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Comparison of the Level of Knowledge and Skills of Trainers and Trainees Applying Cardiopulmonary Resuscitation

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Abstract

The most important element leading to victims' survival is the knowledge of proper and effective performance of Cardiopulmonary Resuscitation (CPR). The main purpose of this research is the assessment of knowledge and objective evaluation of trainers' skills and trainees in applying Cardiopulmonary Resuscitation. The study included 108 trainers and 101 trainees participated in traditional classroom learning of CPR training courses conducted in 2017. Participants responded to knowledge questionnaires and were evaluated for their skills by applying CPR to Mannequin Laerdal Resusci Anne QCPR. Data was recorded and saved using compatible software. Compressions and ventilations were evaluated. Statistical analysis was conducted by using SPSS software. At the level of both knowledge and skills, the results were similar to trainers and slightly excelled trainees' results. By using technology and objective recording through special software, it is possible to extract safe conclusions in evaluating CPR applying efficacy.

Keywords: Basic Life Support, BLS, Cardiopulmonary Resuscitation, CPR, Traditional Learning, Distance Learning.

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1. Introduction

Effectiveness of education in cardiopulmonary resuscitation with traditional classroom learning techniques has been the subject of many studies worldwide. Most of this research concerns CPR education is provided to both trainees and trainers. In terms of training, certified trainers is necessary to acquire a satisfactory level of skills for achieving proper and effective compressions and ventilations. Several researches have been conducted, investigating and evaluating both theoretical level of trainers' knowledge and skills. However, in all these surveys, the validation of the skills was based on a possibly subjective graduation carried out by certified trainers [6, 7]. Common result of all these studies is that no matter the way of CPR training, the educational results were similar [6, 8]. The European Resuscitation Council (ERC), after years of research, released guidelines concerning both the content and way of CPR training [9]. The specific training is an educational process that is the core part of education in Basic Support Living Life Support (BLS).

The aim of this study is to evaluate the level of trainees' knowledge and skills that applied a CPR training program as well as the level of trainers' knowledge and skills of this program, using certified questionnaires and objective measurements of technical skills.

1.1 Terms and Definitions

QCPR (Quality Cardiopulmonary Resuscitation): The specific name was given by Laerdal Medical Company to characterize the scores given by the software. The higher the percentage score, the more effective CPR cardiac resuscitation is considered.

CPR (Cardiopulmonary Resuscitation): A medical procedure that takes place in emergency situations of cardiopulmonary arrest and combines chest compressions and rescue ventilations.

BLS (Basic Life Support): A medical procedure applied in case of victims with life-threatening symptoms until specialist care is taken by specialized health care providers.

MCQ (Multiple Choice Question): A knowledge questionnaire as structured by ERC to evaluate trainees' knowledge.

ERC (European Resuscitation Council): The European Resuscitation Agency that is responsible for certified education in cardiopulmonary resuscitation in Europe.

Mean depth: The ideal average depth of compression during CPR, set for adults in 5-6cm.

Mean rate of all compressions during this session: The ideal compression frequency of effective CPR, set at 100 – 120 compressions / min.

Ventilations: The number of infusions of air during CPR. The ideal number is set at 5-6 breaths / min.

Ventilations with adequate volume: The ideal average volume of air per blowing is 400-700 ml.

2. Materials and Methods

The presented study was conducted from September to November 2017 and included both CPR educators and trainers who followed traditional classroom learning training method as defined by ERC [9].

Participants answered a knowledge questionnaire of 20 questions derived from ERC after the adoption of guidelines in 2015. The questions were adapted to Greek language according to the instructions of the clinical adaptation group [10]. Two independent translators who are familiar to both English and Greek language translated the English questionnaire of twenty questions in Greek. Both translated texts were co-estimated and their joint has been given to a third independent translator whose maternal language was English. They translated Greek text into English language again without knowing the original foreign language version of ERC questionnaire.

Before starting the training programs volunteer trainers were invited to answer knowledge questionnaires and applied a 2-minute cardiopulmonary resuscitation (CPR) in Laerdal's Resusci Anne QCPR manikin. Data was recorded and stored using a compatible software called Resusci Anne Wireless Skill Reporter (Figure 1),

Volunteer trainees were asked to answer the same questionnaire after the end of each educational process and then they underwent a 2-minute CPR apply in Resusci Anne QCPR manikin. Data were also recorded and saved by the above mentioned compatible software.

2.1 Data recorded was the following:

1. The total score that was determined by individual parameters such as compressions (number and quality), ventilations (number and quality).
2. The duration of session, time, number of cycles (compressions per ventilations) and correctness of selected compression point.
3. Data of quality characteristics of compressions such as frequency, time with sufficient frequency, depth of compression as well as adequate - full chest expansion during compressions.
4. Data of the qualities characteristics of ventilation, such as air volume, frequency, successful or non-successful ventilations.

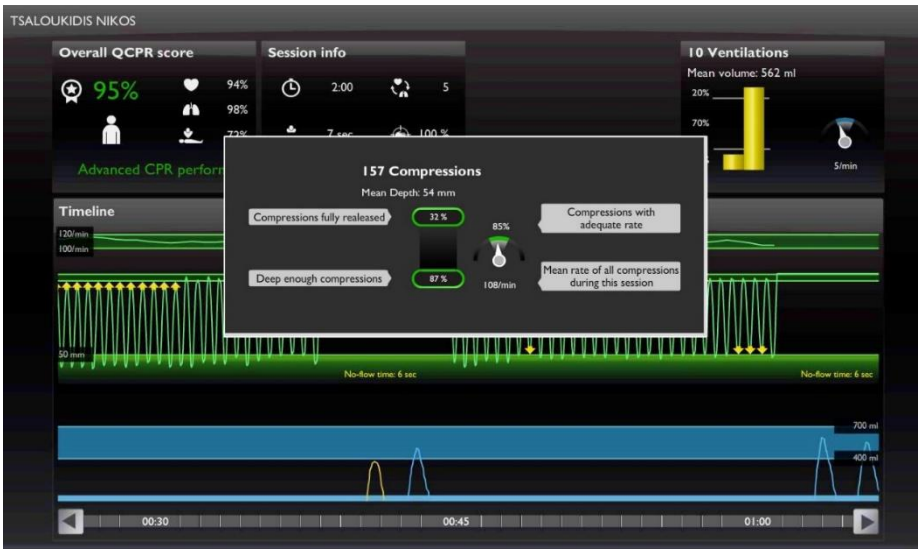

Figure 1. QCPR Score of knowledge questionnaire using Resusci Anne manikin

3. Main Results

Data of 108 trainers with an average age of 38.0 years (SD = 10.5 years) was collected and compared to data of 101 trainees with an average age of 38.6 years (SD = 09.8 years). 40.7% were men and 59% were women. Most of trainers were men while a higher percentage of the trainees were women (Table 1).

Table 1: Gender frequency versus training group

		Trainers (N=108)		Trainees (N=101)		Pearson's x^2 test
		N	%	N	%	
Gender	Men	57	52,8	28	27,7	<0,001
	Women	51	47,2	73	72,3	

There is no statistically significant difference in the education level between the two groups. Many individuals in both groups had completed higher education studies or held a doctorate diploma (Table 2).

Table 2: Education level of target group

		Trainers (N=108)		Trainnes (N=101)		Pearson's x^2 test
		N	%	N	%	
Education level	Secondary Education	10	9,6	3	3,2	0,133
	Post-secondary Education	36	34,6	25	26,9	
	Higher Education	42	40,4	46	49,5	
	Postgraduate and Doctorate	16	15,4	19	20,4	

The largest proportion of both trainees and trainees concerns healthcare section (Table 3).

Table 3: Professional group of target population

		Trainers (N=108)		Trainees (N=101)		Pearson's x2 test
		N	**%**	**N**	**%**	
Do you belong in healthcare section?	Yes	62	72,9	76	80,9	0,209
	No	23	27,1	18	19,1	

Nurses and doctors were the majority of both trainers and trainees (Table 4).

Table 4: Professional status of target population

		Trainers (N=108)		Trainees (N=101)		Pearson's x2 test
		N	%	N	%	
Which is your professional group?	Doctor	7	11,1	13	17,1	-
	Nurse	26	41,3	34	44,7	
	Nurse assistant	4	6,3	11	14,5	
	Rescuer	24	38,1	6	7,9	
	Radiographer	0	0,0	4	5,3	
	Physiotherapist	1	1,6	1	1,3	
	Midwife	1	1,6	1	1,3	
	Hydrotherapy - gymnastics	0	0,0	4	5,3	
	Pharmacist	0	0,0	2	2,6	

There is no statistical significance of the cognitive level of both groups, regarding the level of theoretical knowledge according to the distribution of correct answers.

Table 1: Level of knowledge of target population

	Trainers	Trainees	P Student's t-test
	Average (SD)	Average (SD)	
Total score	74 (12,2)	71,6 (10,2)	0,126

The rates of trainers' correct answers ranged from 37.0% to 98.1%. 37.0% of trainers correctly answered question 7 while 98.1% correctly answered question 1. The trainees' correct answers ranged from 10.9% to 99.0%. Only 10.96% of learners responded correctly to question 7 while 99% correctly answered question 14. There were significant differences in rates of correct answers between the two groups. In particular, trainees had significantly lower rates of correct answers at questions 2, 7, 9 and 20. They also had a significantly higher percentage of correct answers at question 18 compared to those of trainers.

The table below shows the percentages of right answers for both trainers and trainees (Table 6).

Table 6: Percentages of correct answers of trainers and trainees at the theoretical level

	Trainers	Trainees	Pearson's x2 test
Right answers in:	N (%)	N (%)	
Question1	106 (98,1)	99 (98)	1,000*
Question 2	103 (95,4)	88 (87,1)	0,034
Question 3	102 (94,4)	97 (96)	0,749*
Question 4	50 (46,3)	38 (37,6)	0,204
Question 5	94 (87,0)	87 (86,1)	0,849
Question 6	85 (78,7)	84 (83,2)	0,412
Question 7	40 (37,0)	11 (10,9)	<0,001
Question 8	90 (83,3)	76 (75,2)	0,148
Question 9	60 (55,6)	34 (33,7)	0,001
Question 10	96 (88,9)	82 (81,2)	0,118
Question 11	88 (81,5)	83 (82,2)	0,896
Question 12	73 (67,6)	75 (74,3)	0,290
Question 13	47 (43,5)	40 (39,6)	0,566
Question 14	103 (95,4)	100 (99)	0,214*
Question 15	88 (81,5)	81 (80,2)	0,814
Question 16	99 (91,7)	95 (94,1)	0,503
Question 17	63 (58,3)	70 (69,3)	0,099
Question 18	84 (77,8)	92 (91,1)	0,008
Question 19	83 (76,9)	86 (85,1)	0,128
Question 20	45 (41,7)	29 (28,7)	0,050
*Fisher's exact test ** was not calculated due to lack of distribution			

According to the table below, the overall score extracted from the recording software does not show any statistically significance between the two groups (Table 7).

Table 7: QCPR Score

	Trainers		Trainees		P Mann-Whitney test
	Average (SD)	Median (Intra range)	Average (SD)	Median (Intra range)	
QCPR score based on compression, ventilations and flow flaction	62,1 (25,2)	66,5 (41 - 85)	56,1 (28,9)	64,5 (31 - 81)	0,175

The table below shows the individual scores of both groups as recorded by the software (Table 8).

Table 8: Individual scores of both trainees and trainers

		Trainers		Trainees		P Mann-Whitney test
		Average (SD)	Median (Intra range)	Average (SD)	Median (Intra range)	
Compressions score		60,4 (31,5)	67 (33 - 88)	56,6 (33,8)	63 (24 - 87)	0,495
Ventilations score		73,5 (26,2)	82,5 (54 - 97)	58,6 (30,1)	62 (46 - 82)	<0,001
Percentage of time compressions were performed		70,5 (5,9)	72 (69 - 74)	70,4 (7,1)	71 (66 - 74)	0,529
Total time of this session, N (%)	2 min	98 (100)		90 (100)		-**
	4 min	0 (0)		0 (0)		
	6 min	0 (0)		0 (0)		
Number of cycles		6,1 (6,4)	5 (5 - 6)	3,8 (2,4)	4 (3 - 5)	<0,001
Average time without flow		6,6 (6,3)	6 (5 - 7)	8,5 (8,9)	7 (6 - 9)	<0,001
Compressions with correct hand position		92,7 (20,6)	100 (100 - 100)	90,1 (21,8)	100 (95 - 100)	0,218
Compressions		180,3 (22,8)	179,5 (166 - 195)	155 (30,5)	155,5 (139 -169)	<0,001
Mean depth of compressions		52,4 (7,3)	54 (48 - 59)	48,1 (10,1)	49 (40 - 57)	0,007
Compressions with full chest expansion		46,2 (34,3)	49,5 (10 - 79)	58,2 (33,8)	62,5 (24 - 89)	0,015
Compressions with sufficient depth		67,3 (36,1)	83,5 (39 - 98)	51,2 (40,5)	55 (2 - 97)	0,003
Compressions at a sufficient frequency		29,3 (34,2)	9,5 (0 - 55)	37,7 (34,4)	31,5 (3 - 71)	0,024
Average frequency of all compressions during this session		127,5 (17,3)	125,5 (118 - 137)	110,5 (20,1)	110,5 (98 - 124)	<0,001
Ventilations		9,9 (3)	10 (10 - 12)	6,7 (3,6)	7 (5 - 10)	<0,001
Mean volume		772,7 (354,4)	709,5 (563 - 987)	688,5 (367,9)	717 (507 - 933)	0,285
Ventilations that exceed the maximum volume limit		56,2 (40,5)	67 (13 - 100)	49 (36,7)	50 (0 - 83)	0,090
Ventilations with sufficient volume		30,9 (33,5)	20 (0 - 57)	26,1 (26,9)	17 (0 - 50)	0,512
Ventilations that do not reach the minimum volume limit		7,8 (17,8)	0 (0 - 9)	12,5 (21,6)	0 (0 - 17)	0,056
Average frequency of all ventilations during this session		4,8 (1,5)	5 (5 - 6)	3,2 (1,8)	3 (2 - 5)	<0,001

*not calculated due to lack of distribution

The trainer's ventilation score was significantly higher than that of the trainees. Moreover, the number of trainers' cycles was significantly higher than that of trainees. On the other hand, the trainers' average time without flow was significantly lower than that of the trainees. The number of compressions, the average depth of compression, the number of compressions with sufficient depth and the average frequency of all trainers' compressions during this session were

significantly higher than those of the trainees. The number of compressions with full chest expansion and with sufficient trainers' frequency was significantly lower than that of trainees. The number of ventilations and the average frequency of trainers' ventilations during this session were significantly higher than those of the trainees.

4. Discussion

The evolution of computer technology and the development of software and manikins enabled the improvement of rescuers' skills of, in order to perform effective CPR [11]. According to recent studies, it is widely accepted that there is a subjective evaluation of CPR efficacy, although this evaluation is conducted by very experienced and trained individuals [12-14]. It is widely accepted that training including manikins and the appropriate compatible software not only results in better education and more objective trainees' evaluation but also assists trainers to acquire an objective perspective of their level of efficacy and be retrained. By using these technologies a positive impact on trainers is provided because of the realism of CPR education at all levels [15].

Undoubtedly the goal of all training methods (traditional classroom learning, distance learning) is the effective students' education on CPR and the provision of a high level of trainers' knowledge and skills. In countries such as Australia or New Zealand, the level of CPR training depends on the structures provided. This diversion concerns learners' frequency of exposure to real cases. Having that in mind, trainers, in general are forced to be retrained in order to provide a better educational level [16].

At the first part of the present study, it is claimed that the level of theoretical knowledge of both trainers and trainees is high without any statistical differences between both groups. Undoubtedly, trainers have the characteristics required in order to adequately train (theoretically and technically) adult trainees. Although they are aware of the algorithm that must be followed in CPR appliance, there is a lack of the theoretical background needed by the instructors.

Furthermore both trainers and trainees had a satisfactory skill level. The trainers had better results in individual measurable data, such as cycle between compressions and ventilations, while trainees had better scores, such as the average frequency of compressions. The final QCPR score between two groups is apparently equivalent. The age was not proved to have a statistically significant effect on the instructors' skills or knowledge. The present study argues previous studies claiming that the higher educational level is associated with higher scores. The composition of trainers' sample may be a possible explanation, while the participants appear to be more active in training processes in general due to time availability [17].

The need for instructors' retraining and re-education at regular intervals is also evident in this study by using electronic media (manikins, software). The trainers' level is sufficient, but it's not as satisfactory as expected for CPR trainers neither theoretically nor practically [16, 18].

It is widely accepted that the educational process, including skills training, is validated by the trainers themselves based on their visual evaluation on trainees. Evaluation form that was completed after visual evaluation of the session characterizes the process as correct. However, the present results show that only 1/3 of the participants had a good percentage of correct compressions (between 75-100%). According to data the subjectivity of visual assessment is confirmed. Even if evaluation is conducted by accredited assessors, the credibility and value of this approach is questioned. The use of manikins connected via compatible software is considered to be more accurate and reliable [19, 20]. The software results reveal the rescuers' inability of accurately determine the depth of compressions, which in many cases differs from guidelines suggestions. Moreover, there is an inability to reach the ideal time in chest full expansions in order to achieve the replenishment of the heart with blood, at a rate of almost 50%. Our results are compatible with other studies as van Tulder's et al., in which instructor readers were asked to capture the depth of compressions on plain paper [7].

The above mentioned data should concern us about the characteristics that an adult CPR trainer needs to have. In terms of acquiring the title of a certified trainer, a more systematic study should be undertaken in order to obtain basic theoretical knowledge on the educational process. Furthermore, certified rescuers and possible future trainers must succeed in the objective test of skills performed by using special manikins linked via compatible software.

This test will not be performed in terms of success or fail cutoff, but will aim to significantly improve the trainers' skills by studying the parameters and the wrong practices in real time. The skills level can also be determined by ERC or by individual certified training providers.

5. Conclusions

The trainers evaluate trainees' skills mainly with subjective criteria. The comparison of between software use and trainers' judgment about measuring skills has shown that trainers' crisis, as the sole criterion of evaluation, can't fully determine the success of different skills.

CPR trainers, in addition to the features needed by adult educators, should be re-educated and evaluated at regular intervals. The age and educational level does not seem to affect each person's ability to become a trainer of cardiopulmonary resuscitation.

Nowadays technology is an essential tool in our hands for the evaluation of several procedures. The training by using manikins and appropriate software results make it possible to identify errors in real time. Data recording by using software should be a key tool for determining the successful performance of skills in accordance with ERC guidelines.

In the future, the use of such manikins may be a useful tool in evaluating candidate trainers, in order to rate their skills and become qualified instructors.

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