

Heartbeat of Care: Exploring Radiographers' Insights Into CPR Knowledge and Attitudes in Jordan

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Objective: This study aimed to assess the knowledge and attitude of Jordanian radiographers toward Cardiopulmonary Resuscitation (CPR), in addition to exploring factors associated with their knowledge and attitude.

Methods: This was a cross-sectional study. Convenience sampling was used to collect data from 359 radiographers currently working at governmental, university, military, and private hospitals across the country. Data were collected using an online Google form questionnaire between October 5, 2023 and December 27, 2023. The questionnaire included questions about demographic information, knowledge of CPR, and attitude toward performing CPR. The data were analyzed using SPSS IBM software v. 28, and *P*-values <0.05 were considered statistically significant.

Results: A total of 359 radiographers with a mean age of 31.71±8.22 years participated in the study. More than half of the sample were male (198, 55.2%) compared to 161 (44.8%) females. The mean scores for knowledge of CPR and attitude toward CPR were 5.74 ± 2.31 out of 10 and 3.94 ± 0.46 out of 5, respectively. Radiographers who received CPR training demonstrated significantly higher mean knowledge scores compared to those who did not receive CPR training (*M*=6.51±2.14, vs *M*=4.73±2.14, *P*<0.001). A correlation was observed between the age and knowledge of CPR (*r*=0.157, *P*=0.003), work experience and knowledge of CPR (*r*=0.177, *P*<0.001), and knowledge and attitude toward CPR (*r*=0.326, *P*<0.001), whereas no statistically significant differences were observed between male and female radiographers' knowledge (*P*≥0.05) and attitude (*P*≥0.05) toward CPR.

Conclusion: Radiographers had poor knowledge of CPR. However, there was a positive attitude toward CPR. Previous CPR training and educational level were significantly associated with higher knowledge and positive attitudes toward CPR, whereas radiographers' age and work experience were significantly associated with higher knowledge. Therefore, continuous CPR training is recommended to increase radiographers' knowledge of CPR.

Keywords: radiographers, cardiopulmonary resuscitation, cardiac arrest, knowledge, attitude

Introduction

Cardiac arrest is considered a major public health problem, affecting thousands of people each year, both inside and outside the hospitals, and it accounts for 15–20% of all global deaths.^{1–3} Moreover, it is the abrupt cessation of heart activity and breathing, which in turn leads to the cessation of blood circulation and interruption of pulmonary gaseous exchange, confirmed by loss of consciousness and lack of pulse and respiration.^{4,5}

Cardiopulmonary resuscitation (CPR) is an important medical procedure performed to maintain the integrity of the brain until necessary measures are taken to restore normal blood circulation and breathing to the heart during cardiac

arrest. CPR is a combination of chest compressions and artificial ventilation delivered to patients who are believed to be experiencing cardiac arrest.⁶

The World Health Organization (WHO) indicated that 1.19 million people die due to road accidents every year, and 92% of these deaths occur in low- and middle-income countries. In addition, 20–50 million people suffer from nonfatal injuries worldwide.⁷ Moreover, according to statistics, the annual number of road accidents in Jordan is among the highest in the world.⁸

In general, almost all individuals injured in road accidents, whether critical or superficial, must be transferred to emergency departments in hospitals. Studies indicate that it is difficult to imagine contemporary medicine without diagnostic tools such as X-rays to diagnose road accident casualties.^{9,10} Therefore, to align with this particular situation and in accordance with the given instructions, advanced medical imaging systems, such as computed tomography (CT) and digital radiography are incorporated into the emergency department.

In contrast, some casualties need to be transferred to the radiology department to perform various radiological procedures located away from the emergency department. Health-care professionals usually accompany these casualties during the transfer to the radiology department to monitor the casualties and deal with the potential of critical events. This priority is ignored when a critical event occurs, owing to the lack of trained and qualified medical staff to deal with these conditions.

Likewise, the emergency department casualties who are in critical condition are transferred from the intensive care unit to the radiology department for further evaluation. Moreover, there is a possibility of cardiac arrest in patients who are injected with contrast media during various medical imaging procedures.^{11,12} Many studies have revealed that bystander CPR can improve the survival rate of patients with ventricular fibrillation and can double or triple the chances of survival after cardiac arrest.^{13,14}

According to hospital guidelines, CPR teams are called upon when necessary. However, occasionally, the vital signs of some patients crumble on the table of imaging systems, and eventually, the patient dies before the CPR team arrives. Under such conditions, the radiographer is the first person to initiate CPR when the radiologist is absent in the radiology department. Therefore, radiographers' knowledge of CPR is important to preserve the lives of patients and enhance the level of health care in hospitals.¹²

This prompted us to research radiographers' CPR knowledge. According to previous research, there is a lack of research on the knowledge and attitudes of radiographers toward CPR in Jordan. Only one study was conducted among allied health science students, including radiographic students.¹⁵ Previous studies have investigated the knowledge and attitude toward CPR among physicians, nurses, the public, and school teachers.^{16–21} Limited investigations of the knowledge and attitudes toward CPR among radiographers in developing countries have been conducted.^{4,11,12} Therefore, this study provides baseline information for researchers and health-care providers interested in performing CPR.

Behroozi et al conducted a study in Iran to assess radiographers' CPR knowledge of radiographers and showed that radiographers had not undergone CPR training since employment and the knowledge level was poor, as the mean score of knowledge was 8.8 out of 17.¹¹

Another study conducted in Saudi Arabia to investigate knowledge of BLS at a university hospital found that the overall knowledge score of health interns was 4.02 out of 8, indicating a knowledge score below average.²²

In the same context, a study targeting health-care professionals working in the Department of General Practice and Emergency, BPKIHS in Nepal, showed that knowledge of CPR among participants was average, with a mean score of knowledge of 7.40 out of 15.²³

In contrast, Ahmed et al conducted a study to investigate radiographers' knowledge of CPR. This study reported that none of the radiographers had undergone CPR training since they were employed. However, the majority of the respondents who constituted 97.4% of the entire participants had good knowledge levels.¹²

In addition, a study conducted in Ethiopia to assess the knowledge of CPR among medical students showed that 93.3% of participants had good knowledge of CPR.²⁴ Another study conducted to assess the knowledge of CPR among physiotherapists reported that the knowledge level of CPR was good.²⁵

In terms of attitude, a study conducted among healthcare professionals at Debre Markos Referral Hospital, Northwest Ethiopia, pointed out that more than half of health-care professionals had an unfavorable attitude toward CPR.²⁶ Another study performed to evaluate Nigerian nurses' attitudes toward performing CPR showed that the mean score of attitude was 11.34, which falls within the range score of negative attitudes.²⁷

In contrast, Iqbal et al conducted a study in Lahore, Pakistan, to assess the attitude of medical doctors toward CPR and reported that the overall attitude toward CPR among doctors was positive.²⁸ Ilyas et al investigated the attitudes of dental professionals toward CPR at government and private dental colleges in the same city. They indicated that 96% dental professionals had a positive attitude toward CPR.²⁹ Moreover, a study performed in Oman to evaluate the attitude of nurses working in hospitals and medical centers in South Sharqiyah showed that nurses' overall attitude toward CPR was positive.³⁰

Despite the reviewed literature, many studies have evaluated the knowledge and attitude toward CPR among various health-care professions, including radiographers, radiologists, nurses, medical doctors, dental professionals, and physiotherapists. However, there is a paucity of research regarding CPR knowledge in Jordan in general.¹⁵ Furthermore, few studies have investigated radiographers' knowledge and attitudes toward CPR. To fill this gap, this study aimed to evaluate radiographers' knowledge and attitudes toward CPR in Jordan.

Methods

Design and Sampling

A cross-sectional approach was used to assess the knowledge and attitude of radiographers toward CPR in Jordan.

Study Setting

In Jordan, the Energy and Minerals Regulatory Commission (EMRC) is an authorized institute responsible for granting licenses to radiographers to work in official hospitals. According to the latest statistics, the number of all radiographers who have received licenses to practice radiography has reached 4276 certified radiographers.³¹

To be included in this study, radiographers must be currently working at government, university, military, or private hospitals across the country. The required sample size was estimated using the Raosoft online software with a confidence level of 95% and margin error of 5%, resulting in a minimum of 353 radiographers required for the study to be carried out.³²

The Questionnaire

A three-part self-administered questionnaire was developed specifically for this study based on the 2020 American Heart Association (AHA) guidelines, previous studies,^{15,33,34} clinical and academic experience.

To confirm face and content validity, the questionnaire was reviewed by a multidisciplinary expert panel comprising four associate professors, each with a minimum of five years of experience in the fields of paramedicine and radiologic technology. Each panel member received a formal invitation delivered to their office at the Faculty of Applied Medical Sciences at Jordan University of Science and Technology (JUST). The invitation package included detailed information about the study's objectives, the panel members' roles in the review process, confidentiality measures, and their voluntary right to participate. Each expert was asked to provide consent by signing an enclosed agreement form and returning it to the research team, thereby formalizing their commitment to participate in the validity review.

A pilot study was conducted to assess the reliability of the tool. A Google Forms online questionnaire link shared with 40 radiographers who are primarily working at governmental, university and military and private hospitals across the country through WhatsApp and Facebook profiles. At the beginning of the questionnaire, an informed consent form was integrated. This form delineated the study's objectives, potential benefits, and risks, confidentiality measures, and the voluntary nature of participation. Only radiographers who provided their consent electronically were able to continue with the questionnaire.

The reliability of the tool was checked using reliability coefficient (Cronbach's alpha) and the Kuder–Richardson 20 (KR-20) were KR=0.785 for knowledge questions, $\alpha=0.73$ for attitude questions, respectively, which is considered

satisfactory since it is above threshold cutoff point (0.70).³⁵ The study tool was considered reliable and the expert panel approved the final version of the questionnaire.

The questionnaire included 28 items encompassing three parts: demographic information (6 questions), knowledge of CPR (10 questions), and general attitude toward performing CPR (12 questions). Demographic information included age, sex, education, work experience, place of work, and formal CPR training. The knowledge of CPR part includes 10 multiple-choice questions with only one correct answer. A correct response was assigned a score of 1, whereas an incorrect answer was assigned a score of 0. The score ranges from 0 to 10, with the minimum and maximum values. The general attitude toward CPR included 12 questions measured on a 5-point Likert scale. Individuals trained in CPR were primarily described as radiographers possessing CPR certification or those who had undergone hands-on training with subsequent assessments by professionals.

Data Collection Procedure

The process of data collection was managed by the Jordanian Society of Radiographs, and a Google Forms online questionnaire link was shared with radiographers over social media platforms, primarily through closed WhatsApp and Facebook groups of the Jordanian Society of Radiographers from October 5, 2023 to December 27, 2023. To increase the number of participants in the study, a notification was sent to the group members as a reminder. Moreover, the questionnaire was shared with colleagues in different Facebook profiles and WhatsApp groups. To ensure that the participants understood the survey, we briefly discussed the topic and identified the objectives of the study in the introduction. To reduce the possibility of bias, the survey was distributed on the WhatsApp and Facebook groups of Jordanian society of radiographers because these groups contain the majority of radiographers in Jordan, which guarantees targeting different experience levels, areas, and specializations within radiographer's public. Also, the using of validated tools and ensuring anonymity were considered to minimize such biases.

The Private Hospitals Association in Jordan indicated that there are 71 private hospitals, 33 government hospitals, 15 military hospitals, and 2 university hospitals. Thus, it is hard to distribute paper-based surveys to all hospitals effectively due to some challenges including geographic distance, remote locations, and cost. To fill this gap, this study was performed by an online survey to collect a representative sample size.

Data Analysis

Categorical data are expressed as frequencies and percentages, and scale data are expressed as means and standard deviations. The independent *t*-test was used to find the mean difference between categorical data with two levels, one-way ANOVA was used for independent variables with three or more levels, and Pearson correlation was used to find the relationship between scale data. Statistical significance was set at $P < 0.05$, and SPSS IBM software v. 28 was used to analyze the data.

Ethical Considerations

The ethical approval to perform this study was obtained from Institutional Review Board (IRB) approval at JUST (No. 651–2023) following a preliminary approval letter from research and ethics committee, deanship of faculty of applied medical sciences and department allied medical sciences. No Email addresses and internet protocol addresses were collected from radiographers to ensure anonymity and to enhance a higher response rate. Only radiographers who provided their consent electronically were able to continue with the questionnaire. In addition, we informed the participants that no one would see the information they provided, and confidentiality was ensured by storing their information in a locked file, using symbols instead of names.

Results

Demographics

A total of 359 radiographers with a mean age of (31.71±8.22 years old) were participated in the study. More than half of the sample were male (198, 55.2%) compared to 161 (44.8%) females. Most of the sample held a bachelor's degree (216,

60.2%), while the minority (39, 10.8%) held higher degrees. Approximately half of them worked in the private sector 176 (49.0%), while the minority worked in the military sector 32 (8.9%) with mean years of experience (7.80 ± 4.18 years). Finally, the results showed that more than half of radiographers had attended CPR training (203, 56.5%). [Table 1](#).

CPR Knowledge Among Radiographers

Ten questions were used to evaluate radiographers' knowledge of CPR. A correct response was assigned a score of 1, whereas an incorrect answer was assigned a score of 0. The scores ranged from 0 to 10, with the minimum and maximum values.

The results in [Table 2](#) have demonstrated that 64.1% of radiographers have correctly answered that checking consciousness and breathing is the most important step when witnessing someone lying on the floor. Moreover, 62.4% of them correctly identified that CPR starts with chest compressions. Moreover, less than half of the sample (40.1%) correctly answered the compression-to-breathing ratio (30:2) for an adult patient, and 57.9% pointed out that allowing full chest recoil after each compression is a characteristic of truly effective CPR.

Conversely, only 40.1%, 49.6%, and 33.1% of radiographers have correctly answered the exact number of compressions per minute for an adult patient (100–120/min), the proper depth of compression (5–6 cm), and that chest compressions should start within a maximum of 10s once CPR confirmed, respectively. In the same context, 46.5% of them pointed out that pushing hard and fast is a characteristic of truly effective CPR. The vast majority of the sample indicated that sudden loss of consciousness or collapse may indicate a need for CPR (69.4%), and (96.1%) knew that 911 was an emergency number in Jordan.

The mean score for knowledge about CPR was 5.74 ± 2.31 out of 10, when categorized based on quartiles. The results revealed that 46.2% had a poor knowledge level, 28.2% had a moderate level, and 25.6% had and good CPR knowledge levels ([Table 2](#)).

Attitude Toward CPR Among Radiographers

Twelve questions were used to assess the radiographers' attitudes toward CPR. Ten positively worded questions were measured using a 5-point Likert scale.^{1–5} However, the two negatively worded questions were reversed (5–1) for consistency in the data analysis.

The results in [Table 3](#) demonstrated that question number 3 “I believe that CPR is important and can increase the patient's ‘survival’” scored the highest mean score ($M=4.64\pm 0.67$), while question number 7 “I willing to provide mouth-to-mouth ventilation during CPR” scored the lowest mean score ($M=3.78\pm 1.41$). In terms of negatively worded

Table 1 Sociodemographic Characteristics of radiographers

Variables	Category	Frequency	Percentage
Gender	Female	161	44.8
	Male	198	55.2
Education level	Diploma	104	29.0
	Bachelor	216	60.2
	Higher degrees	39	10.8
Place of working	Private sector	176	49.0
	Governmental sector	93	25.9
	University sector	58	16.2
	Military sector	32	8.9
Have you ever formally received CPR training	No	156	43.5
	Yes	203	56.5
Age/years			Mean 31.71 ± 8.22
Experience/year			Mean 7.80 ± 4.18

Table 2 Level of CPR Knowledge Among Radiographers

No.	Item description	Options	True answer n (%)
1	If you are alone in the radiology department and sighted an adult lying on the floor, what would be the most important step to do?	Check consciousness and breathing Check pulse Start compressions immediately Call for help or emergency number	230 (64.1)
2	Which of the following is true regarding sequence of CPR	CPR Starts with chest compressions CPR starts with mouth-to-mouth breathing CPR starts with mouth to mouth and chest compressions Simultaneously Giving a mouth-to-mouth breathing is more important and Superior to chest compression	224 (62.4)
3	What is the compression to breathing ratio for an adult patient?	30 compression:2 breaths 30 compression:5 breaths 5 compression:1 breath 15 compression:1 breath	144 (40.1)
4	Which of the following is a characteristic of true effective CPR?	Allowing full chest recoil after each compression Compression without allowing chest recoil Compressing fast but not hard Compressing slowly	208 (57.9)
5	What is the number of compressions per minute for an adult patient?	100–120 compressions per minute More than 120 compressions per minute. 80–100 compressions per minute 60–80 compressions per minute	144 (40.1)
6	What is the depth of compression for an adult Patient?	5 to 6 centimeter 2 to 3 centimeter 3 to 4 centimeter At least 6 centimeter	178 (49.6)
7	Once confirmed the need for CPR, chest compressions should start within a maximum of?	10 seconds 5 seconds 15 seconds 30 seconds	119 (33.1)
8	Which of the following is a characteristic of true effective CPR?	Pushing (compressing) hard and fast Pushing (compressing) with medium speed Pushing (compressing) slowly Pushing (compressing) with medium power	167 (46.5)
9	Sudden loss of consciousness or collapse may indicate a need for CPR	Yes No	249 (69.4)
10	What is the emergency Number in Jordan?	911 000 119 112	345 (96.1)

(Continued)

Table 2 (Continued).

No.	Item description	Options	True answer n (%)
	Total knowledge mean scale score		5.74±2.31
	Knowledge categories	Poor (≤5) Moderate (6,7) Good (8-10)	166 (46.2%) 101 (28.2%) 92 (25.6%)

Note: Bold indicate correct answers.

Table 3 Level of Attitude Toward CPR Among Radiographers

No	Item description	Mean	SD
1	I would like to learn and practice CPR encouraged by cultural values and beliefs	4.55	0.67
2	I would like to receive CPR by healthcare professionals when needed	4.52	0.73
3	I believe that CPR is important and can increase the patients 'survival	4.64	0.67
4	I have the confidence to perform CPR	4.09	1.17
5	I have the knowledge and attitude to perform CPR	3.95	1.27
6	I willing to provide chest compressions during CPR	4.08	1.17
7	I willing to provide mouth-to-mouth ventilation during CPR	3.78	1.41
8*	I avoid providing CPR as I am afraid of legal liabilities	2.03	1.26
9*	CPR is characterized as being harmful	2.31	1.48
10	Radiographers should be recertified on CPR course every 2 years	4.45	0.77
11	All radiographers should get BLS training before practicing CPR	4.54	0.68
12	All radiographers should get ACLS training before practicing CPR	4.35	0.94
13	Attitude mean scale score	3.94	0.46
	Attitude categories Negative 1.0–2.33	2	(0.6%)
	Neutral 2.34–3.67	94	(26.2%)
	Positive 3.68–5	263	(73.3%)

Note: *Reversed item.

questions, the radiographers demonstrated a negative attitude regarding the avoidance of CPR due to fear of legal liabilities ($M=2.03\pm 1.26$), and CPR was characterized as being harmful ($M=2.31\pm 1.48$).

The mean attitude score was found to be 3.94 ± 0.46 out of 5, when it was categorized based on Likert scale categories, the results revealed that the vast majority had a positive attitude toward CPR (73.3%), neutral (26.2%), and (0.6%) had negative attitudes toward CPR. [Table 3](#).

Factors Associated With Knowledge of Radiographers About CPR

To show whether knowledge of CPR is significantly associated with sociodemographic variables of Jordanian radiographers, an independent *t*-test was used for independent variables with two levels, a one-way ANOVA for independent variables with three or more levels, and Pearson correlation for both scale variables.

The results in [Table 4](#) reveal that the radiographers' educational levels were significant ($F(2, 356)=10.234, P<0.001$). To demonstrate the individuals toward whom the significant discoveries are relevant, an LSD post hoc test revealed that

Table 4 Associations Between Sociodemographic Factors of Radiographers and Their Knowledge of CPR

Variables	Categories	n	Mean	SD	Test value	p-value
Gender	Female	161	5.55	2.25	1.351	0.178
	Male	198	5.88	2.35		
Education level	Diploma ^a	104	5.02	2.27	10.234	<0.001
	Bachelor ^b	216	5.88	2.24		
	Higher degrees ^c	39	6.82	2.29		
Place of working	Private sector	176	5.52	2.28	1.821	0.143
	Governmental sector	93	5.68	2.42		
	University sector	58	6.26	2.26		
	Military sector	32	6.13	2.14		
Have you ever formally received CPR training	No	156	4.73	2.14	7.796	<0.001
	Yes	203	6.51	2.14		
Age/years					0.157	0.003
Experience/year					0.177	<0.001

Notes: ^arefers to diploma holders, ^brefers to bachelor holders, ^crefers to holders of higher degrees. Bold color is the statistically significant value.

those with higher degrees (6.82 ± 2.29 , $P < 0.001$) demonstrated significantly higher knowledge mean scores than those with bachelor's degree (5.88 ± 2.24 , $P = 0.018$) and diploma (5.02 ± 2.27 , $P < 0.001$). Furthermore, those with a bachelor's degree demonstrated a significantly higher mean knowledge score than those with a diploma ($P < 0.001$).

In the same context, radiographers who received CPR training demonstrated significantly higher mean knowledge scores than those who did not receive CPR training ($M = 6.51 \pm 2.14$, vs $M = 4.73 \pm 2.14$, $P < 0.001$). Furthermore, age and work experience showed a significant positive and weak correlation with the knowledge of CPR ($r = 0.157$, $P = 0.003$ and $r = 0.177$, $P < 0.001$, respectively). Neither radiographers' gender nor place of work yielded a significant finding. [Table 4](#).

Factors Associated With the Attitude of Radiographers Toward CPR

As shown in [Table 5](#), the radiographers' educational levels demonstrated significant findings ($F(2, 356) = 8.634$, $P < 0.001$). The LSD post hoc test revealed that those with diploma degrees (3.80 ± 0.52 , $P < 0.001$) demonstrated

Table 5 Associations Between Sociodemographic Factors of Radiographers and Their Attitudes Towards CPR

Variables	Categories	n	Mean	SD	Test value	P-value
Gender	Female	161	3.96	0.45	0.654	0.519
	Male	198	3.93	0.48		
Education level	Diploma ^a	104	3.80	0.52	8.634	<0.001
	Bachelor ^b	216	3.98	0.43		
	Higher degrees ^c	39	4.10	0.39		
Place of working	Private sector	176	3.96	0.47	0.453	0.715
	Governmental sector	93	3.92	0.49		
	University sector	58	3.97	0.36		
	Military sector	32	3.87	0.55		

(Continued)

Table 5 (Continued).

Variables	Categories	n	Mean	SD	Test value	P-value
Have you ever formally received CPR training	No	156	3.81	0.54	4.772	<0.001
	Yes	203	4.04	0.36		
Age/years					-0.040	0.452
Experience/year					0.017	0.747

Notes: ^arefers to diploma holders. ^brefers to bachelor holders. ^crefers to holders of higher degrees. Bold color is the statistically significant value.

significantly lower attitude mean scores than bachelor's degrees (3.98 ± 0.43 , $P=0.001$) and higher degree holders (4.10 ± 0.39 , $P<0.001$), while no statistically significant mean difference was noted between those holding bachelor's degrees and those holding higher degrees ($P=0.128$). In addition, radiographers' who received CPR training significantly demonstrated a higher attitude mean score than those who did not receive CPR training ($M=4.04 \pm 0.36$, vs $M=3.81 \pm 0.54$, $P<0.001$). In contrast, neither radiographers' gender, place of work, age, nor work experience had a significant impact on their attitude toward CPR. [Table 5](#).

The Correlation Between the Knowledge and Attitude of Radiographers Regarding CPR

The Pearson product-moment correlation revealed a statistically significant moderate positive correlation between knowledge and attitude toward CPR ($r=0.326$, $P<0.001$, $n=359$). [Figure 1](#).

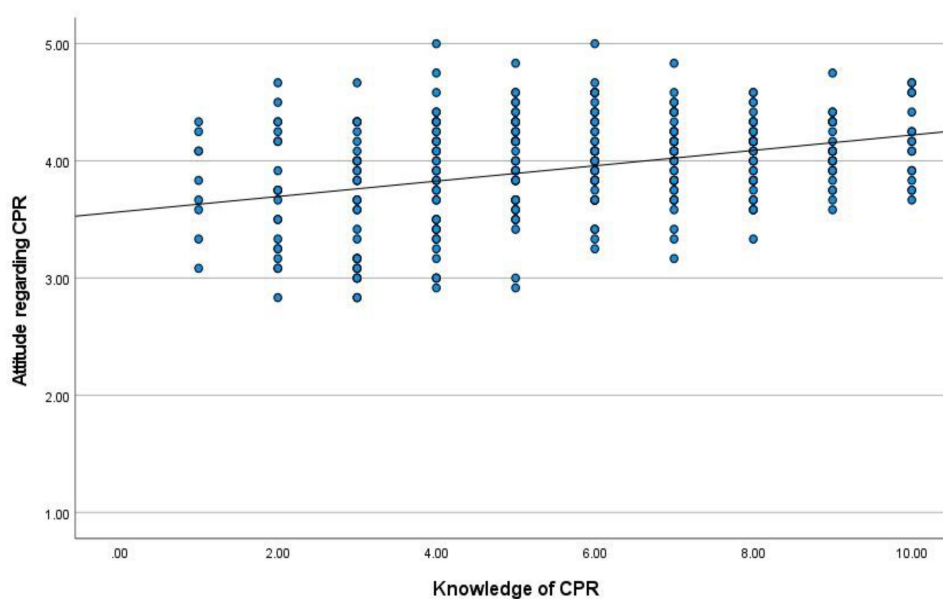


Figure 1 Correlation between radiographers' knowledge mean score and attitude mean score.

Discussion

This study aimed to assess the knowledge and attitude of radiographers in Jordan regarding CPR. Owing to the paucity of similar studies in the literature, general comparisons were performed. This study indicated that the mean score of knowledge about CPR was 5.74 ± 2.31 out of 10, indicating low knowledge scores among radiographers. Despite the difference in questionnaire and populations, similar low mean score of knowledge was observed in studies conducted in Iran, Jordan and India were (8.8 ± 2.3 out of 17), (3.9 ± 1.7 out of 10) and (4.16 ± 1.40 out of 10), respectively.^{11,15,36} In addition, the results revealed that knowledge of CPR was significantly associated with experience, age, education level, and participants who received previous CPR training. These results are consistent with those of studies conducted in Kuwait, Kenya, and Nepal.^{23,37,38}

Specifically, higher mean knowledge scores were observed for those with higher degrees than for those holding bachelor's degree and diploma. Similar findings were found in a study by Manono et al, who reported higher knowledge of CPR among participants who held a degree or master's compared to others.³⁸ In contrast, a study conducted in Malaysia to assess knowledge among nurses indicated that there was no statistically significant difference between knowledge and education level.³⁹ This is because CPR knowledge is widely prevalent among Malaysian nurses, as it is part of the curriculum that nurses pass in universities and colleges.

Moreover, the current study revealed a positive correlation between work experience and knowledge of CPR. This result is in concordance with the Veettil et al study, which assessed CPR knowledge among health-care providers in Qatar.⁴⁰ Experience is widely recognized as a key factor in acquiring knowledge. Consequently, those with extensive clinical experience were more likely to encounter CPR situations, which helped them learn about, research, and comprehend CPR. A contradictory result was observed in the study by Alkandari et al, which indicated that younger participants with <10 years of medical experience and a lower career hierarchy scored significantly higher on knowledge of CPR than other participants. A possible explanation for this difference is that without adequate CPR training and practice, a significant amount of theoretical information has elapsed during 12 months and after 18 months, and there will not be any remaining adequate hands-on skills.³⁷ Similarly, a positive correlation was observed between age and knowledge of CPR. This means that as the age of the participants increased, their knowledge of CPR also increased. A similar result was reported by Ahmed et al, who found that participants in the older age group had the best knowledge of CPR.¹² Furthermore, no statistically significant differences were observed between sexes and CPR knowledge. This is in agreement with the results of studies conducted in Qatar and Ethiopia.^{34,40}

Despite the low mean knowledge score observed in the present study, participants who received CPR training had significantly higher mean knowledge scores than those who did not receive CPR training. The results are in line with other studies performed in Pakistan, Nepal, India, and Botswana.^{41–44} This is because radiographers who have received CPR training have only recently acquired CPR information. As a result, they had better knowledge of CPR than the others.

Our study revealed that the majority of radiographers, specifically 56.5%, had received training in CPR. Nevertheless, radiographers exhibited a rather low average knowledge score of 5.74 out of 10. Multiple studies have demonstrated a rapid deterioration in both knowledge and skills related to BLS over time.^{45,46} Moreover, it was reported that participants who were involved in resuscitation frequently achieved better outcomes than those who did it infrequently.⁴¹ In the real world, radiographers are not commonly involved in resuscitation, which implies that their knowledge and skills could decline over time. Therefore, it is important for radiographers to conduct regular workshops and training sessions to ensure a current and relevant understanding of CPR.

The Mersha et al study showed that 38.9% of participants answered the recommended rate of effective chest compression correctly. This is in agreement with our study, as less than half of the sample (40.1%) correctly reported compression-to-breathing ratio (30:2) for in adult patients.³⁴ Moreover, Alam et al reported that 58.1% of participants correctly identified that CPR starts with chest compressions, which is consistent with the findings of our study.⁴⁷ About 40.1%, 49.6% of radiographers correctly answered the exact number of compressions per minute for an adult patient (100–120/min), the proper depth of compression (5 to 6 cm), respectively. These results were not in line with the Behroozi et al study, which pointed out that 66% and 62% of radiographers correctly answered the number of chest compressions in adults and the depth of chest compressions in adults, respectively.¹¹ The reason for this difference is that

this study included 359 radiographers, while another study included only 87. Therefore, a large variation in sample size will cause a significant difference.

According to the current study, 46.5%, 33.1%, and 69.4% of radiographers correctly answered pushing (compressing) hard and fast is a characteristic of true effective CPR; chest compressions should start within a maximum of 10s once CPR is confirmed, and sudden loss of consciousness or collapse may indicate a need for CPR, respectively. The findings of this study concur with the findings of a study targeting allied health-care professionals' students in Saudi Arabia, as 43.9%, 32.8%, and 69.7% of allied health-care professionals' students correctly answered the previous questions, respectively. Moreover, a low mean score for knowledge about CPR was observed in 5.1 of 10, which is consistent with our study.⁴⁸ Finally, the vast majority of radiographers (96.1%) knew that 911 was an emergency number in Jordan. The result for this question was higher than the others because this number is the emergency number in Jordan. Therefore, it is commonly and widely known among populations.

In terms of attitude, the mean score of the attitude toward CPR was found to be 3.94 out of 5 indicating a positive attitude toward CPR among radiographers. Despite the difference in questionnaires, a similar finding was observed in a study targeting radiographers in Iran, which indicated that radiographers had a positive attitude toward CPR.¹¹ In addition, other studies targeting health-care professionals have reported that participants had a positive attitude toward CPR.^{22,23,44}

In terms of positive worded questions, our study indicated that the question "I believe that CPR is important and can increase the patient's 'survival'" had the highest mean score (4.64 out of 5). This finding is consistent with that of a study conducted in Saudi Arabia, which reported the same question with the highest mean score (4.63 out of 5). In addition, the same study showed that the question "I would provide mouth-to-mouth ventilation to strangers" had a mean score of 3.13 out of 5, which was similar to our study.⁴⁹

In terms of negatively worded questions, the radiographers demonstrated a negative attitude regarding the avoidance of CPR due to fear of legal liabilities (2.03 out of 5), and CPR was characterized as harmful (2.31 out of 5). This indicates that the radiographers had misunderstandings about certain CPR concepts, as a low score was observed toward CPR as being harmful, which suggests that some radiographers believe that CPR is harmful. Therefore, CPR training should be regularly performed. In addition, radiographers showed a negative attitude toward fear of legal liabilities, which may affect their level of confidence and attitude towards performing CPR, resulting in decreased patient survival rates. To fill this gap, policymakers in Jordan must clarify the laws and legislation defining the rights, responsibilities, and immunity of CPR providers in hospital settings.

The results revealed that attitude toward CPR was significantly associated with educational level and CPR training attendance. These findings are in agreement with a study focusing on health-care professionals.³⁴ In addition, this study showed that radiographers with a diploma degree demonstrated a lower mean attitude score than those with a bachelor's degree or higher degree. This is because higher education can positively influence attitudes toward CPR by providing radiographers with the knowledge, skills, and confidence necessary to recognize the importance of CPR and respond effectively to emergencies. However, a contradictory result was observed in the AL Nasri et al study, which reported that nurses with diplomas had a slightly more positive attitude than bachelor's degrees and above.³⁰

In addition, radiographers who received CPR training demonstrated significantly higher mean attitude scores than did those who did not receive CPR training. A similar finding was reported by Oteir et al who compared the attitudes of trained and untrained participants toward CPR. A higher proportion toward CPR questions were observed in the trained group.³³ This might be because previous CPR training provided radiographers with the knowledge and skills necessary to efficiently perform CPR. In addition, they understood that their actions can significantly increase the chances of patient survival. These principles breed confidence, leading to a more positive attitude toward CPR procedures.

This study revealed a statistically significant positive correlation between knowledge of and attitude toward CPR ($r=0.326$). This finding is in line with a study targeting junior doctors and medical students in Egypt, which reported a positive correlation between knowledge and attitude toward CPR among medical students ($r=0.41$).⁴⁹ Therefore, creating increased knowledge and positive attitudes toward CPR increases the possibility of radiographers acquiring information about CPR and wanting to implement it in the future. Therefore, attractive and accessible CPR training should be

available for all radiographers. This advancement in CPR knowledge can be achieved in many ways, including through workshops, lectures, online courses, and seminars.

Limitations and Recommendations

The researcher found some difficulty in obtaining the relevant Jordanian literature because there is a paucity of studies that investigate the same or similar topic in Jordan. This study used a cross-sectional approach, which allows for the determination of associations only, rather than causality. Also, the use of online questionnaire may increase the opportunity of bias. Further research is suggested to evaluate specific training program effects on radiographers' knowledge and attitude towards CPR. Besides, exploring the potential barriers that may hinder radiographers' learning and application of CPR.

Conclusion

To our knowledge, this is the first study to assess the knowledge and attitude of radiographers toward CPR. This study showed that radiographers had poor knowledge of CPR. However, there was a positive attitude toward CPR. Previous CPR training and educational level were significantly associated with higher knowledge and positive attitudes toward CPR, whereas radiographers' age and experience were significantly associated with higher knowledge. Therefore, continuous CPR training is recommended to increase radiographers' knowledge of CPR. An improvement in CPR knowledge of CPR could be accomplished using a variety of methods, such as workshops, lectures, and refresher courses. Policymakers in Jordan must clarify the laws and legislation that define the rights, responsibilities, and immunity of health-care providers performing CPR in hospital settings.

Ethical Approval

The ethical approval to perform this study was obtained from Institutional Review Board (IRB) approval at Jordan University of Science and Technology (No. 651-2023).

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Disclosure

The authors declare no conflict of interest of any type.

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