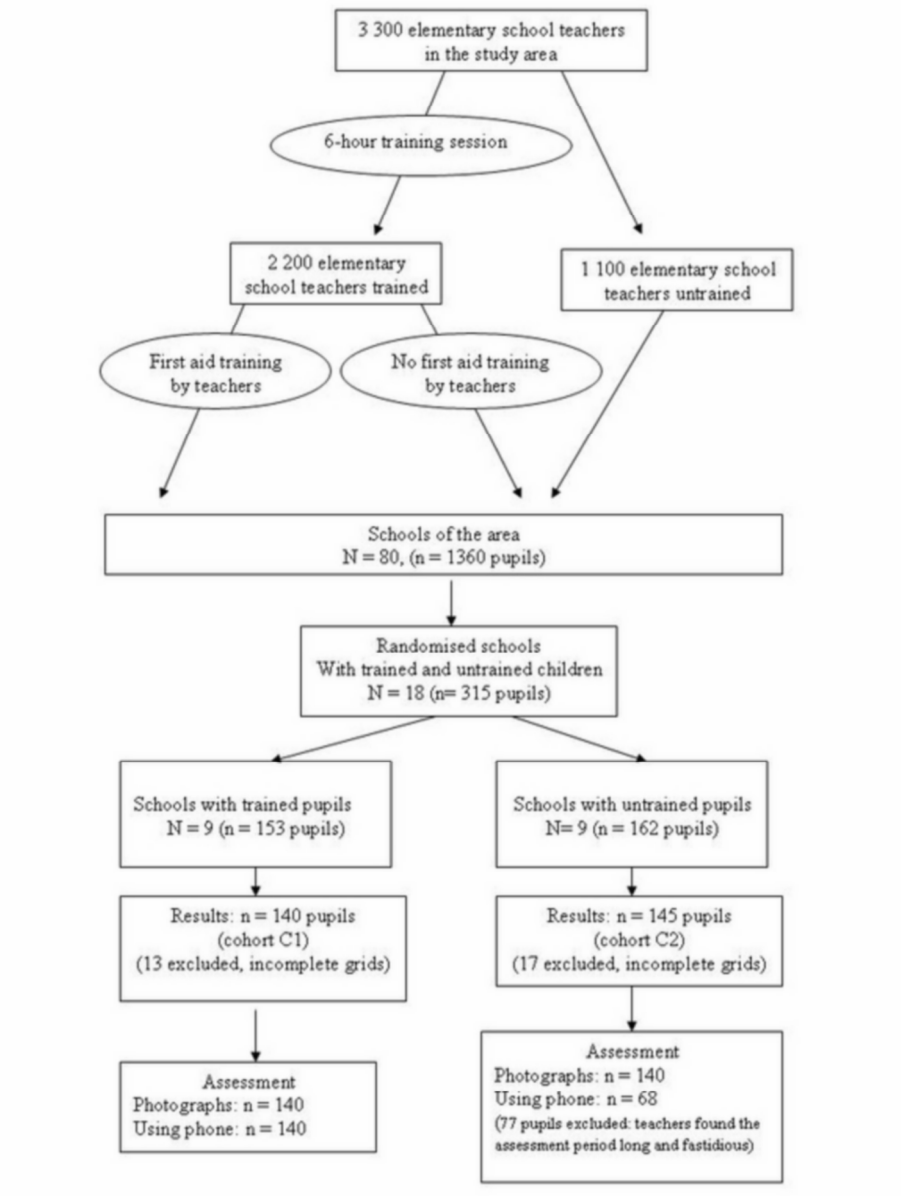
Formatted: French (France)

Field Code Changed

Formatted: French (France)

Field Code Changed

36. Bollig G. First Aid Training in the Kindergarten: A Review of the Literature and Reflections from Practical Experience in Two Countries. NOVA Science Publishers New York 2013.



Flowchart
278x371mm (300 x 300 DPI)

Photograph 1. A Boy Who Has Fallen Off a Stepladder and Is Holding His Leg
102x67mm (300 x 300 DPI)

Photograph 2. A Young Girl Crying Because She Has Broken Her Doll.
98x73mm (300 x 300 DPI)

Photograph 3. A Young Boy Who Has Injured His Hand While Peeling An Apple.
180x134mm (300 x 300 DPI)

BMJ Open

Are schoolteachers able to teach first aid to children younger than 6 years? A comparative study.

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2014-005848.R2
Article Type:	Research
Date Submitted by the Author:	25-Aug-2014
Complete List of Authors:	AMMIRATI, Christine; University Hospital of Amiens, Active Teaching and Health Simulation Training Center (CPA-SimUSanté©) GAGNAYRE, Rémi; University Paris 13, Sorbonne Paris Cité, Laboratory Education and Health Practices, EA3412 AMSALLEM, Carole; University Hospital of Amiens, Active Teaching and Health Simulation Training Center (CPA-SimUSanté©) NEMITZ, Bernard; University Hospital of Amiens, Active Teaching and Health Simulation Training Center (CPA-SimUSanté©) GIGNON, Maxime; Active Teaching and Health Simulation Training Center (CPA-SimUSanté©), ; University Paris 13, Sorbonne Paris Cité, Laboratory Education and Health Practices, EA3412 , France, Laboratory Education and Health Practices, EA3412
Primary Subject Heading:	Public health
Secondary Subject Heading:	Emergency medicine, Medical education and training, Public health
Keywords:	EDUCATION & TRAINING (see Medical Education & Training), Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PRIMARY CARE, PUBLIC HEALTH

Are schoolteachers able to teach first aid to children younger than 6 years? A comparative study.

Short title: Emergency first aid training for children

Christine Ammirati[a, b, c], Rémi Gagnayre[b], Carole Amsallem[a, c], Bernard Némitz[a], Maxime Gignon[b, c, d]

[a] Emergency Medicine Department, University Hospital of Amiens, France

[b] University Paris 13, Sorbonne Paris Cité, Laboratory Education and Health Practices, EA3412 Bobigny, France

[c] Active Teaching and Health Simulation Training Centre (CPA-SimUSanté©), Amiens, France

[d] Public Health department, University Hospital of Amiens, France

Address correspondence to:

Prof. Christine AMMIRATI, MD, PhD

Professor

CHU d'Amiens

Service de médecine d'urgence

Place Victor Pauchet

F-80000 Amiens

Phone: +33 3 22 66 84 60

Fax: +33 3 22 66 87 13

E-mail: christine.ammirati@chu-amiens.fr

Keywords: Education, Child, Preschool, Educational Measurement, first aid, Schools.

Word count: 3 679

Keywords: Education, Child, Preschool, Educational Measurement, first aid, Schools.

ABSTRACT

Objectives. This study was designed to assess the knowledge acquired by very young children (< 6 years) trained by their own teachers at nursery school. This comparative study assessed the effect of training before the age of 6 years compared with a group of age-matched untrained children.

Setting. Some schoolteachers were trained by emergency medical teams to perform basic first aid.

Participants. Eighteen classes comprising 315 pupils were randomly selected: nine classes of trained pupils (cohort C1) and nine classes of untrained pupils (cohort C2).

Primary and secondary outcome measures. The test involved observing and describing three pictures and using the phone to call the medical emergency centre. Assessment of each child was based on nine criteria, and was performed by the teacher 2 months after completion of first aid training.

Results. This study concerned 285 pupils: 140 trained and 145 untrained. The majority of trained pupils gave the expected answers for all criteria and reacted appropriately by assessing the situation and alerting emergency services (55.7−89.3% according to the questions). Comparison of the two groups revealed a significantly greater ability of trained pupils to describe an emergency situation ($p<0.005$) and raise the alert ($p<0.0001$).

Conclusions. This study shows the ability of very young children to assimilate basic skills as taught by their own schoolteachers.

"Strengths and limitations of this study"

- This study was designed to assess the knowledge and the ability to analyse situations acquired by very young children (< 6 years) trained by their own teachers at nursery school.
- This study demonstrated that first aid programmes for very young children can improve their ability to assess and describe a medical emergency situation and alert the medical emergency centre.
- As required by the French national education system, randomisation was performed *post hoc* by the Ministry of Education and the children's performance was assessed by their own teachers.
- No correlation can be established between the simulation used in this study and the way in which children would react in a real life emergency situation.

INTRODUCTION

In France, all trainee schoolteachers must learn basic first aid to be applied in the classroom and to be taught to their pupils. More than 9,875,000 school children ranging from 4-year-old nursery schoolchildren to end of secondary school teenagers, about 14 to 15 years of age, should receive this first aid training. This programme is called "*apprendre à porter secours*" ("learn how to help") and pupils can obtain a "basic-life saving diploma" at the end of secondary school. In a medical emergency, it is essential for the first witness to raise the alert and provide emergency first aid as soon as possible. First aid has been defined as help given to any "sick or injured person until professional help arrives". [1] The challenge of enabling everyone to provide life-saving first aid when faced with a medical emergency implies that everyone should be trained at some point in their life. The construction of knowledge and skills can be easily mobilized in a medical emergency situation. Many experts and Emergency medicine societies recommend teaching first aid at school so that every citizen knows how to perform first aid appropriately and raise emergency alerts at the earliest possible time. [2-6] Children can provide first aid measures and save lives by recognizing life-threatening emergency situations and by making an emergency call. [7]

Although up to now there is no proof of positive effects of first aid measures on patient outcome, except from Basic Life Support. In addition, there could concern about adverse effects of training, like recovery position performed by lays during cardiac arrest. However, one important obstacle to perform bystander CPR is the attitude towards helping. This is a fundamental problem in the general population which could be addressed by first aid training at early childhood.

The age and weight of schoolchildren are significant factors determining the quality of cardiopulmonary resuscitation [8], as the depth of chest compression correlates with physical

factors such as weight, Body Mass Index and height. [9] Abelairas-Gómez et al. showed that thirteen years was the minimum age at which children are able to achieve a minimum CPR quality similar to that achieved by adults. [10] However, determining an age is controversial. [8-11] This results do not justify to withhold CPR training from younger children. Children who underwent training in younger years significantly improved their performance after 3-4 years. [9, 11, 12] Young children who are not yet physically able to compress the chest can nevertheless be taught how to perform appropriate first aid, and can therefore be the first link of the Chain of Survival by calling for help. [13]

Published studies on emergency first aid training at school have focused on children aged 6 years or older, often trained by first aid instructors. [14-20] A recent systematic review highlighted that no conclusions can be drawn concerning the most effective first-aid training courses or programmes or the age at which training can be most effectively provided. [21] It is important to assess the effectiveness of standardised first-aid training as a basis for policy development and provision of first-aid training. More evidence is required to determine the most appropriate types of training according to the child's age, taking into account the child's psychomotor development and degree of autonomy.

Very limited scientific literature is available concerning children under the age of 6 years. Studies on emergency first aid training at school have focused on children often trained by first aid instructors, while few studies have assessed emergency first aid training at school provided by teachers themselves.

However, there are a number arguments in favour of training provided by teachers, [22-25] as they know their pupils and their representations and can work on the basis of their previous knowledge and experience. Teachers are familiar with each child's sensitivity and can measure the emotional charge associated with emergency situations. The teacher establishes a relationship of trust with the child and can use situations experienced in the classroom as a

pretext for learning and enhancing knowledge. The teacher is familiar with the required curriculum and skills. The teacher is a mentor, and the child is able to imitate the teacher's first aid skills.

The aims of this preliminary study were to assess the knowledge and abilities of very young children trained in the nursery by their own teacher and to compare the results with those of age-matched untrained children.

METHODS

This study, carried out in the Somme department (560,000 inhabitants), was supervised by the University Hospital emergency medicine department, national education teachers, and a University research unit specialised in health education. This study took place in "real life." Due to the importance of public health issue, we were required to adapt our research methodology to the national education system's educational, legal and ethical constraints.

Intervention

Training of teachers.

A programme was initially developed to train teachers in basic first aid to deal with an emergency situation. The most common emergency situations occurring in elementary schools were used to design this programme. In the Somme department, 2,200 of all 3,300 elementary schoolteachers have been trained by emergency medical teams, assisted by Ministry of Education health professionals since 2002. During a 6-hour training session, the teachers learned when to alert the medical call centre and how to act when faced with trauma, burns, bleeding, a choking victim, or an unconscious person. Teachers received first aid training to improve their prior knowledge and then worked on educational applications in the

context of nursery schools. This training was conducted by emergency medical teams and education specialists, assisted by Ministry of Education health professionals.

Training of children by teachers.

After training, the teachers had to integrate specific skills into various subjects of the curriculum, depending on the learning pace of the class. The children's psychological, cognitive, and moral development was taken into account when setting up the course. The principle of the course is to plan a yearly increase in complexity, allowing the revision of acquired skills and the learning of new skills. [23-27] Young children in nursery schools should be able to recognize an "unusual" situation and alert the medical emergency call centre. To do so, they need to dial the emergency medical number (Phone: 15, SAMU in France), describe what they have observed, and name the various parts of the human body. Children aged between 6 and 8 years must be able to alert the SAMU by precisely locating the event. They must be able to describe injuries and perform simple tasks to deal with a burn, a bleeding wound or trauma. Children aged between 9 and 11 years must be able to recognize an unconscious patient, determine the presence of breathing and place the unconscious person on the side. They learn how to assist a person who is choking and perform chest compression and defibrillation in the case of cardiac arrest in secondary education. The progression of the child's abilities during the curriculum was assessed in the Somme department.

Teachers have introduced first aid knowledge and skills into the curriculum, suitable to the child's stage of psychological, cognitive, and emotional development, as recommended by experts in the education of young children. For example, when teaching basic anatomy, teachers addressed the issue of how to deal with trauma. The number of hours of training therefore cannot be assessed in the context of this educational approach adapted to young children.

Participants

Due to the requirements of the national education system, in nursery schools in this area, some children were trained by their teachers, while others were not, because their teachers did not wish to train them or were not trained themselves. This study was approved by the regional section of the Ministry of Education, which designated part of the region to participate in this study (80 schools, n=1,360 pupils). Eighteen classes comprising 315 pupils were randomly selected: nine classes of trained pupils and nine classes of untrained pupils (Figure 1). The untrained pupils had never received any first aid education. The families gave their consent to this study.

Instrumentation

The children's ability to observe pictures, and then to use a telephone to raise an alert were assessed. Three pictures illustrated three different situations, one of which did not require alerting the SAMU:

- A boy who has fallen off a stepladder and who is holding his leg (Figure 2).
- A young girl crying because she has broken her doll (Figure 3).
- A young boy who has injured his hand while peeling an apple (Figure 4).

Assessment of each child was based on nine criteria, and was performed by the teacher 2 months after completion of first aid training. These nine criteria consisted of answers to the following questions testing the child's ability to observe each picture and decide whether or not to raise an alert: "*What is happening?"* and *"You are alone with him (her), nobody is here to help you, what would you do?"* The answers were classified into two categories: "expected answer" (with key-words or synonyms) or "other answer".

The expected answer in relation to the first picture was: *"He has fallen over, his leg hurts"*. The expected answer in relation to the second picture was: *"She has broken her doll and is crying"* and the expected answer in relation to the third photograph was *"He has cut himself, he is bleeding"*. The child was required to *"alert the SAMU"* for the first and third situations The teacher then tested the pupil's ability to alert the SAMU in relation to the third picture. The teacher gave the children access to a standard landline telephone, playing the role of the SAMU emergency doctor. When the child did not use the telephone spontaneously, the teacher encouraged the child to do so. The teacher's instructions were**:** *"You see, he has cut himself, he is bleeding. You are alone at home with him, the SAMU must be alerted, do it!"*

The assessment of the child's reaction was binary: did or did not. The three criteria were;

- using the telephone;
- introducing himself, explaining where he is;
- describing the situation.

The pictures had been previously tested on two classes (not included in this study).

Procedure

The national education system required each child to be assessed by his/her own teacher because children of this age are not usually assessed, especially by an unknown adult not part of the classroom. In order to obtain the most objective results possible, written instructions were given and discussed individually with each teacher approximately 2 months after completion of first aid training.

Data Analysis

To ensure anonymous grids, the results were collected by Ministry of Education staff. For reasons of confidentiality required by the national education system, the researchers did not have access to personal data from children. Only fully completed assessments were analyzed. Data were presented as percentages with 95% confidence intervals (95% CI). Statistical

analysis of the results was performed using a Chi-square test (significance level: p <0.05). analyses were performed using the Statistical Package for the Social Sciences (version 11.0, SPSS, Inc).

RESULTS

For the overall analysis, 315 pupils were prospectively evaluated, 285 with complete grids were included: 140 trained children (cohort C1) and 145 untrained children (cohort C2) (Figure 1). The sex ratio (male/female) was 0.94 and the mean age was 5.4 years.

Only 68 children in cohort C2 were tested for their use of the telephone, as some teachers decided not to complete this assessment, which they considered to be time-consuming and fastidious.

Children's ability to observe pictures, describe the situation and raise the alert (Table 1).

The majority of trained pupils were able to describe the three pictures and gave the expected answers (67.9%, 71.4% and 75.7%, respectively). The ability to observe and describe the situation was significantly higher in cohort C1 for the three pictures (p<0.001 for the first and second pictures and p<0.01 for the third picture).

Table 1. Results: Children's ability to observe pictures

Exercise	**Question** & *- Expected answers*	**C1 cohort % of expected answers (n=140)**	**C2 cohort % of expected answers (n=145)**	**Odds ratio**	***P value***

Photograph 1	What is going on? *- He has fallen over, his leg hurts (criterion 1)* You are alone at home, what do you do? *-I call the SAMU (criterion 2)*	67.9% (95) 62.1% (87)	45.5% (66) 8.3% (12)	2.5 18.2	<0.001 <0.0001
Photograph 2	What is going on? *- She has broken her doll and is crying (criterion 3)* You are alone at home, what do you do? *- I do not call the SAMU (criterion 4)*	71.4% (100) 75% (105)	41.4% (60) 75.9% (110)	3.5 -	<0.0001 0.24
Photograph 3	What is going on? *- He has cut himself, he is bleeding (criterion 5)* You are alone at home, what do you do? *- I call the SAMU (criterion 6)*	75.7% (106) 66.4% (93)	60.0% (87) 13.8% (20)	2.8 12.4	0.01 <0.0001

When the SAMU had to be alerted, the majority of trained pupils were willing to raise the alert.

A marked difference was observed between the two cohorts in terms of alerting the SAMU, which was significantly higher in cohort C1 ($p<0.0001$). In relation to the first picture, 61.9% of children in cohort C2 were willing to help the injured child after the picture had been explained to them, but did not know who to alert (73.8% for the third picture). Note that 23% of pupils in cohort C1 and 43.8% of pupils in cohort C2 misinterpreted picture 2 and the intention to act was not significantly different between the two groups (to help or comfort the girl) (Table 1).

Simulation exercise with a telephone using the third picture.

This exercise involved the 140 trained children of cohort C1 and 68 children of the cohort C2. Overall, 55.7% pupils of cohort C1 knew how to use the telephone correctly and how to call the SAMU (vs. 17.7% of children in cohort C2; p <0.0001) (Table 2), and 82.1% of children in cohort C1 gave their first name, last name and personal address (vs. 33.8% of C2; p <0.0001) (Table 2). Lastly, 89.3% of children in cohort C1 correctly described the situation using the keywords “cut”,” hand”, “blood” (vs. 75% of C2; p <0.01) (Table 2).

Table 2. Results: Simulation exercise with a telephone

Exercise	Criteria	C1 cohort % of expected answers (n=140)	C2 cohort % of expected answers (n=68)	Odds ratio	*p*
Use of the phone	1 - Using the telephone *(criterion 7)*	55.7% (78)	17.7% (12)	5.9	<0.0001
	2 - Introducing oneself, Explaining the location*(criterion 8)*	82.1% (115)	33.8% (23)	9	<0.0001
	3 - Describing the situation*(criterion 9)*	89.3% (125)	75% (51)	2.8	0.01

DISCUSSION

For all criteria, the majority of trained pupils gave expected answers and presented an appropriate reaction to the situation by recognizing the medical problem and appropriately raising the alert. Comparison of the two cohorts revealed significant differences in terms of the ability of pupils to describe an emergency situation and raise the alert.

Observation capacity

The situation shown in each picture had not been previously raised or discussed in class. The teachers were not aware of the assessment methods used and therefore could not have prepared their pupils beforehand. The vast majority of trained pupils spontaneously gave expected answers without prompting from their teacher, making this result even more relevant. The results related to the non-emergency situation (young girl with a broken doll) showed that the observation capacity of trained pupils was significantly better than that of

untrained pupils. The teachers of the trained cohort may have more generally emphasized observation capacities, as an emergency call to the SAMU (or to an adult) required an oral description of the situation. It would be interesting to test these capacities with other assessments comprising less obvious situations.

The situations described in the pictures focused on trauma and injuries, which correspond to common situations encountered by children. [28-30] Many emergencies in western countries deal with acute emergencies in the field of internal medicine (heart attack, stroke, etc.) but, education experts from the Ministry of Education thought that it would be too emotionally disturbing for a young child to be faced with an adult in a life-threatening situation and therefore proposed that young children should act out situations involving injured children.

Intention to alert the SAMU

A highly significant difference was observed between the two cohorts in the two situations in which the SAMU had to be alerted. This study can be compared with Bollig's study in which the same ability was assessed. [20] Despite the obvious willingness of untrained children to help, they did not know which number to dial or what role the SAMU played. It is noteworthy that trained pupils did not associate the picture of a broken doll with the need to alert emergency services as they were able to differentiate the various situations. This indicates that pupils are able to distinguish according to severity, and that the induction over-sending is less likely.

Ability to raise the alert

Overall, trained pupils felt more confident than their untrained counterparts. Although two-thirds of trained pupils intended to call the SAMU in a medical emergency situation, only about one half of them really knew how to call the SAMU with a landline. However, as a

result of age-related psychological and cognitive maturity, the child's comprehension and the intention to take a particular action may not be automatically linked.

Integrating a first aid course in the curriculum

In a pilot study of 10 children, Bollig et al. showed that kindergarten children aged 4-5 years can learn basic first aid with training provided by a first aid instructor and kindergarten teachers. [26] The results of the present study support training by teachers themselves. It was considered important for teachers to learn first aid in order to be subsequently able to teach first aid to their pupils at school as part of "daily life education". In contrast with first aid training provided by external instructors, teachers know their pupils. They can plan emergency first aid training along with other topics and assess the children in different ways. Finally, the teachers' active participation in "role-playing games", placing the child in a situation in which he/she is responsible for somebody else's health, appears to be a more efficient method to acquire complex skills, according to the concept of situated learning. [27] Teacher training lasted 6 hours. Our experience and an unpublished evaluation suggest that a 6-hour training course is sufficient. Teachers have satisfactory prior first aid knowledge and are trained in science education. This 6-hour training upgraded their knowledge and helped them to integrate first aid training in the curriculum. The effectiveness of this training needs to be evaluated and further studies are required to define the optimal design.

Limitations

This study has several limitations. As stated in the methods section, randomisation was not performed before setting up the study for ethical reasons, as the Ministry of Education refused the idea of predefining two groups with and without first aid training. Assessment of the children's performance by their own teachers could constitute a bias in favour of the trained group. As explained in the Methods section, each child were assessed by his/her own teacher. It would be interesting to investigate differences between schoolteacher and first aid instructor

interventions during a limited training period, as teachers integrate specific skills into various subjects of the curriculum, depending on the learning pace of the class. In addition, some teachers decided not to perform this assessment, which they considered to be “time-consuming and fastidious”. This study was conducted under "real life" conditions. We had to adapt our research methodology to the educational, legal and ethical requirements of the French national education system.

Our study presents a number of biases. Use of the telephone was tested in only 48% of untrained children (C2). The main bias is that some teachers failed to comply with the study protocol, leading to incomplete data collection for certain aspects of the study, highlighting the difficulties of working with teachers who are sometimes unwilling to comply with study protocols. This bias favours the trained group. The follow-up-rates differ markedly between trained and untrained children (for photographs 91.5% vs. 86.4%, and for the phone call 91.5% vs. 42.0%). This reduces the strength of our results.

Although the instructions were explained to all teachers, evaluation and interpretation of these instructions may have differed between teachers. The pictures had been previously tested on two classes, but interpretation of the pictures may nevertheless have been biased. As this study was based exclusively on pictures, it would be interesting to include the observation of videos or “role-playing games”.

As this is the first assessment of its kind, we confined ourselves to a global assessment and did not take into account variables such as gender, class atmosphere, or family background.

The child’s knowledge and ability to analyse a situation from photographs were assessed by the teacher, although it may have been preferable to assess the acquired skills in a role play situation, as performed by several authors. [20, 26] It could be difficult to ensure similar and reproducible scenarios in each school. Photographs were designed by teachers themselves and

had been previously tested on a sample of 50 children not included in the present study. Another possibility would be to evaluate children in the context of a video or serious game.

Finally, simulations present a number of limitations. No correlation can be established between the simulation used in this study and the way in which children would react in a real life emergency situation.

Prospects

In collaboration with the Ministry of Education, we discussed the possibility of increasing the complexity of the exercises on a yearly basis, which would enable revision of acquired skills and learning of new skills. [21] Assessment of pupils at the end of elementary school and in secondary school will be the subject of other studies in our research unit.

To adapt this training to the children's psychological and physical development, pupils at the end of elementary school were taught which behaviour to adopt when faced with an unconscious person who is still breathing [Table 3]. Cardiac arrest was not addressed until an age of 10 years in line with Bollig's propositions. [20, 31-32] In order to meet public health requirements, emergency first-aid training is now a compulsory part of the national curriculum in France.

Table 3 Skills / Age in the French curriculum

	Nursery school	Primary school		Secondary school	
Skills/ Age	Age 4 - 6 years	Age 6 - 8 years	Age 8 – 11 years	Age 11 – 12 years	Age 12 – 15 years
Alert - Recognize an emergency medical situation - Stay in a safe place - Tell an adult - Alert an emergency medical centre					
Trauma - Recognize a burn - Place the burned part under running water - Recognize an injury to the head, limb or spine - Avoid mobilization of the injured part - Recognize bleeding - Stop bleeding					
Consciousness					

- Recognize an unconscious person - Turn on the side					
Breathing - Look, listen and feel for breathing - Assist the person who is choking - Perform mouth to mouth*					
Circulation - Recognize a cardiac arrest - Administer chest compressions - Use automatic external defibrillator					

	Skill introduced
	Skill reinforced
	Skill acquired

IMPLICATIONS

The challenge of enabling everyone to give life-saving first aid when faced with a medical emergency implies that everyone should be trained at some point in their life. The complexity of the training suggests that this training should be started as early as possible in the educational curriculum.

The public health goal is that every pupil should learn first aid. To achieve this objective, schoolteachers must first acquire appropriate emergency skills in the classroom. The present study concerned children aged 6 years or younger attending nursery school, trained by their own teachers. It demonstrated that first aid programmes given to very young children may improve their ability to assess and describe a medical emergency situation and alert the medical emergency call centre as necessary. The results of trained pupils were significantly better than those of untrained pupils.

These preliminary results demonstrate the advantages of integrating this first aid course into the national curriculum, mainly provided by teachers themselves. Since 2006, the assessments carried out by our team support the current general implementation of this training course in all French schools. This programme is now compulsory starting at the age of 4 to 6 years.

Acknowledgements

The authors are very grateful to Mrs Kerneur and Mrs Lagarde (Ministry of National Education, France) for their very helpful contribution to this research and Mr. Jean-Michel Mercieca (Amiens University hospital) for his help.

Contributorship Statement

CA: conception of the work, analyse, draft, revising it critically for important intellectual content and final approval

RG: conception of the work, analyse, draft, revising it critically for important intellectual content and final approval

CA: interpretation of data, revising critically for important intellectual content and final approval

BN: interpretation of data, revising critically for important intellectual content and final approval

MG: interpretation of data, draft, revising it critically for important intellectual content and final approval

Competing interests

The authors have indicated they have no financial and personal relationships with other people or organisations that could inappropriately influence this article.

Funding

None

Data sharing

None additional data available

Figure legends

Figure 1: Flowchart

Figure 2: Photograph 1. A Boy Who Has Fallen Off a Stepladder and Is Holding His Leg

Figure 3: Photograph 2. A Young Girl Crying Because She Has Broken Her Doll.

Figure 4: Photograph 3. A Young Boy Who Has Injured His Hand While Peeling An Apple.

Abbreviations: SAMU - Service d'aide médicale urgente; 95% CI - 95% confidence interval

REFERENCES

1. IFRC. International first aid and resuscitation guidelines 2011. Geneva: International Federation of Red Cross and Red Crescent Societies, 2011.
2. Guidelines for basic life support. A statement by the Basic Life Support Working Party of the European Resuscitation Council, 1992. *Resuscitation.* 1992;24:103-110.
3. American Academy of Pediatrics Committee on School Health. Basic life support training school. *Pediatrics.* 1993;91:158-159.
4. Lester CA, Weston CF, Donnelly PD, et al. The need for wider dissemination of CPR skills: are schools the answer? *Resuscitation.* 1994;28:233-237.
5. Eisenburger P, Safar P. Life supporting first aid training of the public--review and recommendations. *Resuscitation.* 1999;41:3-18.
6. Education in resuscitation: An ILCOR symposium: Utstein Abbey, Stavanger Norway. June 2001. *Circulation* 2003;108:2575-2594.
7. C. Amsallem, C. Ammirati, M. Gignon, et al. Appel d'un enfant: rôle de la régulation médicale. In. Urgences 2011, Société Française de Médecine d'Urgences, 2011:1035-44.
8. Jones I, Whitfield R, Colquhoun M, et al. At what age can schoolchildren provide effective chest compressions? An observational study from the Heartstart UK schools training programme. *BMJ* 2007;334(7605):1201.
9. Plant N, Taylor K. How best to teach CPR to schoolchildren: a systematic review. *Resuscitation* 2013;84(4):415-21. doi: 10.1016/j.resuscitation.2012.12.008.

10. Abelairas-Gómez C, Rodríguez-Núñez A, Casillas-Cabana M, et al. Schoolchildren as life savers: at what age do they become strong enough? *Resuscitation* 2014;85(6):814-9. doi: 10.1016/j.resuscitation.2014.03.001.

11. Bohn A, Van Aken HK, Möllhoff T, et al. Teaching resuscitation in schools: annual tuition by trained teachers is effective starting at age 10. A four-year prospective cohort study. Resuscitation. 2012 May;83(5):619-25. doi: 10.1016/j.resuscitation.2012.01.020.

12. Bohn A, Van Aken H, Lukas RP, et al. Schoolchildren as lifesavers in Europe – Training in cardiopulmonary resuscitation for children, Best Pract Res Clin Anaesthesiol 2013;27:387-96.

13. Koster RW, Baubin MA, Bossaert LL, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 2. Adult basic life support and use of automated external defibrillators. Resuscitation. 2010;81(10):1277-92. doi: 10.1016/j.resuscitation.2010.08.009.

14. Lester C, Donnelly P, Weston C, et al. Teaching schoolchildren cardiopulmonary resuscitation. *Resuscitation.* 1996;31:33-38.

15. Lewis RM, Fulstow R, Smith GB. The teaching of cardiopulmonary resuscitation in schools in Hampshire. *Resuscitation.* 1997;35:27-31.

16. Bernardo LM, Doyle C, Bryn S. Basic emergency lifesaving skills (BELS): a framework for teaching skills to children and adolescents. *Int J Trauma Nurs.* 2002;8:48-50.

17. Uray T, Lunzer A, Ochsenhofer A, et al. Feasibility of life-supporting first aid (LSFA) training as a mandatory subject in primary schools. *Resuscitation.* 2003;59:211-220.

18. Lubrano R, Romero S, Scoppi P, et al. How to become an under 11 rescuers: a practical method to teach first aid to primary schoolchildren. *Resuscitation.* 2005;64:303-307.

19. Thurston M. Emergency life support training for school children: exploring local implementation and outcomes of the Heartstart UK School Programme within the context of the National Healthy School Standard. *Centre for Public Health Research, University of Chester, externally commissioned research reports,* 2005:1-86.

20. Bollig G, Walh H A, Svendsen MV. Primary school children are able to perform basic life-saving first aid measures, *Resuscitation*, 2009;80:689–692.

21. He Z, Wynn P, Kendrick D. Non-resuscitative first-aid training for children and laypeople: a systematic review. *Emerg Med J.* 2013; 18. doi: 10.1136/emermed-2013-202389.

22. Tardif J. Pour un enseignement stratégique. L'apport de la psychologie cognitive. 2ème edition. Ed Logiques 1997.

23. Kohlberg L. Moral stages and Moralization: The Cognitive-developmental Approach. In: Lickona T, eds. *Moral development and behavior: Theory, research, and social issues*. New-York, NY: Holt, Rinehart & Winston 1976:31-53.

24. Smith PL, Ragan TJ. Strategies for psychomotor skill learning. In: *Instructional Design*. 3rd ed. Chap. 15, Hoboken, NJ:Wiley 2005:276-283.

25. Bruner J. The process of education, Cambridge, MA: Harvard University Press 1960.

26. Bollig G, Myklebust AG, Østringen K. Effects of first aid training in the kindergarten--a pilot study. Scand J Trauma Resusc Emerg Med. 2011 Feb 28;19:13. doi: 10.1186/1757-7241-19-13.

27. Lave J, Wenger E. Situated Learning: Legitimate Peripheral Participation. Cambridge University Press. 1991.

28. Enquête Permanente sur les accidents de la vie courante. Résultats 2012. Institut de Veille Sanitaire, Saint Denis, 2012. http://www.invs.sante.fr/content/download/83774/306579/version/1/file/TR13G263_%28resultats_Epac2012%29.pdf (accessed 10 July 2014).

29. Principales causes de décès des jeunes et des enfants en 2011. Institut national de la statistique et des études économiques, 2011. http://www.insee.fr/fr/themes/tableau.asp?ref_id=NATCCJ06206&reg_id=0 (accessed 10 july 2014).

30. Philippakis A1, Hemenway D, Alexe DM, et al. A quantification of preventable unintentional childhood injury mortality in the United States. Inj Prev. 2004 Apr;10(2):79-82.

31. Bollig G. First Aid and the family. In: Craft-Rosenberg M, Pehler SR. Encyclopaedia of Family Health, SAGE Publications, Thousand Oaks 2011.

32. Bollig G. First Aid Training in the Kindergarten: A Review of the Literature and Reflections from Practical Experience in Two Countries. NOVA Science Publishers New York 2013.

Are schoolteachers able to teach first aid to children younger than 6 years? A comparative study.

Short title: Emergency first aid training for children

Christine Ammirati[a, b, c], Rémi Gagnayre[b], Carole Amsallem[a, c], Bernard Némitz[a], Maxime Gignon[b, c, d]

[a] Emergency Medicine Department, University Hospital of Amiens, France

[b] University Paris 13, Sorbonne Paris Cité, Laboratory Education and Health Practices, EA3412 Bobigny, France

[c] Active Teaching and Health Simulation Training Centre (CPA-SimUSanté©), Amiens, France

[d] Public Health department, University Hospital of Amiens, France

Address correspondence to:

Prof. Christine AMMIRATI, MD, PhD

Professor

CHU d'Amiens

Service de médecine d'urgence

Place Victor Pauchet

F-80000 Amiens

Phone: +33 3 22 66 84 60

Fax: +33 3 22 66 87 13

E-mail: christine.ammirati@chu-amiens.fr

Keywords: Education, Child, Preschool, Educational Measurement, first aid, Schools.

Word count: 3 679~~3 725~~

Formatted: Section start: Continuous

ABSTRACT

Objectives. This study was designed to assess the knowledge acquired by very young children (< 6 years) trained by their own teachers at nursery school. This comparative study assessed the effect of training before the age of 6 years compared with a group of age-matched untrained children. **Setting.** Some schoolteachers were trained by emergency medical teams to perform basic first aid. **Participants.** Eighteen classes comprising 315 pupils were randomly selected: nine classes of trained pupils (cohort C1) and nine classes of untrained pupils (cohort C2). **Primary and secondary outcome measures.** The test involved observing and describing three pictures and using the phone to call the medical emergency centre. Assessment of each child was based on nine criteria, and was performed by the teacher 2 months after completion of first aid training. **Results.** This study concerned 285 pupils: 140 trained and 145 untrained. The majority of trained pupils gave the expected answers for all criteria and reacted appropriately by assessing the situation and alerting emergency services (55.7−89.3% according to the questions). Comparison of the two groups revealed a significantly greater ability of trained pupils to describe an emergency situation ($p<0.005$) and raise the alert ($p<0.0001$). **Conclusions.** This study shows the ability of very young children to assimilate basic skills as taught by their own schoolteachers.

Keywords: Education, Child, Preschool, Educational Measurement, first aid, Schools.

“Strengths and limitations of this study”

- This study was designed to assess the knowledge and the ability to analyse situations acquired by very young children (< 6 years) trained by their own teachers at nursery school.

- This study demonstrated that first aid programmes for very young children can improve their ability to assess and describe a medical emergency situation and alert the medical emergency centre.
- As required by the French national education system, randomisation was performed *post hoc* by the Ministry of Education and the children's performance was assessed by their own teachers.
- No correlation can be established between the simulation used in this study and the way in which children would react in a real life emergency situation.

INTRODUCTION

In France, all trainee schoolteachers must learn basic first aid to be applied in the classroom and to be taught to their pupils. More than 9,875,000 school children ranging from 4-year-old nursery schoolchildren to end of secondary school teenagers, about 14 to 15 years of age, should receive this first aid training. This programme is called "*apprendre à porter secours*" ("learn how to help") and pupils can obtain a "basic-life saving diploma" at the end of secondary school. In a medical emergency, it is essential for the first witness to raise the alert and provide emergency first aid as soon as possible. First aid has been defined as help given to any "sick or injured person until professional help arrives". [1] The challenge of enabling everyone to provide life-saving first aid when faced with a medical emergency implies that everyone should be trained at some point in their life. The construction of knowledge and skills ~~that~~ can be easily mobilized in a medical emergency ~~situation suggests~~situation. ~~that this training should be started as early as possible in the educational curriculum. The public health goal is that every pupil should learn first aid, as laypersons play an important role in saving lives in emergency situations. Many experts now recommend training children starting at primary school to ensure that these skills are deeply and permanently ingrained.~~ Many experts and Emergency medicine societies recommend teaching first aid at school so that every citizen knows how to perform first aid appropriately and raise emergency alerts at the earliest possible time. [2-6] Children can provide first aid measures and save lives by recognizing life-threatening emergency situations and by making an emergency call. [7] ~~A young child may be the only person present in the event of an emergency and first aid education should therefore be started as early as feasible.~~

Although up to now there is no proof of positive effects of first aid measures on patient outcome, except from Basic Life Support. In addition, there could concern about adverse

effects of training, like recovery position performed by lays during cardiac arrest. However, one important obstacle to perform bystander CPR is the attitude towards helping. This is a fundamental problem in the general population which could be addressed by first aid training at early childhood.

The age and weight of schoolchildren are significant factors determining the quality of cardiopulmonary resuscitation [8], as the depth of chest compression correlates with physical factors such as weight, Body Mass Index and height. [9] Abelairas-Gómez et al. showed that thirteen years was the minimum age at which children are able to achieve a minimum CPR quality similar to that achieved by adults. [10] However, determining an age is controversial. [8-11] This results do not justify to withhold CPR training from younger children. Children who underwent training in younger years significantly improved their performance after 3-4 years. [9, 11, 12] Young children who are not yet physically able to compress the chest can nevertheless be taught ~~-~~how to perform appropriate first aid, and can therefore~~.~~ be the first link of the Chain of Survival by calling for help. [1~~1~~3]

Published studies on emergency first aid training at school have focused on children aged 6 years or older, often trained by first aid instructors. [142-~~24~~20] A recent systematic review highlighted that no conclusions can be drawn concerning the most effective first-aid training courses or programmes or the age at which training can be most effectively provided. [2~~5~~1] It is important to assess the effectiveness of standardised first-aid training as a basis for policy development and provision of first-aid training. More evidence is required to determine the most appropriate types of training according to the child's age, taking into account the child's psychomotor development and degree of autonomy.

Very limited scientific literature is available concerning children under the age of 6 years. Studies on emergency first aid training at school have focused on children often trained by

first aid instructors, while few studies have assessed emergency first aid training at school provided by teachers themselves.

However, there are a number arguments in favour of training provided by teachers, [26~~2~~-29~~5~~] as they know their pupils and their representations and can work on the basis of their previous knowledge and experience. Teachers are familiar with each child's sensitivity and can measure the emotional charge associated with emergency situations. The teacher establishes a relationship of trust with the child and can use situations experienced in the classroom as a pretext for learning and enhancing knowledge. The teacher is familiar with the required curriculum and skills. The teacher is a mentor, and the child is able to imitate the teacher's first aid skills.

The aims of this preliminary study were to assess the knowledge and abilities of very young children trained in the nursery by their own teacher and to compare the results with those of age-matched untrained children.

METHODS

This study, carried out in the Somme department (560,000 inhabitants), was supervised by the University Hospital emergency medicine department, national education teachers, and a University research unit specialised in health education. This study took place in "real life." Due to the importance of public health issue, we were required to adapt our research methodology to the national education system's educational, legal and ethical constraints.

Intervention

Training of teachers.

A programme was initially developed to train teachers in basic first aid to deal with an emergency situation. The most common emergency situations occurring in elementary schools were used to design this programme. In the Somme department, 2,200 of all 3,300 elementary schoolteachers have been trained by emergency medical teams, assisted by Ministry of Education health professionals since 2002. During a 6-hour training session, the teachers learned when to alert the medical call centre and how to act when faced with trauma, burns, bleeding, a choking victim, or an unconscious person. Teachers received first aid training to improve their prior knowledge and then worked on educational applications in the context of nursery schools. This training was conducted by emergency medical teams and education specialists, assisted by Ministry of Education health professionals.

Training of children by teachers.

After training, the teachers had to integrate specific skills into various subjects of the curriculum, depending on the learning pace of the class. The children's psychological, cognitive, and moral development was taken into account when setting up the course. The principle of the course is to plan a yearly increase in complexity, allowing the revision of acquired skills and the learning of new skills. [2~~7~~3-~~31~~27] Young children in nursery schools should be able to recognize an "unusual" situation and alert the medical emergency call centre. To do so, they need to dial the emergency medical number (Phone: 15, SAMU in France), describe what they have observed, and name the various parts of the human body. Children aged between 6 and 8 years must be able to alert the SAMU by precisely locating the event. They must be able to describe injuries and perform simple tasks to deal with a burn, a bleeding wound or trauma. Children aged between 9 and 11 years must be able to recognize an unconscious patient, determine the presence of breathing and place the unconscious person on the side. They learn how to assist a person who is choking and perform chest compression

and defibrillation in the case of cardiac arrest in secondary education. The progression of the child's abilities during the curriculum was assessed in the Somme department.

Teachers have introduced first aid knowledge and skills into the curriculum, suitable to the child's stage of psychological, cognitive, and emotional development, as recommended by experts in the education of young children. For example, when teaching basic anatomy, teachers addressed the issue of how to deal with trauma. The number of hours of training therefore cannot be assessed in the context of this educational approach adapted to young children.

Participants

Due to the requirements of the national education system, in nursery schools in this area, some children were trained by their teachers, while others were not, because their teachers did not wish to train them or were not trained themselves. This study was approved by the regional section of the Ministry of Education, which designated part of the region to participate in this study (80 schools, n=1,360 pupils). Eighteen classes comprising 315 pupils were randomly selected: nine classes of trained pupils and nine classes of untrained pupils (Figure 1). The untrained pupils had never received any first aid education. The families gave their consent to this study.

Instrumentation

The children's ability to observe pictures, and then to use a telephone to raise an alert were assessed. Three pictures illustrated three different situations, one of which did not require alerting the SAMU:

- A boy who has fallen off a stepladder and who is holding his leg (Figure 2).

- A young girl crying because she has broken her doll (Figure 3).

Formatted: Left: 0.98", Right: 0.98", Top: 0.98", Bottom: 0.98", Section start: Continuous, Header distance from edge: 0.49", Footer distance from edge: 0.49"

- A young boy who has injured his hand while peeling an apple (Figure 4).

Assessment of each child was based on nine criteria, and was performed by the teacher 2 months after completion of first aid training. These nine criteria consisted of answers to the following questions testing the child's ability to observe each picture and decide whether or not to raise an alert: "*What is happening?"* and *"You are alone with him (her), nobody is here to help you, what would you do?"* The answers were classified into two categories: "expected answer" (with key-words or synonyms) or "other answer".

The expected answer in relation to the first picture was: *"He has fallen over, his leg hurts"*. The expected answer in relation to the second picture was: *"She has broken her doll and is crying"* and the expected answer in relation to the third photograph was *"He has cut himself, he is bleeding"*. The child was required to *"alert the SAMU"* for the first and third situations The teacher then tested the pupil's ability to alert the SAMU in relation to the third picture. The teacher gave the children access to a standard landline telephone, playing the role of the SAMU emergency doctor. When the child did not use the telephone spontaneously, the teacher encouraged the child to do so. The teacher's instructions were**:** *"You see, he has cut himself, he is bleeding. You are alone at home with him, the SAMU must be alerted, do it!"*

The assessment of the child's reaction was binary: did or did not. The three criteria were;

- using the telephone;
- introducing himself, explaining where he is;
- describing the situation.

The pictures had been previously tested on two classes (not included in this study).

Procedure

The national education system required each child to be assessed by his/her own teacher because children of this age are not usually assessed, especially by an unknown adult not part of the classroom. In order to obtain the most objective results possible, written instructions

were given and discussed individually with each teacher approximately 2 months after completion of first aid training.

Data Analysis

To ensure anonymous grids, the results were collected by Ministry of Education staff. For reasons of confidentiality required by the national education system, the researchers did not have access to personal data from children. Only fully completed assessments were analyzed. Data were presented as percentages with 95% confidence intervals (95% CI). Statistical analysis of the results was performed using a Chi-square test (significance level: $p < 0.05$). analyses were performed using the Statistical Package for the Social Sciences (version 11.0, SPSS, Inc).

RESULTS

For the overall analysis, 315 pupils were prospectively evaluated, 285 with complete grids were included: 140 trained children (cohort C1) and 145 untrained children (cohort C2) (Figure 1). The sex ratio (male/female) was 0.94 and the mean age was 5.4 years.

Only 68 children in cohort C2 were tested for their use of the telephone, as some teachers decided not to complete this assessment, which they considered to be time-consuming and fastidious.

Children's ability to observe pictures, describe the situation and raise the alert (Table 1).

The majority of trained pupils were able to describe the three pictures and gave the expected answers (67.9%, 71.4% and 75.7%, respectively). The ability to observe and describe the situation was significantly higher in cohort C1 for the three pictures ($p<0.001$ for the first and second pictures and $p<0.01$ for the third picture).

Table 1. Results: Children's ability to observe pictures

Exercise	Question & - *Expected answers*	C1 cohort % of expected answers (n=140)	C2 cohort % of expected answers (n=145)	Odds ratio	*P value*
Photograph 1	What is going on? - *He has fallen over, his leg hurts (criterion 1)*	67.9% (95)	45.5% (66)	2.5	<0.001
	You are alone at home, what do you do? -*I call the SAMU (criterion 2)*	62.1% (87)	8.3% (12)	18.2	<0.0001
Photograph 2	What is going on? - *She has broken her doll and is crying (criterion 3)*	71.4% (100)	41.4% (60)	3.5	<0.0001
	You are alone at home, what do you do? - *I do not call the SAMU (criterion 4)*	75% (105)	75.9% (110)	-	0.24
Photograph 3	What is going on? - *He has cut himself, he is bleeding (criterion 5)*	75.7% (106)	60.0% (87)	2.8	0.01

You are alone at home, what do you do? *- I call the SAMU (criterion 6)*	66.4% (93)	13.8% (20)	12.4	<0.0001

When the SAMU had to be alerted, the majority of trained pupils were willing to raise the alert.

A marked difference was observed between the two cohorts in terms of alerting the SAMU, which was significantly higher in cohort C1 ($p<0.0001$). In relation to the first picture, 61.9% of children in cohort C2 were willing to help the injured child after the picture had been explained to them, but did not know who to alert (73.8% for the third picture). Note that 23% of pupils in cohort C1 and 43.8% of pupils in cohort C2 misinterpreted picture 2 and the intention to act was not significantly different between the two groups (to help or comfort the girl) (Table 1).

Simulation exercise with a telephone using the third picture.

This exercise involved the 140 trained children of cohort C1 and 68 children of the cohort C2. Overall, 55.7% pupils of cohort C1 knew how to use the telephone correctly and how to call the SAMU (vs. 17.7% of children in cohort C2; $p<0.0001$) (Table 2), and 82.1% of children in cohort C1 gave their first name, last name and personal address (vs. 33.8% of C2; $p<0.0001$) (Table 2). Lastly, 89.3% of children in cohort C1 correctly described the situation using the keywords “cut”,” hand”, “blood” (vs. 75% of C2; $p<0.01$) (Table 2).

Table 2. Results: Simulation exercise with a telephone

Exercise	Criteria	C1 cohort % of expected answers (n=140)	C2 cohort % of expected answers (n=68)	Odds ratio	*p*
Use of the phone	1 - Using the telephone *(criterion 7)*	55.7% (78)	17.7% (12)	5.9	<0.0001
	2 - Introducing oneself, Explaining the location*(criterion 8)*	82.1% (115)	33.8% (23)	9	<0.0001
	3 - Describing the situation*(criterion 9)*	89.3% (125)	75% (51)	2.8	0.01

DISCUSSION

For all criteria, the majority of trained pupils gave expected answers and presented an appropriate reaction to the situation by recognizing the medical problem and appropriately raising the alert. Comparison of the two cohorts revealed significant differences in terms of the ability of pupils to describe an emergency situation and raise the alert.

Observation capacity

The situation shown in each picture had not been previously raised or discussed in class. The teachers were not aware of the assessment methods used and therefore could not have prepared their pupils beforehand. ~~A significant difference was observed between the two cohorts, reflecting the existence of cognitive links between the test situations.~~ The vast majority of trained pupils spontaneously gave expected answers without prompting from their teacher, making this result even more relevant. The results related to the non-emergency

situation (young girl with a broken doll) showed that the observation capacity of trained pupils was significantly better than that of untrained pupils. The teachers of the trained cohort may have more generally emphasized observation capacities, as an emergency call to the SAMU (or to an adult) required an oral description of the situation~~. It is difficult to define this aspect from these results alone:~~. ~~i~~ It would be interesting to test these capacities with other assessments comprising less obvious situations.

The situations described in the pictures focused on trauma and injuries, which correspond to common situations encountered by children. [~~32~~28-3~~04~~] Many emergencies in western countries deal with acute emergencies in the field of internal medicine (heart attack, stroke, etc.) but, education experts from the Ministry of Education thought that it would be too emotionally disturbing for a young child to be faced with an adult in a life-threatening situation and therefore proposed that young children should act out situations involving injured children.

Intention to alert the SAMU

A highly significant difference was observed between the two cohorts in the two situations in which the SAMU had to be alerted. This study can be compared with Bollig's study in which the same ability was assessed. [~~24~~20] Despite the obvious willingness of untrained children to help, they did not know which number to dial or what role the SAMU played. It is noteworthy that trained pupils did not associate the picture of a broken doll with the need to alert emergency services as they were able to differentiate the various situations. This indicates that pupils are able to distinguish according to severity, and that the induction over-sending is less likely.

Ability to raise the alert

Overall, trained pupils felt more confident than their untrained counterparts. Although two-thirds of trained pupils intended to call the SAMU in a medical emergency situation, only about one half of them really knew how to call the SAMU with a landline. However, as a result of age-related psychological and cognitive maturity, the child's comprehension and the intention to take a particular action may not be automatically linked.

~~This difference between intention and ability to act shows that learning methods must be based on real-life situations and must be regularly revised.~~

Integrating a first aid course in the curriculum

In a pilot study of 10 children, Bollig et al. showed that kindergarten children aged 4-5 years can learn basic first aid with training provided by a first aid instructor and kindergarten teachers. [~~30~~26] The results of the present study support training by teachers themselves. It was considered important for teachers to learn first aid in order to be subsequently able to teach first aid to their pupils at school as part of "daily life education". In contrast with first aid training provided by external instructors, teachers know their pupils. They can plan emergency first aid training along with other topics and assess the children in different ways. Finally, the teachers' active participation in "role-playing games", placing the child in a situation in which he/she is responsible for somebody else's health, appears to be a more efficient method to acquire complex skills, according to the concept of situated learning. [~~31~~27]

Teacher training lasted 6 hours. Our experience and an unpublished evaluation suggest that a 6-hour training course is sufficient. Teachers have satisfactory prior first aid knowledge and are trained in science education. This 6-hour training upgraded their knowledge and helped them to integrate first aid training in the curriculum. The effectiveness of this training needs to be evaluated and further studies are required to define the optimal design.

Limitations

This study has several limitations. As stated in the methods section, rRandomisation was not performed before setting up the study~~, but was performed *post hoc* by the Ministry of Education, at their request~~ for ethical reasons, as the Ministry of Education refused the idea of predefining two groups with and without first aid training. ~~A consensus therefore had to be found to randomly select classes receiving and not receiving first aid training.~~ Assessment of the children's performance by their own teachers could constitute a bias in favour of the trained group. As explained in the Methods section, ~~the national education system required~~ each child ~~to~~ were~~be~~ assessed by his/her own teacher~~ because children of this age are not usually assessed, especially by an unknown adult not part of the classroom~~. It would be interesting to investigate differences between schoolteacher and first aid instructor interventions during a limited training period, as teachers integrate specific skills into various subjects of the curriculum, depending on the learning pace of the class. In addition, some teachers decided not to perform this assessment, which they considered to be "time-consuming and fastidious". This study was conducted under "real life" conditions. We had to adapt our research methodology to the educational, legal and ethical requirements of the French national education system.

Our study presents a number of biases. Use of the telephone was tested in only 48% of untrained children (C2)~~.~~. The main bias is that some teachers failed to comply with the study protocol, leading to incomplete data collection for certain aspects of the study, highlighting the difficulties of working with teachers who are sometimes unwilling to comply with study protocols. This bias favours the trained group. The follow-up-rates differ markedly between trained and untrained children (for photographs 91.5% vs. 86.4%, and for the phone call 91.5% vs. 42.0%). This reduces the strength of our results.

Although the instructions were explained to all teachers, evaluation and interpretation of these instructions may have differed between teachers. The pictures had been previously tested on two classes, but interpretation of the pictures may nevertheless have been biased. As this study was based exclusively on pictures, it would be interesting to include the observation of videos or "role-playing games". ~~A size difference was also observed between the two cohorts for the last exercise.~~

As this is the first assessment of its kind, we confined ourselves to a global assessment and did not take into account variables such as gender, class atmosphere, or family background. The child's knowledge and ability to analyse a situation from photographs were assessed~~. For practical reasons, as this assessment was performed~~ by the teacher ~~in each classroom~~, although it may have been preferable to assess the acquired skills in a role play situation, as performed by several authors. [~~24~~20, ~~30~~26] It could be difficult to ensure similar and reproducible scenarios in each school. Photographs were designed by teachers themselves and had been previously tested on a sample of 50 children not included in the present study. Another possibility would be to evaluate children in the context of a video or serious game. Finally, simulations present a number of limitations. No correlation can be established between the simulation used in this study and the way in which children would react in a real life emergency situation.

Prospects

In collaboration with the Ministry of Education, we discussed the possibility of increasing the complexity of the exercises on a yearly basis, which would enable revision of acquired skills and learning of new skills. [~~25~~21] Assessment of pupils at the end of elementary school and in secondary school will be the subject of other studies in our research unit.

To adapt this training to the children's psychological and physical development, pupils at the end of elementary school were taught which behaviour to adopt when faced with an unconscious person who is still breathing [Table 3]. Cardiac arrest was not addressed until an age of 10 years ~~high school~~ in line with Bollig's propositions. [~~24~~20, ~~35~~31-3~~26~~] In order to meet public health requirements, emergency first-aid training is now a compulsory part of the national curriculum in France.

Table 3 Skills / Age in the French curriculum

	Nursery school	Primary school		Secondary school	
Skills/ Age	Age 4 - 6 years	Age 6 - 8 years	Age 8 – 11 years	Age 11 – 12 years	Age 12 – 15 years
Alert - Recognize an emergency medical situation - Stay in a safe place - Tell an adult - Alert an emergency medical centre					
Trauma - Recognize a burn - Place the burned part under running water - Recognize an injury to the head, limb or spine - Avoid mobilization of the injured part - Recognize bleeding - Stop bleeding					
Consciousness					

- Recognize an unconscious person - Turn on the side					
Breathing - Look, listen and feel for breathing - Assist the person who is choking - Perform mouth to mouth*					
Circulation - Recognize a cardiac arrest - Administer chest compressions - Use automatic external defibrillator					

	Skill introduced
	Skill reinforced
	Skill acquired

IMPLICATIONS

The challenge of enabling everyone to give life-saving first aid when faced with a medical emergency implies that everyone should be trained at some point in their life. The complexity of the training suggests that this training should be started as early as possible in the educational curriculum.

The public health goal is that every pupil should learn first aid. To achieve this objective, schoolteachers must first acquire appropriate emergency skills in the classroom. The present study concerned children aged 6 years or younger attending nursery school, trained by their own teachers. It demonstrated that first aid programmes given to very young children may improve their ability to assess and describe a medical emergency situation and alert the medical emergency call centre as necessary. The results of trained pupils were significantly better than those of untrained pupils.

These preliminary results demonstrate the advantages of integrating this first aid course into the national curriculum, mainly provided by teachers themselves. Since 2006, the assessments carried out by our team support the current general implementation of this training course in all French schools. This programme is now compulsory starting at the age of 4 to 6 years.

Acknowledgements

The authors are very grateful to Mrs Kerneur and Mrs Lagarde (Ministry of National Education, France) for their very helpful contribution to this research and Mr. Jean-Michel Mercieca (Amiens University hospital) for his help.

Contributorship Statement

CA: conception of the work, analyse, draft, revising it critically for important intellectual content and final approval

RG: conception of the work, analyse, draft, revising it critically for important intellectual content and final approval

CA: interpretation of data, revising critically for important intellectual content and final approval

BN: interpretation of data, revising critically for important intellectual content and final approval

MG: interpretation of data, draft, revising it critically for important intellectual content and final approval

Competing interests

The authors have indicated they have no financial and personal relationships with other people or organisations that could inappropriately influence this article.

Funding

None

Data sharing

None

Figure legends

Figure 1: Flowchart

Figure 2: Photograph 1. A Boy Who Has Fallen Off a Stepladder and Is Holding His Leg

Figure 3: Photograph 2. A Young Girl Crying Because She Has Broken Her Doll.

Figure 4: Photograph 3. A Young Boy Who Has Injured His Hand While Peeling An Apple.

Abbreviations: SAMU - Service d'aide médicale urgente; 95% CI - 95% confidence interval

Formatted: French (France)

REFERENCES

1. IFRC. International first aid and resuscitation guidelines 2011. Geneva: International Federation of Red Cross and Red Crescent Societies, 2011.

2. Guidelines for basic life support. A statement by the Basic Life Support Working Party of the European Resuscitation Council, 1992. *Resuscitation.* 1992;24:103-110.
3. American Academy of Pediatrics Committee on School Health. Basic life support training school. *Pediatrics.* 1993;91:158-159.
4. Lester CA, Weston CF, Donnelly PD, et al. The need for wider dissemination of CPR skills: are schools the answer? *Resuscitation.* 1994;28:233-237.
5. Eisenburger P, Safar P. Life supporting first aid training of the public--review and recommendations. *Resuscitation.* 1999;41:3-18.
6. Education in resuscitation: An ILCOR symposium: Utstein Abbey, Stavanger Norway. June 2001. *Circulation* 2003;108:2575-2594.
7. C. Amsallem, C. Ammirati, M. Gignon, et al. Appel d'un enfant: rôle de la régulation médicale. In. Urgences 2011, Société Française de Médecine d'Urgences, 2011:1035-44.
8. Jones I, Whitfield R, Colquhoun M, et al. At what age can schoolchildren provide effective chest compressions? An observational study from the Heartstart UK schools training programme. *BMJ* 2007;334(7605):1201.
9. Plant N, Taylor K. How best to teach CPR to schoolchildren: a systematic review. *Resuscitation* 2013;84(4):415-21. doi: 10.1016/j.resuscitation.2012.12.008.
10. Abelairas-Gómez C, Rodríguez-Núñez A, Casillas-Cabana M, et al. Schoolchildren as life savers: at what age do they become strong enough? *Resuscitation* 2014;85(6):814-9. doi: 10.1016/j.resuscitation.2014.03.001.
11. Bohn A, Van Aken HK, Möllhoff T, et al. Teaching resuscitation in schools: annual tuition by trained teachers is effective starting at age 10. A four-year prospective cohort study. Resuscitation. 2012 May;83(5):619-25. doi: 10.1016/j.resuscitation.2012.01.020.

Formatted: Bullets and Numbering

12. Bohn A, Van Aken H, Lukas RP, et al. Schoolchildren as lifesavers in Europe – Training in cardiopulmonary resuscitation for children, Best Pract Res Clin Anaesthesiol 2013;27:387-96.

~~11.~~13. Koster RW, Baubin MA, Bossaert LL, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 2. Adult basic life support and use of automated external defibrillators. Resuscitation. 2010;81(10):1277-92. doi: 10.1016/j.resuscitation.2010.08.009.

~~12.Lind B. Teaching resuscitation in primary schools. *Anaesthesist* 1973;22:464-465.~~

~~13.Berkebile P, Benson D, Ersoz C, et al. Public education in heart-lung resuscitation. Evaluation of three self-training methods in teenagers. Proceedings of the National Conference on Standards for Cardiopulmonary Resuscitation and Emergency Cardiac Care. Dallas, TX: *American Heart Association;* 1975:13-23.~~

~~14.Vanderschmidt H, Burnap TK, Thwaites JK. Evaluation of a cardiopulmonary resuscitation course for secondary schools. *Med Care.* 1975;13:763-774.~~

~~15.Gardiner AW. Teaching first aid to children. *Br Med J.* 1977;2:1088.~~

~~16.Plotnikoff R. Retention of expired air resuscitation skills of sixth class students. *Environ Health Rev.* 1986;18:35-49.~~

~~17.Plotnikoff R, Moore PJ. Retention of cardiopulmonary resuscitation knowledge and skills by 11- and 12-year-old children. *Med J Aust.* 1989;150:296-302.~~

~~18.~~14. Lester C, Donnelly P, Weston C, et al. Teaching schoolchildren cardiopulmonary resuscitation. *Resuscitation.* 1996;31:33-38.

~~19.~~15. Lewis RM, Fulstow R, Smith GB. The teaching of cardiopulmonary resuscitation in schools in Hampshire. *Resuscitation.* 1997;35:27-31.

~~20.~~16. Bernardo LM, Doyle C, Bryn S. Basic emergency lifesaving skills (BELS): a framework for teaching skills to children and adolescents. *Int J Trauma Nurs.* 2002;8:48-50.

~~21.~~17. Uray T, Lunzer A, Ochsenhofer A, et al. Feasibility of life-supporting first aid (LSFA) training as a mandatory subject in primary schools. *Resuscitation.* 2003;59:211-220.

~~22.~~18. Lubrano R, Romero S, Scoppi P, et al. How to become an under 11 rescuers: a practical method to teach first aid to primary schoolchildren. *Resuscitation.* 2005;64:303-307.

~~23.~~19. Thurston M. Emergency life support training for school children: exploring local implementation and outcomes of the Heartstart UK School Programme within the context of the National Healthy School Standard. *Centre for Public Health Research, University of Chester, externally commissioned research reports,* 2005:1-86.

~~24.~~20. Bollig G, Walh H A, Svendsen MV. Primary school children are able to perform basic life-saving first aid measures, *Resuscitation*, 2009;80:689–692.

~~25.~~21. He Z, Wynn P, Kendrick D. Non-resuscitative first-aid training for children and laypeople: a systematic review. *Emerg Med J.* 2013; 18. doi: 10.1136/emermed-2013-202389.

~~26.~~22. Tardif J. Pour un enseignement stratégique. L'apport de la psychologie cognitive. 2ème edition. Ed Logiques 1997.

~~27.~~23. Kohlberg L. Moral stages and Moralization: The Cognitive-developmental Approach. In: Lickona T, eds. *Moral development and behavior: Theory, research, and social issues*. New-York, NY: Holt, Rinehart & Winston 1976:31-53.

~~28.~~24. Smith PL, Ragan TJ. Strategies for psychomotor skill learning. In: *Instructional Design*. 3rd ed. Chap. 15, Hoboken, NJ:Wiley 2005:276-283.

~~29.~~25. Bruner J. The process of education, Cambridge, MA: Harvard University Press 1960.

~~30.~~26. Bollig G, Myklebust AG, Østringen K. Effects of first aid training in the kindergarten--a pilot study. Scand J Trauma Resusc Emerg Med. 2011 Feb 28;19:13. doi: 10.1186/1757-7241-19-13.

~~31.~~27. Lave J, Wenger E. Situated Learning: Legitimate Peripheral Participation. Cambridge University Press. 1991.

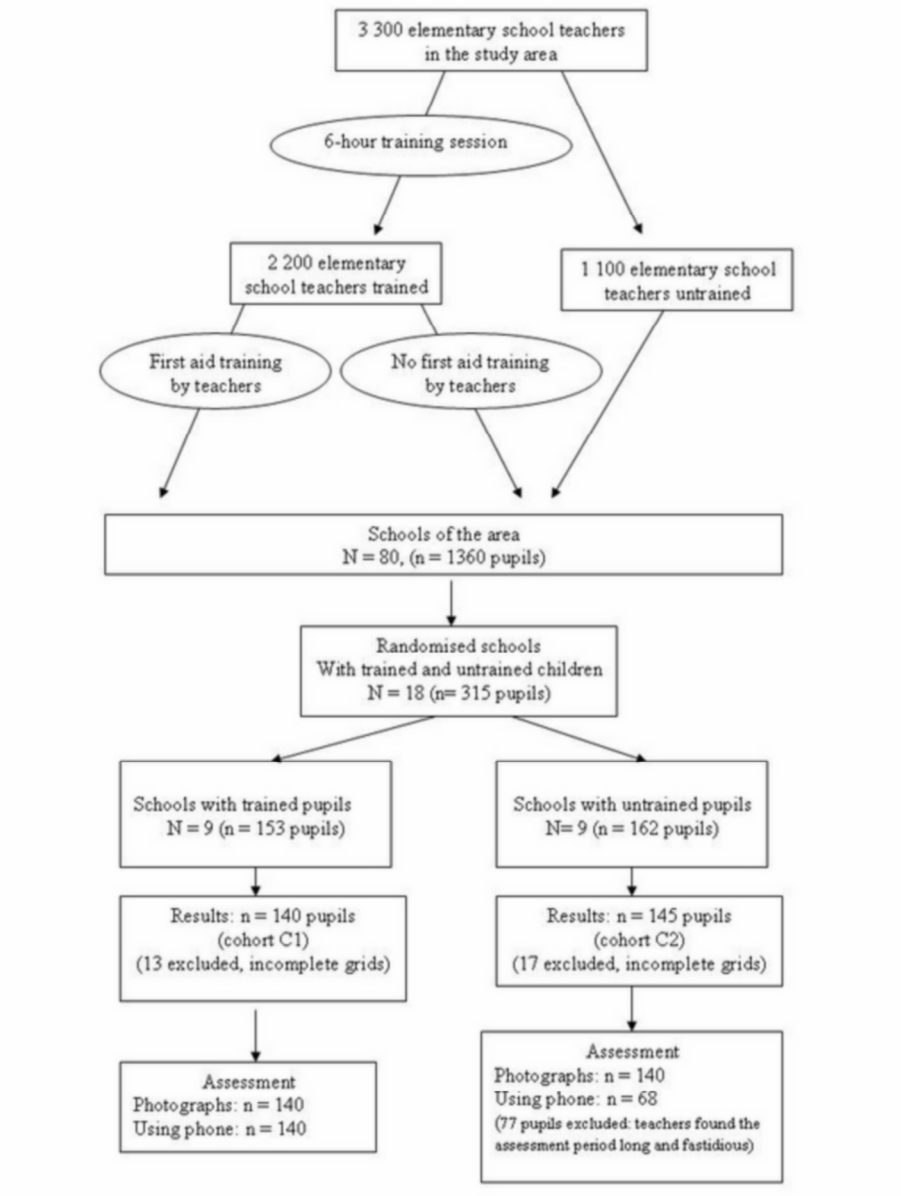
~~32.~~28. Enquête Permanente sur les accidents de la vie courante. Résultats 2012. Institut de Veille Sanitaire, Saint Denis, 2012. http://www.invs.sante.fr/content/download/83774/306579/version/1/file/TR13G263_%28resultats_Epac2012%29.pdf (accessed 10 July 2014).

~~33.~~29. Principales causes de décès des jeunes et des enfants en 2011. Institut national de la statistique et des études économiques, 2011. http://www.insee.fr/fr/themes/tableau.asp?ref_id=NATCCJ06206&reg_id=0 (accessed 10 july 2014).

~~34.~~30. Philippakis A1, Hemenway D, Alexe DM, et al. A quantification of preventable unintentional childhood injury mortality in the United States. Inj Prev. 2004 Apr;10(2):79-82.

~~35.~~31. Bollig G. First Aid and the family. In: Craft-Rosenberg M, Pehler SR. Encyclopaedia of Family Health, SAGE Publications, Thousand Oaks 2011.

~~36.~~32. Bollig G. First Aid Training in the Kindergarten: A Review of the Literature and Reflections from Practical Experience in Two Countries. NOVA Science Publishers New York 2013.



Flowchart
278x371mm (300 x 300 DPI)

Photograph 1. A Boy Who Has Fallen Off a Stepladder and Is Holding His Leg
102x67mm (300 x 300 DPI)

Photograph 2. A Young Girl Crying Because She Has Broken Her Doll.
98x73mm (300 x 300 DPI)

Photograph 3. A Young Boy Who Has Injured His Hand While Peeling An Apple.
180x134mm (300 x 300 DPI)