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Effectiveness of Basic Life-Support Programme and Public Cardiopulmonary Resuscitation (CPR) Training Event Among Medical Students: A Pilot Quasi-Experimental Study

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ABSTRACT

Immediate resuscitation is crucial for the survival of a patient with cardiac arrest. Research has suggested that self-led bystander cardiopulmonary resuscitation (CPR) is significantly associated with favourable neurological outcomes for patients. Furthermore, medical students play an important role in providing public CPR training to the community. This study aims to evaluate the effects of a CPR training programmes and a public training event on the knowledge, attitudes, and perceived competency towards CPR among medical students. The quasi-experimental study was conducted among the medical students in clinical years studying at a private medical institution in Malaysia. The intervention group received CPR training for two sessions and participated as trainers in a community-training event; the control group was excluded from these activities. A total of 106 students (intervention group, n = 51; control group, n = 55) participated in this study. The total knowledge score (5.24 ± 1.67 vs 3.75 ± 1.22, $P < 0.001$), attitude score (22.38 ± 3.67 vs 20.82 ± 2.33, $P = 0.011$), and perceived competencies to perform CPR and automated external defibrillator (AED)

(7.22 ± 2.33 vs 4.93 ± 2.40, $P < 0.001$) were significantly higher among the participants in the intervention group compared to those in the control group after the intervention. Meanwhile, concerns regarding initiating CPR was significantly higher in the intervention group compared to the control group (12.44 ± 5.15 vs 9.55 ± 3.96, $P = 0.002$). The results suggested that CPR training is beneficial for students and should be organised regularly. In addition to providing physical skills training, such sessions should explain legal implications of initiating CPR and should encourage and assure students to do so in case of an emergency.

Keywords: *Cardiopulmonary resuscitation, CPR, Basic life support, Resuscitation, Automatic external defibrillator*

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INTRODUCTION

Cardiac arrest is a global public health concern (1). An estimated 3 million deaths occur worldwide every year because of cardiac arrests (2). It can occur either in a hospital setting (in-hospital cardiac arrest) or in a community setting (out-of-hospital cardiac arrest [OHA]) (3). A systematic review of out-of-hospital cardiac arrests found that the incidences varied around the world (4). In the United States, the estimated incidences of out-of-hospital cardiac arrests treated by emergency services were approximately 184,000 annually. The estimated survival for discharge was 10.8% to 11.4% (5–6). However, the survival to discharge rate was as low as 2% (4).

Immediate resuscitation helps a patient survive in the immediate aftermath of a cardiac arrest. According to the chain of survival concept, early recognition of cardiac arrest signs, early activation of emergency medical services (EMS), basic cardiopulmonary resuscitation (CPR), rapid defibrillation, and early initiation of advanced cardiac support and integrated post-cardiac arrest care are crucial to saving the patient (7). CPR helps the heart to continue the perfusion; that is how oxygenation to the brain and other vital organs is maintained while the patient waits for the EMS (8). Evidence has shown that the survival rate was better among patients who received CPR during out-of-hospital cardiac arrest before the arrival of the EMS (9–12).

Bystander CPR is given to out-of-hospital cardiac arrest patients by any person, including medical personnel, who is not part of the EMS team (13–14). Self-led bystander CPR was found to be significantly associated with favourable neurological outcomes compared to no bystander CPR (9% vs 3.2%, p-value < 0.01) (15). However, a study conducted among Malaysian college students revealed that their knowledge on hands-only CPR was not encouraging and approximately half of the respondents (45%) were not willing to perform CPR on a stranger in an emergency situation (16). Hence, early bystander CPR and early defibrillation training should be organised for students, healthcare personnel, and the public. A systematic review on CPR training, which included 34 research articles, revealed that training improved the psychomotor skills, and the skills retention period lasted approximately three to six months (17). Therefore, well-

organised, systematic CPR training should be organised regularly in various institutions as well as communities.

Competency, knowledge, and positive attitudes towards CPR are important for trainees to effectively apply CPR in case of an emergency. A study conducted in Sweden revealed that healthcare providers and nurses' knowledge and attitudes towards CPR improved after they attended a training programme (18). Similar findings were observed in a study conducted among healthcare personnel in Saudi Arabia, where improvement was observed in the training group as knowledge increased and attitudes towards CPR changed (19).

An observational study was conducted in Kota Bharu, Kelantan, Malaysia, over one year (13). Among the 23 OHA admitted to the hospital, only two had received bystander CPR. This finding showed the urgent need for public awareness on the importance of CPR as well as skills required to perform it. Medical students played an important role in providing public CPR training in a programme in the United Kingdom, which helped spread awareness. The programme saw participation and promotion on social media with an overwhelmingly positive response from the public (20). However, in Malaysia, basic life support (BLS) certified instructors who can deliver public training are limited (21). Therefore, medical students have the potential role to provide CPR training to other students and public to improve their awareness and skills (21–23). It is a promising strategy to overcome the shortage of CPR trainers at schools and in their community (21, 23). Medical students should attend proper training to become competent CPR trainers. Existing literature exploring CPR training given to medical students and their role as public CPR instructors is limited.

Therefore, this study aims to evaluate the effect of a CPR training programme and a public training event on the knowledge, attitudes, and perceived competency among medical students.

METHODS

Study Setting

The study was conducted at a private medical institution in Malaysia. The students in clinical years, including years 4 and 5, were recruited. All students had attended CPR training once during the preclinical year.

Study Design and Participants

The quasi-experimental study was conducted among medical students. Written informed consent was obtained from the participants. The experimental group included participants who had attended the recent CPR training and participated in the public CPR awareness event. Those who did not attend the training and participate in the event were recruited under the control group. All respondents were recruited on a voluntary basis. Therefore, the proportion of the year 4 and 5 students were not recruited equally. Self-administered questionnaires were distributed to all of them.

The sample size was estimated to analyse the difference between two independent means with a *t*-test (two-tailed) by using G*Power 3.1.9.2. The statistical significance level was set at 0.05, 80% power, alpha 0.05, and effect size of 0.60. The estimated sample size was 45 for each group, with a total of 90 participants. With the consideration of a dropout rate of 20%, a total of 108 participants were recruited. The data were collected between December 2019 and February 2020.

Intervention

The students in the experimental group attended three sections of CPR activities. In the first session, a theory presentation on CPR was delivered, which was

followed by a demonstration of CPR and automated external defibrillator (AED) by professionals. The students were then given hands-on training on CPR and AED using mannequins. The duration of the training was approximately two hours.

In the second session, a group training was conducted, with presentations on CPR and cardiac arrest. Students practiced hands-only CPR by using CPR balls for three hours.

In the third session, the students participated as troopers to train laypersons as a mass community event for four hours. In the mass community event, the participants served as trainers to conduct hands-on CPR by using CPR balls (Figure 1).

Study Tool

The questionnaire included five sections: (a) demography; (b) knowledge about CPR and AED; (c) attitude towards CPR (19); (d) factors influencing attitudes in initiating CPR and AED (19); and (e) perceived competency and preference on CPR.

The demographic section included questions on age, gender, ethnicity, and previous attendance of CPR training during preclinical year. Knowledge about CPR and AED section included seven questions regarding knowledge on AED, methods to use it, chest compression and ventilation ratio for adults, depth of CPR, rate of chest compression, and correct sequence of conducting adult CPR. The responses were recorded as binary answers (yes/no), single best answer, and sequence answers for CPR steps. The correct answers were rated 1, and incorrect answers 0. Attitudes towards CPR training included 15 items, and responses were recorded on a 3-point Likert scale (disagree = 1, neutral = 2, agree = 3). Factors that influenced attitude in initiating CPR and AED included 10 items, and the responses were recorded on a 3-point Likert scale (disagree = 1, neutral = 2, agree = 3). Lastly, perceived competency on CPR included five items, and the responses

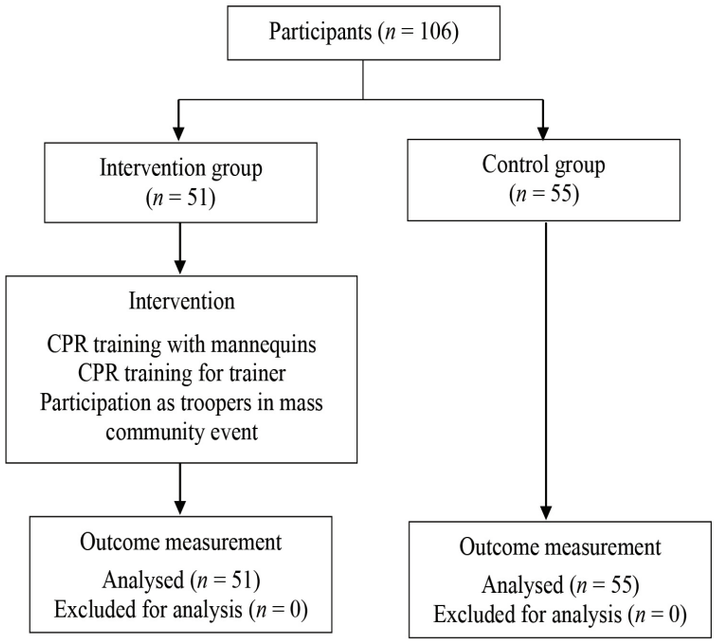

Figure 1: The study design and interventions.

were recorded on a 3-point Likert scale (disagree = 1, neutral = 2, agree = 3).

Content validation was carried out for items in the questionnaire by using expert ratings. The items' content validity index (CVI) was 0.83 and above. The items were considered acceptable in the content validation and were included in the questionnaire (24–25). Reliability analysis was conducted by calculating the coefficient for Kuder-Richardson 20 (KR-20) for knowledge items (0.61), Cronbach's alpha for attitude towards CPR and AED items (Cronbach's α, 0.66), factors that influenced attitude in initiating CPR (Cronbach's α, 0.83), and perceived competency on CPR (Cronbach's α, 0.80). The analysis revealed that the items in the questionnaire were acceptable for good reliability.

RESULTS

A total of 106 final-year medical students participated in this study. Female participants comprised majority in both the groups: 80.9% in the intervention group and 63.6% in the control group. Almost all of them had attended BLS training previously (98.0% in the intervention and 94.5% in the control group) (Table 1).

The knowledge score of participants in both the groups was compared. The knowledge score was significantly higher in the intervention group compared to the control (5.24 ± 1.67 vs 3.75 ± 1.22, $P < 0.001$).

The participants' attitude was compared between those who had recently received training (intervention group) and those who had not (control group). Participants' agreement on each statement was reported in Table 2. The intervention group had a higher attitude score compared to the control group (22.38 ± 3.67 vs 20.82 ± 2.33, $P = 0.011$). The agreement on the statements that enquired about BLS skills was significantly higher in the intervention group, such as "I am able to work as a member of a resuscitation team", "I can perform CPR on my own", and "I know how to defibrillate." Meanwhile, approximately 30% of the participants in the intervention group agreed that the prognosis of the resuscitated patient was poor, and that defibrillation could damage the patients' heart (Table 2).

Concern regarding initiating CPR was significantly higher in the intervention group compared to the control group (12.44 ± 5.15 vs 9.55 ± 3.96, $P = 0.002$). The intervention group's biggest concerns were fear of lack of training (58%) and lack of legal coverage (56.9%). The control group's biggest concerns were related to fear of lack of training (81.8%) and lack of self-confidence (76.4%) (Table 3).

The total score of perceived competencies to perform CPR and AED was significantly higher among the participants in the intervention group compared to that of participants in the control group (7.22 ± 2.33 vs 4.93 ± 2.40, $P < 0.001$). The highest perceived competency among the intervention group was "I am competent to perform both chest compression and ventilation" (60%); only 34.5% participants in the control group agreed with the statement (Table 4).

Table 1: Participants' characteristics and previous experiences on CPR training among intervention and control groups

Participants' characteristics	Intervention group, *n* (%)	Control group, *n* (%)	Statistical analysis	*P*
Gender				
Male	9 (19.10)	20 (36.40)	3.691*	0.055
Female	38 (80.90)	35 (63.60)		
Mean age in years (mean ± SD)	23.67 (1.77)	22.71 (1.10)	3.312†	0.001
Ethnicity				
Malay	14 (29.80)	7 (13.00)	8.996*	0.029
Chinese	8 (17.00)	17 (31.50)		
Indian	22 (46.80)	20 (37.00)		
Others	3 (6.40)	10 (18.50)		
Previous CPR training in preclinical year				
Yes	50 (98.00)	52 (94.50)	0.890*	0.346
No	1 (2.00)	3 (5.50)		

Notes: *Pearson Chi-square test; †Independent sample *t*-test

Table 2: Attitude towards CPR training among medical students in the intervention and control group

Statements	Intervention group (agreement) *n* (%)	Control group (agreement) *n* (%)	X^{2*}	*P*
I think CPR and use of AED should be rehearsed at least once per year.	38 (74.5)	52 (94.5)	8.44	0.015
I am able to work as a member of a resuscitation team.	37 (72.5)	14 (25.5)	24.14	< 0.001
I can perform CPR on my own.	31 (60.8)	14 (25.5)	14.30	0.001
Prognosis of resuscitated patient is poor.	16 (32.0)	3 (5.5)	12.53	0.002
Only doctors should defibrillate.	16 (31.4)	9 (16.4)	6.76	0.034
I know how to defibrillate.	28 (54.9)	17 (30.9)	15.80	< 0.001
I think defibrillation damages a patient's heart.†	16 (31.4)	1 (1.8)	22.62	< 0.001
Defibrillation should be performed by any healthcare professional on the scene.	31 (62.0)	36 (65.5)	0.14	0.935
I hesitate to use an AED because I fear damaging the patient.	19 (37.3)	15 (27.3)	4.43	0.109
If an AED is available, I would use it to attend a cardiac arrest patient.	39 (76.5)	33 (60.0)	3.71	0.156
I am willing to attend an AED training course at my own expense.	32 (62.7)	39 (70.9)	0.87	0.65
I agree that all clinics should be equipped with an AED.	40 (78.4)	53 (96.4)	8.28	0.016

(*Continued on next page*)

Table 2: (*Continued*)

Statements	Intervention group (agreement) *n* (%)	Control group (agreement) *n* (%)	X^{2*}	*P*
I would support/participate in community CPR/AED project.	42 (82.4)	50 (90.9)	2.24	0.326
I would perform mouth-to-mouth ventilation during CPR.	37 (72.5)	37 (67.3)	1.85	0.396
I think AED should be mandated in the clinic and office settings.	41 (82.0)	50 (90.9)	1.99	0.370
Attitude total score				
Mean score	Mean (±SD)	Mean (±SD)	*t*-test	*P*
	22.38 (3.67)	20.82 (2.33)	2.60	0.011

Notes: X^{2*} = Pearson Chi-Square

Table 3: Participants' concern in initiating CPR and AED in the intervention and control group

Statements	Intervention group (agreement) *n* (%)	Control group (agreement) *n* (%)	X^{2*}	*P*
I think that the fear of further harming a heart attack victim affects me.	21 (41.2)	24 (43.6)	5.15	0.063
I believe that lack of self-confidence influences me in initiating CPR.	25 (49.0)	42 (76.4)	8.51	0.014
I fear that my lack of training influences me greatly in initiating CPR.	29 (58.0)	45 (81.8)	7.31	0.026
I believe that a young victim positively affects my decision to initiate CPR.	22 (43.1)	18 (32.7)	8.87	0.012
I think a victim being of a different gender affects me.	19 (37.3)	5 (9.1)	29.58	< 0.001
I think a victim being from a different geographic area affects me.	13 (25.5)	4 (7.3)	23.60	< 0.001
I think that lack of legal coverage greatly affects me.	29 (56.9)	12 (21.8)	14.07	0.001
I think that my fear of contracting a disease affects me.	20 (39.2)	15 (27.3)	1.92	0.383
I believe that if I know the victim, this will positively affect my decision.	27 (52.9)	26 (47.3)	0.73	0.694
I think that a victim being of the same gender will affect my decision to initiate CPR.	18 (35.3)	3 (5.5)	25.22	< 0.001
Concern total score				
Mean score	Mean (±SD)	Mean (±SD)	*t*-test	*P*
	12.44 (5.15)	9.55 (3.96)	3.25	0.002

Note: X^{2*} = Pearson chi-square

Table 4: Perceived competency to perform CPR and AED in the intervention and control group

Statements	Intervention group (agreement) *n* (%)	Control group (agreement) *n* (%)	X^{2*}	*P*
I am well-trained the steps of CPR.	25 (49.0)	8 (14.8)	17.55	< 0.001
I am competent to perform chest compression only resuscitation.	22 (43.1)	22 (40.0)	0.00	0.609
I am competent to perform both chest compression and ventilation.	30 (60.0)	19 (34.5)	6.82	0.033
I am competent to use the AED.	25 (49.0)	14 (25.5)	11.15	0.004
I am competent to teach CPR to public.	29 (56.9)	3 (5.5)	38.04	< 0.001
Concern total score				
Mean score	Mean (±SD)	Mean (±SD)	*t*-test	*P*
	7.22 (2.33)	4.93 (2.40)	4.94	< 0.001

Note: X^{2*} = Pearson chi-square

DISCUSSION

This study investigated the effectiveness of CPR training and participation in a public training event among undergraduate medical students. To the best of our knowledge, this is the first study in Malaysia investigating this effect of on-campus CPR training and participation in public CPR training event.

Several studies have reported that retention of knowledge and skills declined after a certain period of attending CPR training (26–30). A scientific review conducted by the American Red Cross Advisory Council on First Aid, Aquatics, Safety and Preparedness (ACFASP) revealed that the degradation of CPR skills occurred within the first year after training (31). Therefore, frequent training is needed to retain the quality CPR skills (32). The participants in this study had previously attended CPR training during year 3, which was conducted over a year before the current study was carried out. Hence, the knowledge retention might have been varied among study participants from years 4 and 5 at the baseline. However, since the last CPR training was conducted than a year ago, all participants' knowledge may have degraded. The participants' knowledge of CPR significantly improved in the intervention group compared to the control group after a series of interventions. Similar findings were reported in a quasi-experimental study in Iran, wherein the intervention group's knowledge and performance had significantly improved after training (33).

In addition to knowledge, skills, and competency of CPR, attitudes towards CPR play an important role in initiating CPR in a real-life situation. In general, attitude towards CPR training was significantly higher in the intervention group. Our finding was supported by previous studies in which the completion of BLS training led to an improvement in attitudes towards CPR among health care professionals (18–19) and college students (34). Concerns about the patients' prognosis and defibrillation were found to be higher among participants in the intervention group. Our findings can be correlated with another study, where the latter reported participants having anxiety for getting bad outcomes, which subsequently hindered CPR initiation to strangers (34). Furthermore, a qualitative study among lay rescuers (bystander CPR) revealed that the participants were concerned and uncertain about the outcome

in patients, and knowing the positive outcome was a relief for them (35). Even though the training could improve their knowledge and skills, attendees need to be encouraged to perform CPR in a real-life situation.

Interestingly, concerns about the victim being of a different gender and from a different geographic region, along with legal issues, were significantly higher among participants in the intervention group. Similar to our findings, a study among high school students reported that some of them were not willing to perform chest compression due to fear of legal consequences (13.06%), fear of injuring the patient (24.75%), and fear of infection (11.62%) (36). A higher level of concern with our study could be explained by the fact that the students in the intervention group participated not only in in-house training, but also as trainers in the community event. Therefore, they might have had more concerns regarding the real-life situation and obstacles they might face in performing CPR (19). Further qualitative research is needed to better understand concerns that hinder initiation of CPR among undergraduate medical students.

Learning CPR is related to the acquisition of motor skills. For learners, motor skills learning is related to intrinsic motivation, attainment of self-efficacy, and perceived competency (37–38). In our study, improvement in the psychological aspect of perceived competency was observed in the intervention group. Therefore, our finding suggested that BLS training and participation in community events improved their attitudes and perceived competencies psychologically. Similarly, after the CPR training, the improvement in the trainees' perceived competency was found to be correlated with improvement of physical chest compression skills among undergraduate health science students (38).

Limitations

Our study has a few limitations. Students' voluntary participation was ascertained by the training and community event. Therefore, the quasi-experimental design could not provide causality like randomised controlled trials would. Even though trainers assessed the participants' skills, the score data was not collected. Hence, we were unable to compare participants' physical skills scores. The students had attended their last CPR course in year 3. Therefore, year 4 students had a one-year gap and year 5 students had a two-year gap until the current research. The participants were recruited on a voluntary basis and therefore, the proportion of year 4 and year 5 students in the intervention and control groups was different. Since the knowledge and skills retention may vary depending on the duration of the last training, the baseline knowledge may have some extent of variation among the participants in both groups.

CONCLUSION AND RECOMMENDATIONS

Our study showed that CPR training and participation in community events improved knowledge, attitude, and perceived competency among undergraduate medical students. Participants in the intervention group had more concerns regarding administering CPR. The results suggested that CPR training was beneficial for students and should be organised regularly. In addition to providing physical skills training, these sessions should explain legal implications of initiating CPR and should encourage and assure students to do so in case of an emergency. Both on-campus training and exposure to community events can motivate students as trainers and improve their perceived competency.

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ETHICAL APPROVAL

The ethical approval to conduct this study was granted by the Research Ethics Committee, Faculty of Medicine, Manipal University College Malaysia (Reference no: MMMC/FOM/Research Ethics Committee – 2/2020).

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