Knowledge of Adult Cardiopulmonary Resuscitation among Nursing Students in Selected Nursing Colleges in Kenya

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Abstract

BACKGROUND

Sudden cardiac arrest remains a global health concern. In Kenya 25% of all hospital admissions are related to cardiovascular diseases thus all healthcare workers and trainees should have updated cardiopulmonary resuscitation knowledge and skills. Despite Cardiopulmonary resuscitation knowledge and skills being life-saving, global and local research findings indicate that nursing students are deficient in this life-saving procedure. The objective of the study was to evaluate the senior diploma nursing student's knowledge of adult cardiopulmonary resuscitation.

MATERIALS AND METHODS

The study adopted a cross-sectional design, a pre-intervention phase of a quasi-experimental study. Four high-volume nurse training colleges were conveniently sampled. A total of 175 senior nursing students in their final year of study were recruited through the census. A questionnaire was used to evaluate their knowledge of adult basic life support which included; general principles, circulation, airway, breathing and automated external defibrillation concepts. Data was in a period of one month and analysed using SPSS version 26. Descriptive statistics were used to summarize the findings while one sample t-test was used to compare the means. According to American Heart Association, the study applied 84% as the competence score. A p-value less than 0.05 was considered significant

RESULTS

The mean knowledge scores for CPR were; general CPR principles 6.06±1.6 out of 13, circulation 4.07±1.51 out of 9, airway 2.69±1.30 out of 6, breathing 1.38±0.93 out of 5 and AED 2.69±1.30 out of 7. The overall mean per cent for CPR knowledge score was 41.83%±8.29, with a minimum of 23% and a maximum of 65%. The mean was compared to the American Heart Association competence score using one sample t-test that showed a significant difference of very large magnitude measured using Cohen d statistic; t (174) = 67.276, p=0.000, d= 5.1

CONCLUSION AND RECOMMENDATION

The mean basic life support knowledge for the senior nursing students was below average as compared to the local institutional pass mark of 50% and international standards score of 84%. There is a need to review the curriculum to cater for refresher training and advocate for certified CPR training before the completion of the study.

Keywords: *Cardiopulmonary Resuscitation, Nursing, CPR*

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Introduction

Sudden cardiac death (SCD) remains a leading cause of death in developed and developing countries. Sudden cardiac deaths and unexpected cardiac deaths account for 17 million deaths yearly. In the United States, approximately 180000-300000 deaths occur annually following sudden cardiac deaths (1). Though sudden cardiac death statistics in Africa are unknown, the disease burden is high and awareness of the disease and resuscitation is suboptimal(2). According to a study done in sub-Saharan Africa, the annual incident rate for SCD was 24.2/100000 (3). In Kenya, it is approximated that 25% of all hospital admissions are as a result of cardiovascular diseases and 13% of autopsies indicated the cause of the deaths was due to cardiovascular diseases. The most prevalent diseases in Kenya accounting for 25% of admissions are coronary heart disease, cerebral vascular disease, peripheral arterial disease, rheumatic heart disease, infective endocarditis, congenital heart disease and venous thromboembolism(4).

Cardiopulmonary (CPR)is a life-saving skill following a sudden cardiac arrest that involves chest compressions, artificial ventilation and the application of a shock using an automated external defibrillator (AED). Chest compressions increase the intra-thoracic pressure forcing the heart to pump blood manually. Ventilations are delivered using a pocket mask or bag valve mask. The AED corrects abnormal cardiac rhythms like ventricular fibrillation and pulseless ventricular tachycardia(5). Early recognition of cardiac arrest, prompt initiation of CPR and early defibrillation increases the chances of survival(6). Nurses are usually the first health providers to attend to in-patients with sudden cardiac arrest based on the nature of their work (7). Student nurses should be equipped with updated CPR knowledge and psychomotor skills. They should complete a basic life support course before they begin their clinical rotations (8).

Despite Cardiopulmonary resuscitation knowledge and skills being life-saving, global and local research findings indicate that nursing students are deficient in this life-saving procedure (9). According to American Heart Association, a health provider who scores 84% on the basic life support exam is deemed proficient at practice (10). A study done in New Delhi India comparing qualified nurses and nursing students revealed that the pre-service nurses who were senior undergraduate nursing students had significant ($p=0.001$) low knowledge of CPR as compared to the already practising nurses (11). A study done in Palestine among qualified nursing students revealed that the student nurses had an average score of 48.6% (12). A study done in India indicated that medical, dental and nursing students were deficient in CPR knowledge (13).

In Kenya, few studies have been done to assess CPR knowledge among student nurses. A study done at Kenyatta National Hospital nursing training college among post-basic students indicated low-performance scores (14). In another study done at Mombasa county referral hospital, 75.9 of doctors, nurses and clinical officers had below average level of knowledge. In the same study, only 26.1% indicated that they learned CPR in their respective training colleges (15). This study therefore aimed at assessing CPR knowledge for the senior nursing students ready to join the service.

Materials and Methods

Study design and procedure

The study adopted a cross-sectional design, a pre-intervention phase of a quasi-experimental study. It was conducted among senior nursing students in four selected campuses of Kenya Medical Training College. This study was a pre-intervention phase of a quasi-experimental study, Sample size was calculated based on the main statistical test for the study

which was a t-test. This was calculated based on the beta, power, alpha, and standardized effect size and then use a statistical table to identify sample size.

The first step was to develop the null hypothesis and indicate the direction. The researcher developed a null hypothesis that CPR training and certification did not enhance knowledge and skill acquisition which was a one-tailed test. The second step involved the estimation of the effect size (E) which is the difference in the mean value of the outcome variable between the treatment and control groups. A previous study had a mean difference of 8.07± 2.26 (16). The researcher wanted a 10% or more difference in the outcomes thus the effect size was 10% of 8.07 giving rise to 0.807. The third step was the estimation of the study variability of the outcome variable approximated to be 2.26 from the previous study (16). The fourth step involved the calculation of the standardized effect size by dividing the effect size (0.807) by the standard deviation (2.26) giving rise to a standardized effect size of 0.4. The fifth step was setting α and β; α was set at 0.05, power at 0.80 and thus the β was 0.20. Then, the sample size was estimated using a sample size table based on a t-test and each group was to have a minimum of 78 participants. The calculations informed the use of four KMTC campuses to cater for 156 students

Four KMTC campuses; Nyeri, Embu, Murang'a and Thika were conveniently sampled from four counties based on students practising in a level 5 hospital and also the institutions had fully equipped skills laboratories. A total of 175 third-year nursing students were recruited into the study using the census method.

Data was collected using 40 multiple-choice questions designed from the American Heart Association Basic Life Support manual for health providers in 2020. The questions included general CPR principles, circulation, airway, breathing and automated external defibrillation concepts. The tool was pretested for reliability in Mathari medical training college among senior nursing students. Test-retest reliability was used which yielded a Cronbach alpha of 0.995. Expert reviews were done to test for content validity by two specialists in emergency nursing. Participants were given 40 minutes to undertake the exercise.

Data management

Data were analysed using SPSS version 26. Descriptive data were presented using counts, percentages, mean, standard deviation, median, mode, minimum and maximum. One sample chi-square test was used to test whether the distribution of the responses was statistically different. One sample t-test was done to compare the group mean and the American Heart Association pass mark of 84 points. A p-value of <0.05 was considered significant.

Ethical considerations

Ethical approval was sought from Kenyatta University Ethics and Research Committee (PKU/2166/E1310). Permission from KMTC headquarters was also granted to undertake the study. Participants were informed about the study and consented to participate. The data collection tool was coded to maintain confidentiality. Covid-19 considerations were also adhered to as prescribed by the Ministry of Health.

Results

Demographic characteristics

From the findings, the majority of the respondents 132(75.4%) were aged between 21-25 years. Female students constituted a majority (108, 61.71%) of the respondents. None of the respondents had done a certified BLS course (Annex 1).

Cardiopulmonary resuscitation knowledge

Five sections covering general CPR principles, circulation, airway, breathing and automated external defibrillator concepts were assessed.

1. Knowledge of CPR general principles

The respondents were asked thirteen questions to evaluate their knowledge of the CPR general principles. Each score was one mark. The mean knowledge score was 6.06 ±1.602. The majority of the respondents 159(90.9%) were able to expand the BLS initials while 148(84.6%) knew the importance of checking for responsiveness. However, the majority 171(97.7%) were not aware of the recommended BLS sequence while 137(78.3%) were not aware of the recommended five cycles to alternate the roles. In almost all questions there was a statistically significant difference in distribution p <0.01 between those who knew and those who did not as shown in table 1.

2. Knowledge of circulation assessment during CPR

Respondents were asked nine questions on circulation assessment during CPR. The mean knowledge was 4.07 ± 1.51 which was below average. A majority of the respondents 138(78.9%) knew the correct position of hands during CPR and 113(64.6%) knew the rationale for chest compression. However, a majority 127(72.6%) of the respondents didn't know basic concepts on the depth of adult chest compression and duration of pulse checks. In almost all questions there was a statistically significant difference in distribution p <0.01 between those who knew and those who did not (Table 2).

3. Knowledge of airway assessment and management

On how to assess the airway, respondents were asked six questions. The mean score was 2.69±1.30 which was below average. A majority (106;60.6%) of the respondents were aware of the action needed if the chest was not inflating and the number of rescuers best to control a bag valve mask

Table 1
Knowledge of CPR general principles

	Questions	Correct response	Wrong response	One sample χ^2 *P* value
1	Expanding BLS initials	159(90.9%)	16(9.1%)	0.00*
2	BLS sequence	4(2.3%)	171(97.7%)	0.00*
3	One rescuer adult compression ventilation ratio	56(32.0%)	119(68.0%)	0.00*
4	Two rescuer adult compression ventilation ratio	101(57.7%)	74(42.3%)	0.04*
5	Number of CPR cycles to alternate roles	38(21.7%)	137(78.3%)	0.00*
6	In-hospital adult chain of survival steps	82(46.9%)	93(53.1%)	0.40
7	Where most of out of hospital cardiac arrests occur	79(45.1%)	96(54.9%)	0.20
8	Foundation of CPR	43(24.6%)	132(75.4%)	0.00*
9	Position to take as a lone rescuer	125(71.4%)	50(28.6%)	0.00*
10	The first step in case of a cardiac arrest	61(34.9%)	114(65.1%)	0.00*
11	Checking for responsiveness before CPR	148(84.6%)	27(15.4%)	0.00*
12	Duration to limit interruptions	46(26.3%)	129(73.9%)	0.00*
13	Most fear holding people from doing CPR	69(39.4%)	106(60.6%)	0.00*
Mean= 6.06 ±1.602				

However, a majority of 132(75.4%) were not aware of what to do if delivering oxygen by mask fails and 119(68.0%) were not aware of how to open the airway in a patient with suspected spinal injury. In almost all questions there was a statistically significant difference in distribution p <0.01 between those who knew and those who did not (Table 3).

4. Knowledge of breathing assessment and management

The respondents were asked five questions on breathing concepts. The mean was 1.38± 0.93 which was below average. Approximately half of the respondents 90(51.4%) knew the position of a second rescuer delivering breaths. More than 50% didn't know of the various concepts with 165(94.3%) assuming chest compressions promote breathing rather than circulation. In almost all questions there was a statistically significant difference in distribution p <0.01 between those who knew and those who did not (Table 4).

5. Use of an automated external defibrillator

Seven key questions on the use of an AED were assessed. The mean knowledge was 2.69±1.30 which was below average. Most respondents were not aware of the various concepts. A majority of 150(85.7%) of the respondents knew that the duration between collapse and defibrillation saves lives.

Table 2
Knowledge of circulation concepts

	Questions	Correct response	Wrong response	One sample χ^2 *P* value
1	Depth of adult chest compression	48(27.4%)	127(72.6%)	0.00*
2	Duration of pulse check	48(27.4%)	127(72.6%)	0.00*
3	Correct artery to check for an adult pulse	54(30.9%)	121(69.1%)	0.00*
4	Compressions rate per minute	37(21.1%)	138(78.9%)	0.00*
5	Action to take if you miss pulse within 10 seconds	91(52.0%)	84(48.0%)	0.60
6	Resume CPR in 10 minutes if the victim is pulseless	83(47.4%)	92(52.6%)	0.50
7	CPR should be done on a firm surface	101(57.7%)	74(42.3%)	0.04*
8	Position of hands during chest compression	138(78.9%)	37(21.1%)	0.00*
9	The rationale for chest recoil	113(64.6%)	62(32.4%)	0.00*
Mean= 4.07± 1.51				

Table 3
Knowledge of airway assessment and management

	Questions	Correct response	Wrong response	One sample χ^2 *P* value
1	Opening airway in a patient with a spinal injury	56(32.0%)	119(68.0%)	0.00*
2	Adult choking management	60(34.3%)	115(65.7%)	0.00*
3	Action to take if delivering oxygen by mask fails	43(24.6%)	132(75.4%)	0.00*
4	Action to take if the chest is not inflating	106(60.6%)	69(39.4%)	0.05*
5	Signs of severe airway obstruction	99(56.6%)	76(43.4%)	0.08
6	Number of rescuers best to control bag valve mask	106(60.6%)	69(39.4%)	0.01*
Mean= 2.69±1.30				

However, a majority of 161(92.0%) did not know the recommended age to use adult defibrillator pads. In almost all questions there was a statistically significant difference in distribution p <0.01 between those who knew and those who did not (Table 5).

Overall performance and level of knowledge

We converted the total scores into percentages and classified them according to the Kenya Medical Training College examination policy. The mean score for CPR knowledge was 41.83 ±8.29 which was below average. A majority of the respondents 142(81.1%) had poor to a fair level of CPR knowledge (annexe 2).

Comparison with international standards

The scores were compared with the American Heart Association proficiency standard score of 84 % to analyse how many students had competent knowledge. None of the students achieved this point. The mean CPR knowledge score was 41.83, SD=8.29. A one-sample t-test was carried out regarding the AHA standard score of 84%. There was a significant difference t (174) = 67.276, p=0.000, d= 5.1 between the group mean and the desired AHA pass mark (annexe 3).

Table 4
Knowledge of breathing assessment and management

	Questions	Correct response	Wrong response	One sample χ^2 *P* value
1	Action to take on identifying agonal breaths	45(25.7%)	130(74.3%)	0.00*
2	Duration of delivering a breath	22(12.6%)	153(87.4%)	0.00*
3	Indicator of effective breaths	75(42.9%)	100(57.1%)	0.06
4	Position of a second rescuer delivering breaths	90(51.4%)	85(45.6%)	0.71
5	Chest compressions do not promote breathing	10(5.7%)	165(94.3%)	0.00*
Mean= 1.38 ± 0.93				

Table 5
Knowledge on AED

	Questions	Correct response	Wrong response	One sample χ^2 *P* value
1	AED universal steps	55(35.4%)	120(68.6%)	0.00*
2	Action to take after delivering a shock	43(24.6%)	132(75.4%)	0.00*
3	Action to take if no rhythm is advised by AED	56(32.0%)	119(68.0%)	0.00*
4	The recommended age to use adult defibrillator pads	14(8.0%)	161(92.0%)	0.00*
5	Two shockable rhythms	42(24%)	133(76%)	0.00*
6	Avoid putting defibrillator pads on top of a pacemaker	82(46.9%)	93(53.1%)	0.41
7	The duration between collapse and defibrillation saves lives	150(85.7%)	25(14.3%)	0.00*
Mean= 2.69±1.30				

Discussion

This study analysed the CPR knowledge of senior diploma nursing students in selected nursing colleges in Kenya. Five areas of CPR were assessed based on the AHA BLS manual for health providers. These were general principles, circulation, airway, breathing, and automated external defibrillator concepts.

The findings of the current study showed that no student had done a certified CPR course apart from what was taught in the first year of study. The findings mirrored a study done in Iran where almost all students had not done a certified CPR course (17). This finding can be attributed to the fact that not all nursing training colleges in Kenya have made CPR certification compulsory during training.

Another major finding from this study was that all the students had low CPR knowledge. The mean knowledge score was 41.83 $\pm$ 8.29. No student answered all the questions correctly as would have been expected at a senior level of training. The findings are almost similar to a study done in Uganda among qualified nurses where their mean knowledge percentage was 53.8% (18). Similarly, the findings are closely related to a study done at Nakuru County referral hospital Kenya where the nurses' knowledge of CPR was at 54.3% (19)The findings also mirror a study done in Iran where more than 70% of the students had a low CPR score (17). The findings can be attributed to the fact that the colleges in Kenya do not have a mandatory internationally certified CPR course and there is also no refresher training.

This finding is contrary to other studies that showed nursing students with higher CPR knowledge. A study conducted in Nigeria indicated that 82.5% of the students had an awareness of CPR(20). The findings also differ from a study done in Kolkata India where the students had a higher mean of 61.1% though below the desired AHA pass mark (21). These findings are contrary to a cross international study done in three countries that showed better performance among nursing students (22). The high scores in these studies could be attributed to the fact that there are frequent CPR refresher training and CPR certification is maintained.

The study also found out that majority of the students had poor to fair levels of knowledge which was below 50% performance as compared to local and international standards. There was no single student who achieved the desired mark of competence by AHA which is 84%. There was a statistically significant difference between the actual mean and the desired theoretical mean by AHA p=0.000, d=5.1. The findings are closely related to another study in Kenya among post-basic students where only 7.1% of the students achieved the recommended competence score by AHA (23). The low scores can be attributed to the fact that the college's pass mark is 50% which may not match the international recognized competence standards of CPR.

Conclusions and recommendations

The cardiopulmonary resuscitation knowledge among senior diploma nursing students in the selected nursing colleges was low. The students are not equipped with the desired knowledge to handle cases of sudden cardiac arrest once they occur in the community or clinical settings. There is a need to enhance the training done as part of the curriculum by introducing mandatory certified CPR courses before the students begin the clinical rotations in which the certificates must be maintained valid through refresher training and renewal of the BLS certificates.

Study limitations

The findings of this study lack generalizability since the study was only conducted in four selected nursing colleges. The findings may not reflect the CPR knowledge

among the senior diploma nursing students in Kenya nursing colleges.

Conflict of interest

The authors declare that there is no conflict of interest in the entire study.

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Annexe 1

Respondent's demographic data

Demographics	Response	Frequency	per cent
Age	15-20	6	3.4
	21-25	132	75.4
	26-30	34	19.4
	31-35	3	1.7
	Total	175	100.0
Gender	Male	67	38.3
	Female	108	61.7
	Total	175	100.0
Previous CPR certification	Yes	0	0
	No	175	100
	Total	175	100.0

Annexe 2

Levels of CPR knowledge

		Count	Percentage
Excellent	(75-100)	0	0.0%
Good	(65-74)	2	1.1%
Average	(50-64)	31	17.7%
Fair	(40-49)	87	49.7%
Poor	(0-39)	55	31.4%
		Mean =41.83 $\pm$8.29	

Annexe 3

One sample t-test statistics

One-Sample t-Test Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Total knowledge percentage	175	41.83	8.292	.627

One-Sample Test

	Test Value = 84						Effect size
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		
					Lower	Upper	Cohen
Total knowledge percentage	-67.276	174	.000	-42.171	-43.41	-40.93	d=5.1