Original Research Article

A study of relationship between effective CPR training, physical characteristics of resuscitator and chest compression quality

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Abstract

Background: CPR is one of the most vital therapeutic options for patients with cardiac arrest. The probability of survival decreases significantly after 4 minutes without CPR in witnessed arrests.1 For a victim to have a good chance, a bystander must start CPR early and effectively since emergency medical service providers generally can't get to a scene within 6 to 8 minutes. **Objective:** To Study the Relationship between Effective CPR training, physical characteristics of resuscitator and chest compression quality. **Methodology:** A prospective cohort study was conducted in Department of Emergency Medicine at M S Ramaih Medical College, Bangalore. The study was conducted on Health care professionals who participated in Basic life support course in Ramaiah Medical College during the year 2018-19. All the participants who underwent training in Basic life support were included during the study period. Results: In the study 254 subjects were included, mean age of subjects was 28.09±7.83 years. Mean Chest compression per minute increased to 114.66 ± 3.80 after training from 103.45±8.84 before training. Mean Average compression percentage per minute increased to 81.00 ± 1.65 after training from 52.26 ± 4.53 before training. Mean depth increased to 81.86 ± 2.96 after training, compared to 58.49 ± 2.99 before training. Mean Recoil increased to 90.61 ± 6.616 after training, compared to 59.82 ± 3.95 before training. **Conclusion :** : From the present study it was concluded that effective training in BLS was the most important factor in determining the effectiveness of CPR among Health care professionals irrespective of factors such as age, gender, height, weight and BMI. Hence the study recommends for adequate training of health care professional in CPR to improve the outcome in Cardiac arrest.

Key Words: CPR, CHEST COMPRESSION, LIFE SUPPORT, HEALTH CARE

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INTRODUCTION

CPR is one of the most vital therapeutic options for patients with cardiac arrest. The probability of survival decreases significantly after 4 minutes without CPR in witnessed arrests.[1] For a victim to have a good chance, a bystander must start CPR early and effectively since emergency medical service providers generally can't get to a scene within 6 to 8 minutes.[2,3] Thousands of lives could be saved every year by implementing bystander CPR because effective bystander CPR provided immediately after sudden cardiac arrest could double or triple a victim's chance of survival.[4] However, the quality of chest compressions is influenced by age, gender, body weight and time passed since the most recent BLS training of the bystanders.[5] Effective chest compressions are essential for providing blood flow during CPR. For this reason all patients in cardiac arrest should receive chest compression. To provide effective chest compression, push hard and push fast. It is reasonable for laypersons and healthcare providers to compress the adult chest at a rate of at least 100- 120 compressions per minute with a compression depth at least 5 cm. Chest

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compression in hospital is often insufficient even when applied by in experienced medical staff. According to the guidelines, the rotation time for chest compression should be about 2 min, regardless of physical type. The physical characteristics rescuers and effective training must be considered to provide and maintain high quality CPR with respect to the rotation time for chest compression. The quality of chest compressions is not solely dependent on the physical fitness of the rescuer. This study was conducted to highlight the importance of high quality training personals rather than depending only physical characteristics of resuscitator with the objective to determine CPR training age, gender and physical attributes (height, weight and BMI) affected the quality of chest compressions administered health care professionals during CPR before and after training.

MATERIAL AND METHODS

Study settings: Ramaiah Medical College, Bangalore

Study subjects: Health care professionals who participated in Basic life support course in Ramaiah Medical College during the year 2018-19.

Inclusion Criteria: Health care professionals aged > 18 years or older

Exclusion criteria: Subjects with cardiac disease, respiratory disease or physical disability musculoskeletal or functional mobility issues were excluded from the study.

Study design: Prospective Cohort study.

Study duration: One year

The following information was collected about sex, age, height, weight, body mass index, pre and post training data of chest compression using feedback device collected.

Sample size: All the participants who underwent training in Basic life support were included during the study period.

Data Collection: Data was collected by using pre structured questionnaire. During the assessment, the participant's height, weight was measured as per the standard guidelines. Participants were made to perform chest compression of 2min pre training and post training chest compression per minute, average effective compression per minute, depth, recoil, overall chest compression percentage noted by using Ladearl feedback devices.

Statistical analysis:

Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Continuous data was represented as mean and SD. Independent t test was used as test of significance to identify the mean difference between two quantitative variables and qualitative variables respectively. Paired t test is the test of significance for paired data such as before and after interventions for quantitative data. Pearson correlation was done to find the correlation between two quantitative variables and qualitative variables respectively. Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram and Scatter plots. p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests. Statistical software: MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

RESULTS

Table 1: Baseline Characteristics of the subjects in the study

General Characteristics		Mean	SD
Age		28.09	7.83
Sex	Male	144	56.7%
	Female	110	43.3%
Height		164.91	9.44
Weight		64.27	13.21
BMI		23.61	4.15

In the study 254 subjects were included, mean age of subjects was 28.09 ± 7.83 years, 56.7% were males and 43.3% were females, mean height was 164.91 ± 9.44 cms, mean weight was 64.27 ± 13.21 Kgs, mean BMI was 23.61 ± 4.15.

Table 2: Comparison of physical characteristics of resuscitator and chest compression quality before and after training

		Count	Mean	SD	P value
C/M	Before	254	103.45	8.84	<0.001*
	After	254	114.66	3.80	
A/C	Before	254	52.26	4.53	<0.001*
	After	254	81.00	1.65	
Depth	Before	254	58.49	2.99	<0.001*
	After	254	81.86	2.96	

Recoil	Before	254	59.82	3.95	<0.001*
	After	254	90.48	1.55	
CC %	Pre CC %	254	55.90	4.91	<0.001*
	Post CC %	254	95.59	1.88	

C/M Chest compression per minute, A/C Average compression percentage per minute, CC% overall chest compression

Mean Chest compression per minute increased to 114.66 ± 3.80 after training from 103.45 ± 8.84 before training. Mean Average compression percentage per minute increased to 81.00 ± 1.65 after training from 52.26 ± 4.53 before training. Mean depth increased to 81.86 ± 2.96 after training, compared to 58.49 ± 2.99 before training. Mean Recoil increased to 90.61 ± 6.616 after training, compared to 59.82 ± 3.95 before training. Mean Overall chest compression increased to 95.59 ± 1.88 after training, compared to 55.90 ± 4.91 before training. In the study there was significant increase in C/M, A/C, Depth, Recoil and CC% after training compared to before training.

Table 3: Correlation between Pre CC%, Post CC% with Age, Height, Weight and BMI

Correlations							
		Pre CC %	Post CC %	Age	Height	Weight	BMI
Pre CC %	Pearson Correlation	1		0.043	-0.091	-0.060	-0.042
	P value			0.492	0.148	0.338	0.501
	N	254		254	254	254	254
Post CC %	Pearson Correlation		1	-0.021	0.178**	0.029	-0.061
	P value			0.741	0.004	0.640	0.329
	N		254	254	254	254	254

In the study there was significant positive correlation between Post CC% and Height, i.e. with increase Height there was increase in Post CC% and vice versa. There was significant no significant correlation between pre CC% with age, height, weight and BMI and between Post CC% with age, weight and BMI. Hence there was no effect of Age, Height, Weight and BMI in Pre and Post Chest compression % except for height in post chest compression%.

Table 4: Comparison of physical characteristics of resuscitator and chest compression quality before and after training b/w males and females

		Sex						P value b/w males and females
		Male			Female			
		Mean	SD	P value with in males	Mean	SD	P value with in females	
C/M	Before	104.15	9.51		102.54	7.84		0.149
	After	114.55	3.91	<0.001*	114.80	3.66	<0.001*	0.602
A/C	Before	52.21	4.42		52.32	4.69		0.849
	After	80.88	1.60	<0.001*	81.15	1.70	<0.001*	0.180
Depth	Before	58.39	3.09		58.63	2.87		0.531
	After	81.86	2.94	<0.001*	81.85	3.00	<0.001*	0.986
Recoil	Before	59.75	3.96		59.91	3.96		0.751
	After	90.52	1.63	<0.001*	90.44	1.45	<0.001*	0.669
CC %	Pre CC %	56.02	4.89		55.74	4.96		0.648
	Post CC %	95.71	1.86	<0.001*	95.43	1.91	<0.001*	0.239

Between males and females there was no significant difference in mean C/M, A/C, depth, recoil and CC% before and after training. In both males and females after training there was significant increase in C/M, A/C, Depth, Recoil and CC% respectively.

DISCUSSION

External chest compression are the principal elements of circulatory support during CPR6 and chest compression depth, chest compression rate and complete chest recoil play a key role to obtain high-quality chest compressions.[7] It has been widely demonstrated that anthropometric variables influence chest compression depth and, in particular, underweight rescuers are less likely to be able to perform chest compressions of adequate depth compared to normal weight or overweight rescuers.[8,9] Chest compression requires power to be applied from a point that is vertically above the sternum to a depth of 5 cm. The amount of power required to depress a sternum by 5 cm is about 500 N.[10,11,12] Chest compression force during CPR is generated using gravity and hip flexion torque.[13] Those applying chest

compression develop force by accelerating the upper body downwards using gravity and use hip extension torque to hold the trunk up at decompression, which resists the inertial force of gravity.[13] The moment acting at the lumbar spine represents the loads generated by muscles during chest compression.[14] This study was conducted on 254 health care professionals who underwent training in our institute during the year 2018-19. Mean age of subjects in the study was 28.09 ± 7.83 years, 56.7% were males and 43.3% were females, mean height was 164.91 ± 9.44 cms, mean weight was 64.27 ± 13.21 Kgs, mean BMI was 23.61 ± 4.15. Before training mean Chest compression was 103.45 ± 8.84, mean average compression percentage was 52.26 ± 4.53, mean depth was 58.49 ± 2.99 mm, mean Recoil was 59.82 ± 3.95 and mean Overall chest compression was .90 ± 4.91. After training there was increase in mean Chest compression to 114.66 ± 3.80, mean Average compression percentage to 81.00 ± 1.65, mean depth to 81.86 ± 2.96 mm, mean Recoil to 90.61 ± 6.616 and mean Overall chest compression to 95.59 ± 1.88. The increase after training was statistically significant. Our study demonstrated that there was no significant difference in mean Chest compression per minute, Average compression percentage per minute, depth, recoil and overall chest compression between males and females. In the study by Juan Wang *et al* 15 the average compression depth and rate were 53.7±5.3 mm and 135.1±15.7 compressions per minute respectively. The proportion of chest compressions with appropriate depth was 71.7%±28.4%. CPR was found to be related to gender, body weight, and body mass index of subjects included in the study. The quality of chest compressions was well maintained among males but declined rapidly in female students. Physical fitness and rescuer fatigue did not affect the quality of ventilation. Tomoyuki *et al* concluded that Chest compression caused increased fatigue among the light group, which consequently resulted in a gradual fall in the quality of chest compression. Their results suggested that individuals with a lower body weight should rotate at 1-min intervals to maintain high quality CPR and thus improve the survival rates and neurological outcomes of victims of cardiac arrest. Ahmad Jaafar *et al*, in their study on 72 participants of both genders observed no significant association between gender and the CC depth. Feng-ling Zhang *et al* in their study concluded that CPR training courses are required regularly. They recommended changing the practitioner before fatigue, especially for females or weak practitioners. In training projects, more attention should be paid to the control of compression rate, in order to delay the fatigue, guarantee enough compression depth and improve the quality of chest compression.

CONCLUSION

From the present study it was concluded that effective training in BLS was the most important factor in determining the effectiveness of CPR among Health care professionals irrespective of factors such as age, gender, height, weight and BMI. Hence the study recommends for adequate training of health care professional in CPR to improve the outcome in Cardiac arrest.

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