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Effects of native language on CPR skills and willingness to intervene in out-of-hospital cardiac arrest after film-based basic life support training: a subgroup analysis of a randomised trial

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ABSTRACT

Objectives The aim was to investigate whether the students' native language, Swedish as native language (SNL) versus other native language (ONL), affects cardiopulmonary resuscitation (CPR) skills or willingness to act after film-based training in Swedish.

Setting 13-year-old students in two municipalities.

Design A subgroup from a previous randomised study was analysed. During 2013 to 2014, a film-based CPR method was evaluated. Practical skills and willingness to act were assessed directly after training and after 6 months. CPR skills were evaluated using a modified Cardiff test.

Participants A total of 641 students were included in the analysis (SNL, n=499; ONL, n=142).

Primary and secondary outcome measures Primary endpoint was the total score of the modified Cardiff test at 6 months. The secondary endpoints were total score directly after training, individual variables for the test and self-reported willingness to act.

Results At the practical test, SNL students scored better than ONL students; directly after training, 67% vs 61% of maximum score, respectively (p<0.001); at 6 months, 61% vs 56% of maximum score (p<0.001). Most students were willing to perform compressions and ventilation on a friend (SNL 85% vs ONL 84%). However, if the victim was a stranger, ONL students were more willing to perform both compressions and ventilation than SNL students (52% vs 38% after training, p<0.001; 42% vs 31% at 6 months, p=0.032). SNL students preferred to initiate chest compressions only.

Conclusions SNL students scored slightly higher in the practical CPR skill test than ONL students. Willingness to act was generally high, however ONL students reported higher willingness to perform both compressions and ventilation if the victim was a stranger. Further research is needed to investigate how CPR educational material should be designed and simplified for optimal learning by students. Different language versions or including feedback in CPR training can be a way to increase learning.

Ethics approval The study was approved by the Regional Ethical Review Board of Linköping, Sweden (2013/358-31).

Trial registration number NCT03233490; Pre-results.

Strengths and limitations of this study

- The intervention included students from all socioeconomic areas of two major municipalities in Sweden.
- To study the retention of practical skills and willingness to act after cardiopulmonary resuscitation (CPR) training, assessments were made both directly after intervention and at 6 months, using the validated Cardiff test and a questionnaire.
- Research to investigate how CPR educational material should be designed and simplified for optimal learning by school students are both required and requested.
- The instructors only had a role as facilitators; however, an individual instructors' enthusiasm and/or characteristics may affect the students' learning process.

INTRODUCTION

Early initiation of bystander cardiopulmonary resuscitation (CPR) is associated with double the likelihood of survival from cardiac arrest compared with no CPR before arrival of emergency medical services (EMS).[1–3] An increased level of training within the community may increase the proportion of patients with out-of-hospital cardiac arrest (OHCA) who receive CPR before arrival of the EMS.[2] A significant proportion of the population can be reached by mandatory basic life support (BLS) training in schools.[4 5] Mandatory CPR training in school is endorsed by the European Resuscitation Council (ERC), International Liaison Committee on Resuscitation, the WHO, American Heart Association and many others. Based on recent scientific evidence, they state that all students in compulsory school worldwide should receive at least 2 hours of CPR training annually from

the age of 12 years or earlier.[5] In Sweden, CPR training is mandatory according to the school curriculum.[6] The Swedish CPR training programme taught to the public includes training on (1) compression and ventilation, (2) application and use of automated external defibrillation, (3) placing the patient in the recovery position and (4) actions for foreign body airway obstruction. In addition to practical skills, CPR training in schools can also contribute to social skills, a sense of social responsibility, civic duty and caring for others.[5] Practical training in CPR strengthens the participants' self-efficacy and increases willingness to intervene in a real OHCA situation.[7 8]

The guidelines emphasise the importance of performing high-quality CPR to improve outcomes. High-quality CPR refers to compressions at the correct depth, rate, chest recoil, ratio of compressions and ventilations and minimising hands-off time, as well as rescue breathing at the correct volume and ventilation time.[1] Several studies have reported that participants' skills acquired during CPR training are generally limited.[7] The optimal training method and duration of training are unclear and likely to vary according to the characteristics of the participants (age and previous training).[7] According to Kolb's learning cycle, learning develops if it is based on something (1) concrete, in combination with, (2) experimentation or doing, with the opportunity to, (3) reflect and linked to (4) theory and conceptualisation. All four stages are required to learn effectively, although the order and time for each step may vary.[9] In order to stimulate and optimise the learning process, it is also important to offer training methods (film-based, instructor-led, peer learning, etc) tailored to the target audience.[7]

In Sweden, 23% of students in compulsory school speak a language other than Swedish at home. In 2013 to 2014, the four most commonly spoken native languages at home by elementary school students, other than Swedish, were Arabic, Bosnian/Croatian/Serbian, English and Persian.[10] CPR training in school usually involves a film-based method in Swedish. It is not known how a film-based CPR training method affects students' ability to learn CPR when their native language is not Swedish. Our hypothesis was that the film-based training in Swedish does not give students who speak another native language the same opportunities to acquire skills in CPR. The aim of this paper was to investigate whether the students' native language, Swedish versus other native language, was associated with outcome in terms of practical CPR skills or willingness to act after participating in film-based CPR training in Swedish for seventh grade students (age 13 years).

METHODS

Study population and design

In this study, a subgroup from a previous cluster randomised study was analysed. During 2013 to 2014, we performed a randomised CPR training intervention among seventh grade students. All council schools with

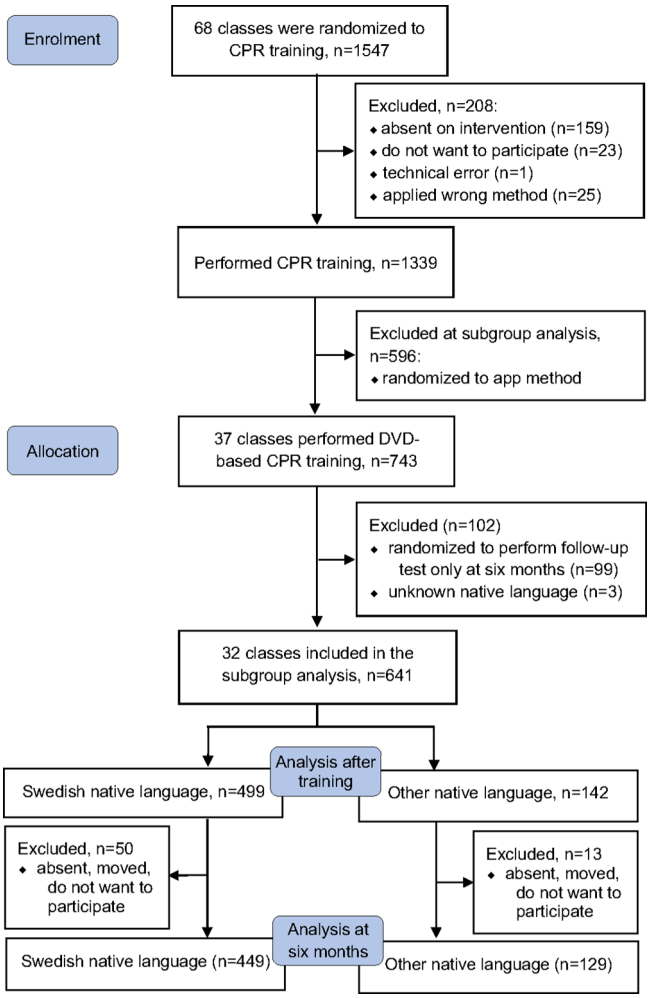

Figure 1 Flowchart of the subgroup analysis. CPR, cardiopulmonary resuscitation; DVD, digital video disc.

13-year-old students in two Swedish municipalities (each with 140 000 inhabitants) were invited to participate in the study. A total of 68 school classes were cluster randomised to two different CPR training interventions. In this study, we analysed a prespecified subgroup that were exposed to a film-based CPR training method (figure 1); the film-based method is more standardised and has been advocated for several years by the Swedish Resuscitation Council. As presented previously, the overall findings show no differences between the film-based methods included in this paper regarding students' practical skills or willingness to act.[11–13] The design of the intervention has been described in detail elsewhere.[13 14] Before the study, a letter with information about the study was sent to the students and their guardians. Participation by individual students was completely voluntary. All participants gave oral informed consent.

The inclusion criteria for the present subgroup analysis were seventh grade students in one of the participating schools who were randomised to the film-based method. Exclusion criteria were students who declined participation, students randomised to perform a practical skills test only at 6 months, students with a physical handicap

that significantly limited their physical performance and classes of students with development disabilities (figure 1).

Film-based CPR training

All CPR training was performed in accordance with the ERC guidelines 2010.[15] During training, all students used an individual training manikin, Mini Anne (Laerdal Medical, Stavanger, Norway). Based on instructions in Swedish on a 31 min film, produced by the Swedish Resuscitation Council, the whole class practised together to identify a cardiac arrest, raise the alarm in an emergency and how to perform compressions, ventilations and the recovery position. The teacher acted as a facilitator, introduced the lesson, started the film, paused if necessary, gave advice on the fly, answered questions and completed the course.

Assessment

To compare learning outcomes, students' practical CPR skills and their attitude to taking action were assessed directly after training and at 6 months. The Laerdal PC skill reporting system V.2.4, linked to manikin Resusci Anne, measured the students' practical skills. Collected data were recorded directly into a scoring sheet, a modified version of the validated Cardiff test[16] adjusted for resuscitation guidelines 2010.[15] The Cardiff test assessed a total of 12 items, resulting in a total score ranging from 12 to 48 points (online supplementary file 1). The tests lasted for 3 min and were performed individually at the school. The participants were introduced to an OHCA scenario and asked to act as if in a real situation. During the test, the students were expected to identify the cardiac arrest and perform at least five cycles of CPR, each consisting of 30 chest compressions and two ventilations. After the test, the investigator (AN) gave individual feedback to the students, partly based on Hattie and Timperley's model[17] answering the following questions: where am I going?, how am I going? and where to next?

At both measurement points, all the students also answered a fixed-response questionnaire with questions about background factors and self-reported confidence, and hypothetical questions about willingness to act in a real cardiac arrest situation (online supplementary file 2). The online survey took 6 to 15 min to complete.

Study outcome measures

The primary endpoint was the total score for the practical CPR skill test at the 6 month follow-up. The secondary endpoints were total score directly after training, individual variables for the test and self-reported willingness to act.

Patient and public involvement

Patients or members of the public were not included in the study design. The headmasters of all council schools in two municipalities received an invitation to participate in the study. Before study entry, 19 teachers at the participating schools received 5 hours of training to become CPR instructors. The teachers were also given written and oral study instructions on how to implement the intervention randomised to each class. During the CPR training for the students, the teachers acted as facilitators, as described above.

Statistical analysis plan

Sample size calculations were performed as described by Chow *et al*[18] and were based on data from a pre-study.[19] In order to detect a two-point difference in the total score for the modified Cardiff test, at a significance level of 0.05, an effective sample size of 76 students was needed to test for superiority with a power of 80%. To adjust for cluster effects, the intraclass correlation coefficient was calculated.[20 21]

Data are presented as means (SD) or proportions (percent). Differences in mean values (the total score for the practical test) between the groups were analysed using the unpaired t-test. To account for a potential cluster effect of the school classes, a mixed models linear test was also applied for comparison of the total score. For comparisons of categorical variables, logistic regression within generalised estimation equations was used to be able to control for a potential cluster effect for the school classes.[20] By calculating (individual total score − 12)/(maximum total score − 12)×100, we obtained a measure of CPR quality in relation to optimal CPR. Multiple linear regression analyses were performed for the total score of the modified Cardiff test, including baseline covariates (gender, native language, previous compression and ventilation training). All tests were two-sided and p values <0.05 were considered statistically significant. All analysis was performed using IBM SPSS V.21 and STATA version 13.1.

RESULTS

A total of 641 seventh grade students from 32 school classes were included in the study, of which 142 students spoke native languages other than Swedish (ONL) at home and 499 students spoke Swedish as their native language (SNL). At 6 months, 129 and 449 of these students, respectively, completed the follow-up test (figure 1). The characteristics of the students are shown in table 1.

The intraclass correlation coefficient (95% CI) was 0.044 (0.00, 0.09). Based on an average cluster size of 20.0, the design effect caused by the cluster randomisation was 1.84. A total of 641 and 578 students performed the first and second practical CPR test, respectively. This corresponds to an effective sample size of 348 and 314, respectively, which is above the 76 persons needed to reach a power of 80%.

CPR skills

ONL students had a significantly lower total score for the practical CPR skill test compared with SNL students: directly after training, 34 (SD 4.4) points (61% of maximum score) versus 36 (SD 3.8) points (67% of

Table 1 Baseline characteristics of the students

	Swedish native language, (n=499)	Other native language (n=142)	P value
Male	45 (226)	46 (66)	0.824
Previous compression training	29 (144)	20 (29)	0.04
Previous ventilation training	20 (99)	16 (23)	0.292
Previously experienced a CA situation	2 (12)	5 (8)	0.166

Results are presented as % (*n*). Differences in proportions between groups were analysed with logistic regression within generalised estimation equations. P values <0.05 were considered statistically significant. CA, cardiac arrest. All numbers are rounded to the nearest integer.

maximum score), respectively (p<0.001); at 6 months, 32 (SD 3.8) points (56% of maximum score) versus 34 (SD 3.9) points (61% of maximum score), respectively (p<0.001). SNL students performed significantly better for 6 of 12 individual variables immediately after training and 7 of 12 variables at 6 months (table 2).

Baseline characteristics were well matched between the groups, except that SNL students had undergone significantly more compression training previously. Nevertheless, multiple linear regression analyses for the total score at the practical test (including baseline covariates) were performed, without any significant change observed for previous compression and ventilation training or gender (table 3).

Self-confidence

Both directly after training and at the 6 month follow-up, most of the students reported (regardless of native language) that they felt more confident about acting in an OHCA situation after the film-based CPR training compared with before the training (table 4). Further, there were no significant differences in how the participants considered themselves to have enough knowledge to do chest compressions or ventilations (table 4).

Willingness to act

Regarding the questions about willingness to act, a significantly higher proportion of ONL students, compared with SNL students, reported they would perform both compressions and ventilation if the victim was a stranger: 52% versus 38% directly after training (p<0.001); 42% versus 31% at 6 months (p=0.032). If the victim was a friend, 84% of the ONL students versus 85% (not significant) of the SNL students responded that they would do both compressions and ventilation directly after training, and 80% versus 78% at the 6 month follow-up, respectively (not significant) (table 4).

DISCUSSION

The main findings of the present study are threefold. First, seventh grade SNL students scored slightly higher points for the practical CPR skill test compared with ONL students after film-based BLS training in Swedish. Second, most students, regardless of native language, were willing to make a life-saving effort. Third, ONL students reported greater willingness to perform both compressions and ventilation if the victim was a stranger, whereas SNL students preferred initiating chest compressions only.

Regardless of native language, the results reflecting the long-term practical skills of the students, 56% versus 61% of the total score at 6 months, are comparable with the results of previous studies where seventh grade students achieved 50% and adults 57% to 61% of the total score at 3 to 4 months follow-up.[22 23] A significantly lower proportion of ONL students had taken part in previous chest compression training. However, the regression analysis showed that previous compression training had no significant impact on the total score for the Cardiff test. This is in line with previous studies, showing that regular or periodic recertification is needed to maintain CPR skills.[7 24 25] There was a significant difference in the total score for the modified Cardiff test between ONL students and SNL students with regard to two points. At 6 months, the largest differences in favour of SNL students were found for the following variables: checks responsiveness, open airway, checks respiration, compression/ventilation ratio, average compression depth and total ventilation counted. A similar observation was reported by Wingen *et al*[26] who stated that an immigrant background is a negative predictor for a long-term increased level of knowledge. The clinical importance of the observed differences is unclear. In addition, there are no guidelines that specify approved results after completing CPR training. The guidelines highlight the importance of early identification of the cardiac arrest.[1] We can speculate that there is a risk that incomplete checks may extend the time taken to identify cardiac arrest in a real cardiac arrest situation. Further, limited native language skills have been identified as a barrier to early activation of an emergency call to 112.[27] The guidelines also emphasise CPR of good quality, mainly regarding chest compressions.[1 28] Improvements in CPR practice and quality can lead to substantial improvements in outcome.[29 30] Regardless of native language, it is important to offer students equal opportunities for knowledge acquisition. The addition of subtitles or different language versions could facilitate learning for students with other native languages. Whole-class teaching can still be conducted, even with different language versions, if ONL students receive their instruction in their own native language using headphones. Previous studies show that feedback in different formats, via prompt devices and individual oral feedback, improves CPR quality.[7] Hattie[31] indicates that feedback is one of the most powerful influences on performance, based on a synthesis of meta-analyses relating to achievement. Feedback is also one of four factors necessary for effective learning, according to Kolb's learning cycle.[9] The time available for systematic

Table 2 Assessment of CPR skills directly after training and at 6 months

	Directly after training			At 6 months		
	Swedish native language (n=499)	Other native language (n=142)	P value	Swedish native language (n=449)	Other native language (n=129)	P value
Checks responsiveness by talking						
2: Yes	68 (338)	60 (85)	Ref	47 (210)	26 (34)	Ref
1: No	32 (161)	40 (57)	0.122	53 (239)	74 (95)	<0.001
Checks responsiveness by shaking						
3: Yes	71 (355)	64 (91)	Ref	48 (214)	27 (35)	Ref
2: No	29 (143)	35 (50)	0.137	52 (235)	73 (94)	<0.001
1: Potentially dangerous	1 (1)	1 (1)	0.344	0	0	
Open airway – chin lift, head tilt						
5: Perfect	5 (23)	2 (3)	Ref	2 (11)	0	
4: Acceptable	24 (118)	9 (13)	0.799	4 (17)	2 (2)	Ref
3: Attempted other	1 (2)	0		1 (1)	0	
2: Only one element	36 (179)	32 (46)	0.273	13 (59)	15 (19)	<0.001
1: No	36 (177)	56 (80)	0.045	80 (361)	84 (108)	<0.001
Checks respiration - see, listen, feel						
2: Yes	78 (390)	59 (84)	Ref	48 (218)	35 (45)	Ref
1: No	22 (109)	41 (58)	<0.001	51 (231)	65 (84)	0.028
Call 112						
2: Yes	83 (412)	66 (93)	Ref	83 (374)	82 (105)	Ref
1: No	17 (87)	34 (49)	<0.001	17 (75)	19 (24)	0.607
Compression/ventilation ratio						
4: 30:2 (28 to 32:2)	56 (282)	47 (67)	Ref	48 (218)	32 (42)	Ref
3: Other	40 (202)	50 (71)	0.064	46 (205)	61 (79)	0.003
2: Compressions only	3 (15)	3 (4)	0.827	6 (26)	8 (8)	0.361
1: Ventilations only	0	0		0	0	
Hand position during compression						
4: Correct	12 (61)	9 (13)	Ref	3 (21)	5 (6)	Ref
3: Other wrong	60 (302)	68 (96)	0.260	50 (233)	53 (69)	0.933
2: Too low	26 (136)	23 (33)	0.709	46 (195)	42 (54)	0.952
1: Not attempted	0	0		0	0	
Average compression depth						
6: 50 to 59 mm	23 (113)	16 (22)	Ref	43 (192)	29 (38)	Ref
5: ≥60 mm	1 (2)	0		4 (18)	0	
4: 35 to 49 mm	51 (255)	49 (70)	0.068	41 (186)	45 (58)	0.023
2: 1 to 34 mm	26 (129)	35 (50)	<0.001	12 (53)	26 (33)	<0.001
1: Not attempted	0	0		0	0	
Total compression counted						

Continued

Table 2 Continued

	Directly after training			At 6 months		
	Swedish native language (n=499)	Other native language (n=142)	P value	Swedish native language (n=449)	Other native language (n=129)	P value
6: 140 to 190	47 (236)	41 (58)	Ref	36 (161)	42 (54)	Ref
5: ≥191	41 (204)	39 (55)	0.672	53 (237)	43 (56)	0.057
4: 121 to 139	7 (33)	11 (15)	0.035	6 (25)	6 (8)	0.882
3: 81 to 120	3 (16)	6 (8)	0.051	5 (24)	7 (9)	0.799
2: 1 to 80	2 (10)	4 (6)	0.027	1 (2)	2 (2)	0.253
1: Not attempted	0	0		0	0	
Average ventilation volume						
5: 500 to 600 mL	6 (32)	6 (9)	Ref	4 (19)	3 (4)	Ref
4: 1 to 499 mL	9 (43)	17 (24)	0.062	7 (32)	11 (14)	0.208
3: ≥601 mL	69 (346)	58 (82)	0.622	54 (243)	38 (49)	0.928
2: 0 mL	13 (63)	16 (23)	0.507	29 (129)	42 (54)	0.166
1: Not attempted	3 (15)	3 (4)	0.924	6 (26)	6 (8)	0.650
Total ventilation counted						
5: 8 to 12	50 (248)	35 (50)	Ref	28 (126)	22 (28)	Ref
4: 1 to 7	21 (107)	32 (46)	<0.001	16 (73)	19 (24)	0.152
3: ≥13	13 (66)	13 (19)	0.241	21 (95)	12 (15)	0.264
2: 0	13 (63)	16 (23)	0.055	29 (129)	42 (54)	0.020
1: Not attempted	3 (15)	3 (4)	0.611	6 (26)	6 (8)	0.573
Total hands-off time						
4: 0 to 60 s	9 (47)	15 (21)	Ref	27 (120)	32 (41)	Ref
3: 61 to 90 s	68 (339)	64 (91)	0.122	64 (285)	57 (73)	0.240
2: 91 to 135 s	21 (107)	19 (27)	0.114	10 (43)	12 (15)	0.967
1: 136 to 180 s	1 (6)	2 (3)	0.900	1 (1)	0	
Total score	36 (3.8)	34 (4.4)	<0.001*†	34 (3.9)	32 (3.8)	<0.001*†

Results are presented as % (*n*) or mean (SD). Differences in proportions between groups were analysed with logistic regression within generalised estimation equations. Differences in total score between intervention groups were analysed by mixed models linear test* and unpaired t-test†. P values <0.05 were considered statistically significant. CPR, cardiopulmonary resuscitation. The table lists the best option for each variable first. All numbers are rounded to the nearest integer.

Table 3 Regression analyses for the total score for the practical CPR skill test

	Model 1	Model 2	Model 3	Model 4
Native language	−1.83 (−2.58 to −1.09)	−1.83 (−2.57 to −1.09)	−1.85 (−2.59 to −1.10)	−1.85 (−2.60 to −1.10)
Gender		−0.32 (−0.94 to −0.30)	−0.32 (−0.94 to −0.30)	−0.32 (−0.95 to −0.30)
Previous compression training			0.21 (−0.48 to −0.91)	0.34 (−0.56 to −1.24)
Previous ventilation training				−0.23 (−1.24 to −0.78)

Values are the estimate (low CI to high CI). CPR, cardiopulmonary resuscitation.

Table 4 Students self-reported confidence and willingness to act in an OHCA situation

	Directly after training			At 6 months		
	Swedish native language (n=499)	Other native language (n=142)	P value	Swedish native language (n=447)	Other native language (n=129)	P value
More confident about acting compared with before training						
Yes	88 (439)	83 (118)	Ref	83 (373)	81 (104)	Ref
No	12 (59)	17 (24)	0.152	17 (74)	19 (25)	0.458
Enough knowledge to do CC						
Yes	84 (419)	81 (115)	Ref	93 (415)	92 (119)	Ref
No	16 (80)	19 (27)	0.328	7 (32)	8 (10)	0.756
Enough knowledge to do ventilation						
Yes	85 (424)	84 (120)	Ref	74 (329)	75 (97)	Ref
No	15 (75)	16 (22)	0.873	26 (118)	25 (32)	0.763
How to act if a friend suffered CA						
CC and ventilation	85 (423)	84 (120)	Ref	78 (350)	80 (103)	Ref
CC only	13 (63)	9 (13)	0.356	16 (70)	12 (16)	0.379
Ventilation only	1 (1)	3 (4)	0.024	1 (6)	1 (1)	0.624
Not dare to act	2 (12)	4 (5)	0.334	5 (21)	7 (9)	0.317
How to act if a stranger suffered CA						
CC and ventilation	38 (188)	52 (74)	Ref	31 (140)	42 (55)	Ref
CC only	51 (253)	37 (52)	<0.001	52 (234)	40 (52)	0.032
Ventilation only	1 (4)	0		1 (3)	1 (1)	0.887
Not dare to act	11 (54)	11 (16)	0.273	16 (70)	16 (21)	0.403

Results are presented as % (*n*). Differences in proportions between groups were analysed with logistic regression within estimating equations. P values <0.05 were considered statistically significant. CA, cardiac arrest; CC, chest compressions; OHCA, out-of-hospital cardiac arrest. All numbers are rounded to the nearest integer.

and individual feedback to students was limited during the film-based training session. Including individual feedback in CPR education can be a way to increase learning, regardless of native language. To allow time for individual feedback during training, it would have been necessary to pause the film repeatedly or teach in smaller groups rather than the whole class. Further research is necessary to investigate how CPR training materials should be designed, adapted and simplified for optimal learning for school students.[26]

Knowledge includes competence, such as practical and theoretical skills, as well as confidence in the form of willingness to perform and self-esteem.[32] In addition to practical training, the participants' self-confidence and their willingness to perform bystander CPR are core content during CPR training. Bandura and social cognitive theory emphasise that an individual's self-efficacy may affect their performance.[33] Several studies show that CPR training strengthened participants' self-confidence and increased their willingness to intervene in an OHCA situation.[7 8 34 35] Most of the ONL and SNL students believed they had enough knowledge to do chest compressions and ventilations and were willing to perform bystander CPR. The survey used to evaluate the students' willingness to act contains hypothetical questions. We do not know how the students would act in a real situation. It was interesting that if the victim was a stranger, ONL students were more willing to perform both compressions and ventilation at both measurement points, whereas SNL students preferred initiating chest compressions only. As far as we know, a similar result has not been reported previously. Previous studies have shown that lower socioeconomic status, as well as access to health-related information, is known to adversely affect the bystander rate and patient outcome after OHCA.[27 36–38] In the present study, we have no information about the students' socioeconomic status. However, in accordance with previous studies, both ONL students and SNL students reported a difference in willingness to intervene in an OHCA situation involving a friend compared with a situation involving a stranger.[8 39 40] This needs to be considered when creating future CPR education tools.

Study limitations

First, we do not have any information about ONL students' skills in understanding Swedish. However, other subjects in school are taught in Swedish. Second, an individual instructors' enthusiasm and/or characteristics

may affect the students' learning process. Therefore, the CPR intervention was standardised to ensure equivalent training, and the instructors only acted as facilitator during the CPR education. Third, students' motivation as well as the expectations of students (both their own and the teachers) also affect the students' learning.[41] We have no information about the teacher or the students' own expectations. Fourth, we have no information about the students' socioeconomic status. Fifth, we do not have any information about students' height and weight, however, student's height and weight mainly affect chest compression depth. SNL students performed significantly better, even for several variables for which weight and length are not relevant.

CONCLUSIONS

In a Swedish CPR training intervention, ONL students scored a significantly lower total score for a practical CPR skills test compared with SNL students. The clinical importance of this difference is unclear. Further research is needed to investigate how CPR educational material should be designed, adapted and simplified for optimal learning of school students. Different language versions or including feedback in CPR education can be a way to increase learning. Willingness to intervene in a real OHCA situation was generally high, however, ONL students reported higher willingness to perform both compressions and ventilation if the victim was a stranger; native students preferred initiating chest compressions only.

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Contributors AN contributed to the study design, conducted measurements, statistical analyses, analysed the results and wrote the initial draft of the manuscript. JH and AC contributed to the study design, analysed the results and revised the manuscript. MR, PN and IAH revised the manuscript. All authors read and approved the final manuscript.

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Patient consent for publication Not required.

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