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Original Article

Assessing Knowledge Differences in Forensic Radiology: A Comparative Study of Diagnostic Imaging and Non-Diagnostic Imaging Students in the Radiology Department

Halima Hawesa[1], Dana Abdullah AlMutairi[1], Hadeel Sultan AlOthman[1], Haifa Mhmas AlShalawi[1], Hind Mubarak AlQahtani[1], Lames Salem Ajaj[1], Maha Khalid AlAnizi[1], Ohood Ali AlQarni[1], Khadija Saliha Bazza[2].

1- Radiological Sciences Department, College of Health and Rehabilitation Sciences, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia.
2- Carleton university, Ottawa, Canada

Abstract:

Background: The use of diagnostic imaging modalities such as X-ray, CT, and MRI has become essential in forensic science for interpreting and reporting radiological examinations and procedures, collectively referred to as Forensic Radiology. This research aims to assess the understanding of their roles among students in the Diagnostic Imaging program compared to students in other radiology programs.

Materials and Methods: A total of 142 students from various radiology department programs participated in a questionnaire assessing the role of diagnostic imaging modalities in forensic radiology. An independent sample test was used to evaluate the knowledge of students in the Diagnostic Imaging program versus those in other radiology programs.

Results: The knowledge of students in the Diagnostic Imaging program regarding forensic radiology was general and comparable to that of students in other radiology programs. The mean scores for both groups were similar for questions about the roles of diagnostic modalities. However, there was a significant difference in their understanding of general information about forensic radiology (P=0.00).

Conclusion: Diagnostic imaging modalities are crucial in forensic science. The findings suggest that the usage and importance of these modalities should be more thoroughly integrated into the Diagnostic Imaging program curriculum to enhance student understanding and preparedness in forensic radiology.

Keywords: forensic science, Diagnostic imaging, Radiology, forensic radiology, diagnostic modalities

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Corresponding Author: Halima Hawesa **E.mail**: hhaweso@pnu.edu.sa

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1. Introduction

Medico-legal death investigation, or forensic death investigation, systematically examines unexplained or violent deaths using advanced analytical methods from various disciplines, including forensic medicine. Forensic radiology, a key component, utilizes imaging tools such as X-ray, CT, MRI, and ultrasound to interpret and report findings for legal cases. These methods are crucial in investigating deaths from aviation accidents, disasters, traffic incidents, firearm injuries, child abuse, and more. While traditional identification methods like fingerprints or genetic profiling are common, radiology is essential when these are insufficient .[1-6]

X-rays have been fundamental to forensic medicine since their invention in 1895, originally for locating projectiles. They are now integral to forensic pathology, essential for documenting evidence and maintaining the chain of custody. [5-6] CT scans, introduced in the medical field in 1977, have significantly enhanced forensic radiology by providing detailed internal and external images, often reconstructed into 3D models. These are used to analyze trauma, identify weapons, document injuries, and assess complications like air embolism. [7-10]

Post-mortem magnetic resonance imaging (PMMR) is another vital tool, particularly for examining the brain, heart, subcutaneous tissue, abdominal organs, and skeletal damage. PMMR provides detailed anatomical insights and can sometimes surpass traditional autopsies in detecting conditions like ischemic damage. [[11-16]

In Saudi Arabia, autopsies are allowed under specific conditions, such as court orders for criminal investigations, educational purposes, and identifying infectious diseases. Diagnostic imaging in forensic radiology is crucial in resolving complex cases worldwide and in Saudi Arabia. The study's objectives are to evaluate the knowledge of radiology students (diagnostic Imaging program and non-diagnostic imaging programs) regarding these modalities in forensic radiology, compare knowledge levels between diagnostic imaging and other radiology programs, and correlate knowledge scores with program specialization. [14,17,20-21]

2. Methodology

The data were collected from an online questionnaire.[21] completed by Radiology department students and Diagnostic Imaging interns in Riyadh. The questionnaire includes three types of questions: the first set covers general information about forensic medicine and its relationship to forensic radiology; the second set addresses imaging modalities and the applications of forensic radiology; and the final set explores forensic techniques, types of imaging data, the history of forensic medicine in the kingdom, legal considerations of forensic radiology evidence in Saudi courts, and the involvement of Saudi females in the forensic field. The completed questionnaires were evaluated using a model answer compiled from various references. [14-15, 17-21])The data were managed confidentially following ethical approval from the PNU research committee (IRB registration number: HAP-01-R-059), and analyzed using independent sample t-test.

3. Data Analysis and Results

The online questionnaire was used to assess the knowledge level of radiological sciences students and interns about the roles of diagnostic imaging in forensic radiology in the Kingdom of Saudi Arabia. The questionnaire was adapted based on models from previously published questionnaires. [21] Figure 3.1 shows the percentage of participation from different divisions of the radiology department.

After collecting responses from both diagnostic and non-diagnostic student groups, statistical analyses, including general descriptive statistics and independent t-tests, were performed. The results are presented in Tables 3.1 to 3.3. For the independent t-tests, non-diagnostic students score was coded as 1, and the score of diagnostic students were coded as 2. The independent t-tests were conducted first for the total responses to all questionnaire questions across both groups, then specifically for the general questions, and finally for the specialized questions focused on diagnostic imaging modalities and their usage in forensic radiology. The results indicated that there was no significant difference between the two groups for the total questionnaire questions (P=0.302, Table 3.1), nor for the specialized questions (P=0.128, Table 3.2).

Table 3.1: Independent sample test for whole questionnaire questions. group scores 1 represents

non diagnostics students, and 2 represents diagnostic students. The independent sample test is not significant with P=0.302.

Table 3.1: Pie chart represents the percentage of students from each program in radiology department.

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	1.072	.302	1.736	140	.085	.92958	.53539	-.12892	1.98807
Equal variances not assumed			1.736	139.882	.085	.92958	.53539	-.12893	1.98808

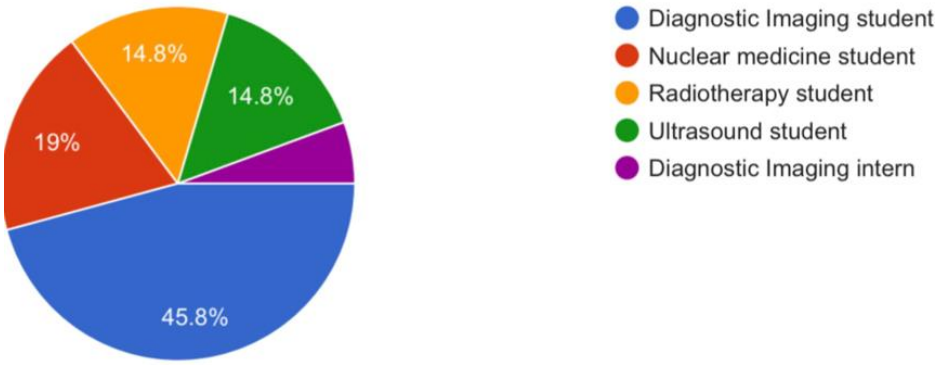

Figure 3.1: Pie chart represents the percentage of students from each program in radiology department

Table 3.2: Independent sample test for specialized questions. group scores 1 represents non diagnostics students, and 2 represents diagnostic students. The independent sample test is not significant with P=0.128.

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	2.341	.128	-1.468	140	.144	-.61972	.42224	-1.45451	.21507
Equal variances not assumed			-1.468	131.246	.145	-.61972	.42224	-1.45500	.21556

However, there was a significant difference in the general questions, with diagnostic students outperforming non-diagnostic students, P=0.00, as shown in Table 3.3.

Table 3.3: independent sample test for general knowledge questions. score 1 for non-diagnostic students, and score 2 for diagnostic students. The independent sample test is significant with P=0.00.

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	116.467	.000	-6.990	140	.000	-4.12676	.59035	-5.29392	-2.95961
Equal variances not assumed			-6.990	85.569	.000	-4.12676	.59035	-5.30042	-2.95310

4. Discussion

This research assesses the knowledge proficiency of students in the radiology department concerning the application of medical imaging modalities in forensic cases. Nearly half of the questionnaire participants belonged to the diagnostic imaging program, constituting 45.8%, while the nuclear medicine program accounted for 19%, and the radiotherapy and ultrasound programs each represented 14.8% of participants. Additionally, interns from the diagnostic imaging program contributed 5.6% to the overall participation. The utilization of diagnostic imaging modalities in forensic radiology holds substantial global significance in resolving complex criminal cases, including those in Saudi Arabia.

The statistical analysis of the total questions in the questionnaire and the specialized questions regarding forensic radiology knowledge among students from diagnostic imaging and non-diagnostic imaging programs indicated no significant difference between the two groups, as shown in Tables 3.1 and 3.2. This outcome can be attributed to the questionnaire containing numerous specialized questions focused on forensic applications in diagnostic imaging, an area not covered by any courses in the diagnostic imaging curriculum. As a result, diagnostic imaging students did not exhibit a greater understanding of forensic radiology than their peers in non-diagnostic imaging programs.

The lack of specialized forensic courses in the diagnostic imaging program likely contributed to the similar levels of knowledge observed across both groups. Consequently, students from both groups demonstrated a similar level of knowledge, as neither group had been exposed to formal education in forensic radiology. This suggests that the lack of targeted forensic training in the diagnostic imaging program leaves students with comparable knowledge to their peers in non-diagnostic imaging disciplines.

However, a notable disparity emerges in the domain of general knowledge questions. Here, students specializing in diagnostic imaging demonstrated a markedly higher level of knowledge compared to their peers in other areas (P=0.00), as shown in Table 3.3. This indicates that while the specialist knowledge remains consistent across the board, those focusing on diagnostic imaging possess a broader and more comprehensive understanding of general forensic principles. This enhanced general knowledge may stem from the interdisciplinary nature of diagnostic imaging education, which often integrates fundamental forensic concepts with advanced imaging techniques. Consequently, diagnostic imaging students are better equipped with a general perspective, enabling them to apply their expertise more effectively in forensic contexts. This discrepancy highlights the importance of a well-rounded educational approach, emphasizing both specialized and general knowledge to produce proficient professionals in the field of forensic science.

Most publications on forensic radiology in Saudi Arabia concentrate on forensic medicine, Saudi law, or forensic medicine in general. Mohamed Madidan et al.[19] highlighted the theoretical aspect of forensic medicine taught in all Saudi medical colleges, emphasizing its importance in Saudi courts. However, their study did not investigate the connection between forensic medicine and medical imaging modalities. Similarly, Osama M. AlMadani and colleagues.

[18] from the Ministry of Health emphasized the inadequacy of teaching materials related to forensic medicine and its alignment with Saudi laws in medical colleges, aligning with our findings and recommendations.

The only identified study on the knowledge and awareness of forensic medicine among medical college students in Saudi Arabia was conducted by M. Madidan and colleagues at Dammam University. [21] Their research echoed our findings, indicating a poor and limited knowledge level and awareness among medical students about forensic medicine. They recommended enhancing educational programs on this topic in college curricula.

This cross-sectional study at radiology department aimed to assess radiology students' knowledge of diagnostic imaging modalities and their role in forensic radiology, and to evaluate the correlation between knowledge and program specialization. The participating students were divided into two groups: those in the diagnostic imaging program and those in non-diagnostic imaging programs.

The research revealed mixed outcomes regarding the students' knowledge of forensic radiology. The questionnaire results showed no significant difference between the two groups in their understanding of the specialized roles of diagnostic imaging modalities in forensic radiology. This suggests that both groups had a comparable level of knowledge in this area, likely due to the absence of dedicated forensic radiology courses in the diagnostic imaging curriculum. However, a significant difference was observed in the responses to general questions about forensic radiology, indicating that diagnostic imaging students may have had broader exposure or a different educational focus that provided them with a more general understanding of the field. These findings highlight the need for enhanced curriculum development to include forensic radiology content, ensuring that all students, particularly those in diagnostic imaging, receive comprehensive education in this important area.

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