Cardiopulmonary Resuscitation Training in Schools: A Comparison of Trainee Satisfaction among Different Age Groups

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Cardiopulmonary resuscitation (CPR) has recently been added to the school curriculum worldwide and is currently taught to students between the ages of 10 and 16 years. The effect of the age of trainees on their satisfaction with CPR training has yet been elucidated. The aim of this study was to compare the satisfaction of trainees of different ages who participated in CPR training in schools in Japan. In total, 392 primary school students (10–11 years old), 1798 junior high school students (12–13 years old), and 4162 high school students (15–16 years old) underwent the same 3-h course of CPR training, according to the guidelines of 2000 for Emergency Cardiovascular Care and CPR. The course was evaluated by a questionnaire completed by the participants. Primary school students responded most positively to all questions, including those reflecting enjoyment and the confidence of participants to apply CPR (Jonckheere-Terpstra test: \( P < 0.01 \)). Exploratory factor analysis defined three latent variables (reaction, concentration, and naïveté) based on the seven variables addressed in the questionnaire. In the causal relationships analyzed by structural equation modeling (SEM), naïveté (which is related to age) directly affected the other latent variables. The current model suggested that the students’ satisfaction with CPR training was strongly related to their age. Primary school students enjoyed CPR training more and were more confident in their ability to perform CPR than junior high and high school students were. Therefore, children aged 10–11 years may be the most appropriate candidates for the introduction of CPR training in schools. (doi: 10.2302/kjm.2015-0009-OA; Keio J Med 65 (3) : 49–56, September 2016)

Keywords: CPR, BLS, education, satisfaction, school

Introduction

Although CPR training has been extensively offered to citizens worldwide, the rates of bystander participation in CPR remain low and may indicate limitations in the teaching of CPR to the adult population. Consequently, students and children have been considered as possible candidates for CPR training. Importantly, CPR has been studied in schools in Europe since the 1970s for children aged up to 7 years old. Recent studies reported that even primary school students are able to master CPR.1–8 It is not currently known, however, at what age it is most appropriate to introduce CPR training in schools and to motivate trainees to do CPR. To answer this question, the satisfaction of trainees with CPR instruction should be evaluated among different age groups who have taken the same course. However, previous studies measuring trainee satisfaction were limited to different train-
ing programs tailored for primary,13–15 junior high,9–12 or high schools. To date, no study has measured satisfaction levels in primary school students and compared them with those of older students who have undergone the same CPR instruction. The aim of the current study was to compare satisfaction scores and the willingness to carry out CPR of students who attended primary, junior high, or high schools who participated in the same CPR training in their schools.

Methods

We carried out a prospective, observational study conducted over a 3-year period from April 2002 to March 2005. Our Institutional Review Board waived the requirement to obtain informed consent. Keio University is closely associated with one primary school, three junior high schools, and four high schools in Tokyo and adjacent cities. In 2001, the university decided to run a CPR program, named Keio basic life support (BLS), which taught CPR to 5th-grade students in primary school (10–11 years old), 1st-grade students in junior high schools (12–13 years old), and 1st-grade students in high schools (15–16 years old). The course lasted 3 h. This program was instigated after a high school student suffered cardiac arrest during athletic activity in 1998 in one of the high schools. In this program, primary school students learn CPR every 2–3 years until they graduate from high school.

In total, 392 primary school students, 1798 junior high students, and 4162 high school students who participated in the Keio BLS program between April 2002 and March 2005 were enrolled in the study. CPR was taught in the same way according to the guidelines of 2000 for Emergency Cardiovascular Care and CPR. The 3 h of the course was divided into a lecture period of 30 min and a demonstration and practice period of 120 min. The remaining 30 min provided break time and time to fill in the questionnaire. The ratios of instructors and mannequins to students were set at 1 instructor per 10 students and 1 mannequin per 4 students. All invited instructors were from the Tokyo Emergency First-Aid Association and were officially qualified as BLS instructors by the Fire and Disaster Agency of the Ministry of Internal Affairs and Communications of Japan.

After completion of the practice period, the course was evaluated by a written questionnaire approved by the Keio BLS Committee; the questionnaire contained questions on enjoyment, confidence to perform CPR, age of the trainee, previous CPR training, appropriateness of the amount of time spent on verbal education, appropriateness of the amount of time spent on practice, number of trainees per instructor, instructor performance, and the calendar year of the course. Responses to each question were rated according to 5-point scales. Techniques for using automated external defibrillators (AEDs) were not included in the course because AEDs were not allowed to be used by laypeople until September 2004 in Japan. The reliability of the questionnaire responses was evaluated using Cronbach’s alpha, and the five-point scales were compared using the Jonckheere-Terpstra test. Two-sided P values of less than 0.05 were regarded as statistically significant.

Exploratory factor analysis was performed to fit the observed questionnaire variables to corresponding latent variables. This analysis was performed using the maximum likelihood procedure and a promax oblique rotation using IBM SPSS Statistics 23 for Windows (IBM, New York, NY, USA). By excluding observed variables with a factor loading of less than 0.40 in the exploratory factor analysis, the presumptive underlying causal relationships among the observed variables and the latent variables were examined using SEM on Amos ver. 23 for Windows (IBM).

Estimation of the best-fit model was carried out by the method of maximum likelihood of SEM. The optimization algorithm was implemented with no missing data parameters. The models employed index criteria for assessing model fitness. The goodness of fit was assessed by the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), and the root mean square residual (RMR).

Results

Ninety-nine percent of the participants responded to the questionnaires, and Cronbach’s alpha was 0.647 (Table 1). The proportion of students who had previously undergone CPR training was 5.2% in the primary school, 12.0% in junior high schools, and 29.5% in high schools (P < 0.001).

For all questions, the responses depended on the age group, with more favorable responses being obtained for younger students (P < 0.001). For example, the course was evaluated as more enjoyable by primary school students (P < 0.001, Fig. 1). The length of time for the lecture part of the course (30 min) was evaluated positively (i.e., much too short, a little short, or just right) by more than half of participants; however, more high school students responded that the lecture was too long than did primary school and junior high school students (P < 0.001). The length of time spent on CPR practice received a more favorable evaluation by primary school and junior high school students (much too short or a little too short) than by high school students (much too short or a little too short) than by high school students (P < 0.001, Fig. 2). The number of instructors was assessed as inadequate (needed a lot more instructors, needed a few more instructors) by more primary school and junior high school students than by high school students (P < 0.001). The teaching skills of the instructors were assessed by the question “Was the course easy to understand?” The responses of younger participants were more favorable (P < 0.001, Fig. 3). Moreover, a larger proportion of younger students said that the course had given them enough confidence in their
### Table 1  Characteristics of the participants

<table>
<thead>
<tr>
<th>Schools</th>
<th>Age (years)</th>
<th>Participants</th>
<th>Male</th>
<th>Response rate to questionnaire (%)</th>
<th>Previous CPR training (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary school</td>
<td>10–11</td>
<td>392</td>
<td>287</td>
<td>98.2</td>
<td>5.2</td>
</tr>
<tr>
<td>A</td>
<td>607</td>
<td>607</td>
<td></td>
<td>99.3</td>
<td></td>
</tr>
<tr>
<td>Junior high school</td>
<td>12–13</td>
<td>703</td>
<td>477</td>
<td>97.6</td>
<td>12.0</td>
</tr>
<tr>
<td>B</td>
<td>607</td>
<td>607</td>
<td></td>
<td>99.3</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>488</td>
<td>246</td>
<td></td>
<td>99.2</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>2216</td>
<td>2216</td>
<td></td>
<td>99.6</td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>15–16</td>
<td>2216</td>
<td>2216</td>
<td>99.6</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>750</td>
<td>750</td>
<td></td>
<td>98.7</td>
<td>29.5</td>
</tr>
<tr>
<td>F</td>
<td>534</td>
<td>0</td>
<td></td>
<td>99.6</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>662</td>
<td>383</td>
<td></td>
<td>98.5</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10–16</td>
<td>6352</td>
<td>4966</td>
<td>99.0</td>
<td>22.4</td>
</tr>
</tbody>
</table>

**Fig. 1** Responses to the question “Did you have fun today?” More than half of participants responded “definitely” or “so so.” Responses were more favorable in younger responders (Jonckheere-Terpstra test: \( P < 0.001 \)).

**Fig. 2** Responses to the question “Do you feel that the length of time spent on practicing was just right?” Responses indicating that the participants would have liked more time practicing were more common in younger students. Although there was no difference between primary school and junior high school students (Mann-Whitney U test: \( P = 0.09 \)), there was a difference between primary school/junior high school students and high school students (Mann-Whitney U test: \( P < 0.001 \)).
Table 2 presents factor loadings for a hypothesized model consisting of the latent variables obtained through exploratory factor analysis. Factor 1 had high loadings for enjoyment and confidence. These variables indicated the students’ response to the training, so we termed factor 1 “reaction.” Factor 2 had high loadings for enjoyment and the lengths of time for lecture and practice. Students who are fully engaged with the training are more likely to report positively on the amount of time spent on lecture and practice. Consequently, we termed factor 2 “concentration.” Finally, factor 3 had high loadings for age only. In this study, the different age groups undertook the same CPR training and we evaluated and analyzed their responses. The observed variables, therefore, indicated the differences of the students’ reactions to the training. These differences might be based on the different life experiences of primary school, junior high school, and high school students. Therefore, factor 3 was termed “naïveté.” The cumulative contribution proportion of the above three factors was 37.9 per cent.

We adopted and analyzed the statistically best-fitting models using SEM. Figure 5 shows the model present-
The model fits the data very well with the following fit indices: GFI = 0.998, AGFI = 0.995, and RMR = 0.006. 

Table 3 indicates the standardized direct and indirect effects of different latent variables on the questions using the best-fit models. We observed relatively large direct and indirect effects of “naïveté” on the evaluation of this program. The current model suggests the importance of age on the level of satisfaction of participants in CPR training.

### Discussion

In the present study, it was shown that primary school students aged 10–11 years responded more favorably to BLS training than did junior high and high school students aged 12–13 and 15–16 years. In the causal relationships analyzed by SEM, naïveté (related to age) directly affected the other latent variables. The current model suggested that age is an important factor affecting the satisfaction of participants in BLS training. Consequently, primary school students may be the most appropriate candidates for BLS training.

The teaching of BLS in schools was pioneered in Norway, where instruction in rescue breathing has been compulsory since 1961. In 1986 the American Academy of Pediatrics urged local school districts to begin CPR training for students in grades 8–12, and in 1992 the European Resuscitation Council stated that all European schools should include BLS in their curricula. Previous research has shown that school-age children are easy to train and show enthusiastic interest in BLS. Regarding the ideal age for learning BLS, although effective learning can be achieved in children as young as 6–7 years old, the age at which basic CPR training is provided to children may influence knowledge acquisition and retention. On studying teenagers, Van Kerschaver et al. demonstrated that older children performed BLS better and that the effectiveness of refresher training was more pronounced in older children. Jones et al. reported that children’s ability to achieve an adequate depth of chest compression depended on their age and weight; they concluded that 13-year-old children were able to achieve this goal. However, they also reported that the ability to provide the correct rate of chest compressions and to employ the correct hand position was similar across all the age ranges tested (9–14 years). Young children who are not yet physi-
cally able to compress the chest can learn the principles of chest compression as well as older children can.

Previous studies have focused on physical ability and retention of skills and knowledge to consider the ideal age to teach BLS. Most studies have focused on high school students\textsuperscript{13,18–23} or junior high school students\textsuperscript{24,25} for teaching BLS. Bollig et al. taught basic first aid to primary school students aged 6–7 years and retested their retention 6 months later. This research found a statistically significant difference between those who had and had not undergone training in the correct assessment of consciousness, correct assessment of breathing, knowledge of the correct emergency telephone number, giving correct emergency call information, knowledge of the correct recovery position, and correct airway management. \textsuperscript{2}

Connolly at al. reported teaching BLS skills to children aged 10–12 years and assessed retention of knowledge 6 months after training. The result was a highly significant increase in level of BLS knowledge following the training session.\textsuperscript{3} Frederick et al. studied the retention of skills in children aged 10–11 years after BLS training and showed that, using strict adherence to Resuscitation Council guidelines as the criterion, the intervention group (1.1\%) performed only marginally better than the control group (0.0\%) did.\textsuperscript{26} Hill et al. studied retention of CPR skills 2 months after training in school children aged 10–12 years and showed that they were capable of performing effective CPR.\textsuperscript{6} Lester et al. studied retention of CPR skills and reported that although most children scored well on theoretical knowledge, this did not correlate with an assessment of practical ability using training manikins.\textsuperscript{7}

Thus, despite much research in the field, there is no report of a study analyzing the effect of the trainees' age on receptiveness and attitude toward BLS training. The current study addressed the causal relationships of the responses to the questionnaire survey including age and satisfaction with CPR training. Exploratory factor analysis defined three latent variables based on the seven observed variables in the questionnaire. We interpreted these latent factors as the trainees' reaction, concentration, and naïveté. In the causal relationships analyzed by SEM, naïveté was related with age and directly affected the other latent variables. Thus the current model suggested the importance of naïveté for the satisfaction of BLS trainees. In the current questionnaire survey, naïveté was correlated only with age. The reason why age was negatively correlated with satisfaction and confidence to perform CPR was probably the difference in curiosity among students in primary schools, junior high schools, and high schools. Primary school students are more flexible and curious, and BLS training could be interpreted by them as play, meaning that they would enjoy it more. In contrast, high school students focus more on school studies, sports activities, provision for their future, and sexual relations, and they may be too busy to focus on BLS training. Previous investigators have reported that school-age children are easy to train and show energetic interest.\textsuperscript{12,16} Instructors in the present study noted that it was easier and more interesting to teach primary school students than high school students, because primary school students paid more attention and were eager to learn BLS, probably because of their curiosity. Comparisons between the attitudes of younger and older students toward BLS training could mirror comparisons between children and the adult population. The adult population is too busy to learn BLS; for them, “time is money.” Bollig et al. reported that it seems appropriate to start with basic first aid education for primary school students aged 6–7 years, even if it is not yet appropriate for them to learn CPR/chest compression skills.\textsuperscript{2} The age of 10 was recommended for introducing CPR by Eisenburger and Safar.\textsuperscript{4}

Because the first basic CPR program for school children aged 12–14 years was tested in Norway, the secondary or high school period has been identified as an ideal time for such training because teenagers’ maturity, intellect, and dexterity allow them to perform CPR skills adequately.\textsuperscript{24}

### Table 3: Standardized direct and indirect effects of different latent variables on the responses using the best-fit model

<table>
<thead>
<tr>
<th>Latent Variables</th>
<th>Standardized Direct Effects</th>
<th>Indirect Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naïveté → age</td>
<td>-0.25</td>
<td></td>
</tr>
<tr>
<td>Naïveté → enjoyment</td>
<td>0.93</td>
<td></td>
</tr>
<tr>
<td>Naïveté → reaction</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>Reaction → teaching skill of the instructor</td>
<td>0.63</td>
<td>0.52</td>
</tr>
<tr>
<td>Reaction → confidence</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>Naïveté → reaction → teaching skill of the instructor</td>
<td>0.67</td>
<td>0.41</td>
</tr>
<tr>
<td>Naïveté → concentration</td>
<td>0.67</td>
<td>0.47</td>
</tr>
<tr>
<td>Concentration → length of time for lecture</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>Naïveté → concentration → length of time for lecture</td>
<td>0.61</td>
<td>0.41</td>
</tr>
<tr>
<td>Concentration → length of time for practice</td>
<td>0.41</td>
<td></td>
</tr>
</tbody>
</table>
However, the attitude of trainees is more favorable toward learning BLS for primary school students, as indicated by this study. Repetition of first aid knowledge and extension of the curriculum throughout the school years would likely lead to improved motivation to provide first aid and to better performance in a real emergency situation. Teaching first aid should include both knowledge transfer and motivation to give first aid. To achieve this goal, primary school students may be appropriate candidates for the initial instruction of CPR skills in schools.

Limitations of the Study

This study was based on analysis of responses to a questionnaire on BLS training completed by participants of different age groups; it was not based on objective evaluation of knowledge or skill retention. As Van Kerschaver et al. demonstrated, older children may perform BLS skills better than younger children and the effectiveness of refresher training may be more pronounced in older students. The secondary or high school stage has been identified as the ideal time for BLS training because teenagers’ maturity, intellect, and dexterity allow them to perform CPR skills adequately. However, this study revealed that the receptiveness and attitudes of primary school students toward BLS training are more favorable than those of junior high and high school students. The causal relationships for this finding analyzed by SEM indicated that naïveté (related with age) directly affected the other latent variables.

The second limitation is that the study was conducted according to the resuscitation guidelines of 2000, when few primary school students participated in BLS training in Japan. Recently, more primary school students have been given the opportunity to attend a short course of BLS training. However, the basic structure of the training has not changed, and there is currently no other study reporting the affect of age on the receptiveness and attitudes of participants in BLS training.

Acknowledgments

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Conflict of Interest

There are no financial and/or personal relationships of any of the authors with other people or organizations that could inappropriately influence this work. The authors thereby state that there are no conflicts of interest.

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