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Medical Student Performance in Diagnosing Common Findings of CT Scan

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Abstract

Diagnostic radiology is a key diagnostic tool in many different conditions and ccrucial for monitoring, treating, and predicting outcomes. Accurately interpreting basic radiological images is a paramount skill for medical professionals. Therefore, this study aimed to assess clinical-phase medical students and interns' knowledge on evident findings on CT scans. This observational cross-sectional study was conducted in a single region in Saudi Arabia from May 2022 to December 2022. An electronic questionnaire were used to collect data. Twenty-one radiograph-based questions were used, for which students were asked to provide the best diagnosis and report their confidence for each question. Ethical approval was obtained. A convenience sampling technique was used to recruit the participants and SPSS were used for data analysis. Two hundred fifty-two medical students were included, with a mean age of 23.02 (SD=1.52) year. Of those, females comprised 65.1% and 86.1% of the total participants were in the clinical year. Most students with above-average knowledge were internship students (37.1%) compared to 9.7% among clinical year students (p=0.001). In addition, students with average knowledge had a higher level of confidence (7.62/10) compared with students with average knowledge (5.24) and students with below-average knowledge (5.24 and 5.057, respectively; p=0.001). In conclusion, the high percentage of incorrect responses reported by the current study reflects a strong deficit in the baseline CT knowledge among medical students. Further interventions are necessary to ensure better radiographic education for future physicians.

Keywords: Clinical Education, CT, diagnostic tools, medical students' assessment

Introduction

Advanced imaging technologies have dramatically improved the quality of medical care for patients. In general, medical imaging approaches can be split into two categories: (a) anatomical consideration and (b) technical and physiological consideration.[1] Medical students need to be more educated about radiology because it is a valuable tool for diagnosing and treating diseases in patients of all ages.

The overuse of imaging is a clear indication of its inappropriate and unnecessary application in healthcare, and it is crucial to note that even low doses of radiation exposure from imaging can significantly raise the risk of cancer.[2,3] In Australia, diagnostic imaging is responsible for around 1.3% (430 cases per year) of cancer risk by the age of 75.[4] One of the main reasons for overuse of medical imaging is the lack of knowledge among physicians regarding the safety and appropriate use of imaging. Research has shown that physicians' inadequate expertise in determining the most suitable radiological tests is resulting in unnecessary interventions on patients.[2,5,6] It is crucial for physicians to be educated on the appropriate utilization, safety, protection, and risks of radiology to ensure optimal patient care.

Several research studies have been done to assess medical students' knowledge of X-ray findings. A study conducted in Jordan involving 530 participants focused on critical X-ray findings and revealed that only 139 (26.2%) respondents answered the questions correctly.[7] In addition, in a cohort study that

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evaluated the knowledge of medical students in CT scans of traumatic injuries, it was found the senior medical students answered questions correctly (mean 4 out of 10) compared to their junior medical students.[8] Another study at the University of Kansas School of Medicine-Wichita (KUSM-W) found that clinical medical students needed more knowledge of life-threatening CT images, as they could not diagnose and treat the majority of scans correctly. Therefore, they suggested that medical students' current standards for radiographic education should be reviewed and revised.[9]

The radiology course offered at Qassim University Hospital extends over two weeks. Topics covered in the first week are chest, cardiovascular, musculoskeletal and spine imaging while in the second week body, neurology, pediatrics, breast, and nuclear imaging. The course contents are lectures, Case Discussions, Hot seats as well and rounds in the Radiology Department at Qassim University Hospital.

However, there are almost no studies conducted in Saudi Arabia on the ability of medical students to diagnose common CT scan findings. Therefore, this study aims to assess the performance of clinical phase medical students and interns in identifying and diagnosing frequently encountered CT scan findings in Qassim University Hospital. The study results will be used to identify areas where the students need further training in radiology. The study will also provide valuable information on the current standards of radiology education in Saudi Arabia.

Methods

This study is a cross-sectional, self-administrated electronic questionnaire that was distributed to clinical phase medical students and all interns who studied in Qassim provenance, Saudi Arabia, from May 2022 to December 2022. The survey included demographic data and several questions about radiology. The questionnaire included 21 questions, where a radiograph was provided in each question, for which students were asked to provide the best diagnosis. Those questions were CT images for common radiological specialties, including general, neuroradiology, cardiothoracic, abdominal, and musculoskeletal radiology. These scans are to be frequently encountered as the students would become fresh graduate general practitioner physicians. For each question, students were asked to report their confidence in the answer using a scale between 0 and 10, where 0 indicates not being sure, and 10 represents complete confidence. The appropriate sample size was calculated using the Epi-Info using a population size of 577, with confidence limits of 5%. Therefore, the final minimum sample size was 231. Therefore, the final minimum sample size was 231. Study inclusion included all clinical phase medical students and all interns of the Qassim provenance. Non-medical students, those in the basic year of medicine, graduated medical students, students from outside the Qassim provenance, and those who still need to complete their survey were excluded from the study. A non-probability convenience sampling technique was used for population sample collection. The survey was provided in English. Ethical approval was taken from an approved ethical committee (IRB#21-22-02). Informed consent was obtained before the survey. Data entry, cleaning, and coding were conducted using MS Excel, while data analysis was performed using SPSS statistics (Version 22; IBM Corp., Armonk, NY, USA).

Frequency and percent were used to describe categorical variables, while mean and standard deviation were used to describe the continuous variables like age and knowledge score. To determine the knowledge, each correct answer was rewarded with one point. In contrast, wrong answers were indicated as zero, and the sum of the answers was calculated, providing a range between 0 and 21. The study had three classifications to classify the sample. Those with more than 14 points (66.7 % of the questions) were classified as above-average knowledge, 7–14 points were classified as average knowledge, and less than 7 were classified as below-average knowledge. The chi-square (x2) test assessed the relationship between two or more qualitative variables. Student t-student test was used for comparing two quantitative normally distributed variables, and the ANOVA test for comparing more than two quantitative normally distributed variables with a significant level set at $p\text{-value}<0.05$.

Results

The 252 clinical-phase medical students and interns with a mean age of 23.02 (SD=1.52) years participated in this study. Most students are between 22 and 25 years old (84.5%). 65.1% of the respondents were females, and 86.1%

Table 1 Demographic Details of the Clinical Phase Medical Students and Interns

Variable		n	%
Age	18–21	26	10.3
	22–25	213	84.5
	26–29	13	5.2
Gender	Male	88	34.9
	Female	164	65.1
Academic level	Clinical years	217	86.1
	Internship year	35	13.9
College of study	Unaizah College of Medicine	74	29.4
	Buraydah College of Medicine (Al–Malida)	111	44.0
	Sulaiman Al Rajhi, College of Medicine	67	26.6
Cumulative GPA	<3.0	4	1.6
	3.00–3.49	13	5.2
	3.50–3.9	54	21.4
	4.0–4.49	85	33.7
	4.5–5	96	38.1
Completed radiology course	No	132	52.4
	Yes	120	47.6
Knowledge	Below average	37	14.7
	Average	181	71.8
	Above average	34	13.5

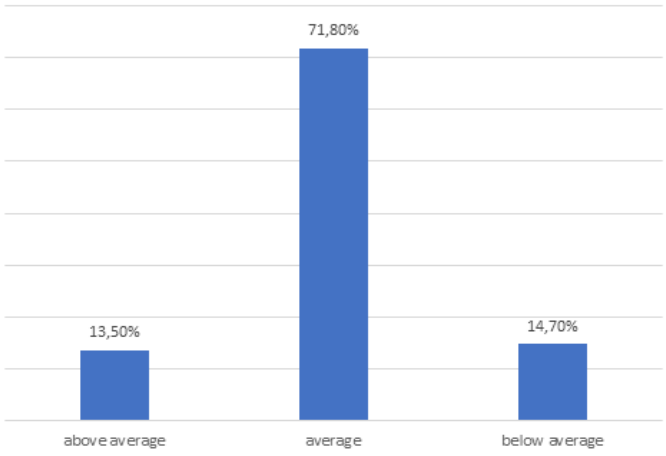

Figure 1 Distribution of Study Participants Based on Knowledge Score Category (Above Average, Average and Below Average) of Correctly Identifying Radiological Findings

Table 2 Correlation Between Various Demographic Factors and Level of Knowledge Score of the Study Participants

Variable		Knowledge						p-value
		Below Average 0–6 Correct Answers		Average 7–14 Correct Answers		Above Average 15–21 Correct Answers		
		n	Row %	n	Row %	n	Row %	
Age (Mean (SD))		22.98 (1.51)		22.92 (1.57)		23.71 (1.059)		0.020*
Gender	Male	13	14.8	59	67.0	16	18.2	0.268
	Female	24	14.6	122	74.4	18	11.0	
Academic level	Clinical years	34	15.7	162	74.7	21	9.7	0.000*
	Internship year	3	8.6	19	54.3	13	37.1	
College of study	Unaizah College of Medicine	10	13.5	52	70.3	12	16.2	
	Buraydah College of Medicine (Al Malida)	13	11.7	85	76.6	13	11.7	0.421
	Sulaiman Al Rajhi, College of Medicine	14	20.9	44	65.7	9	13.4	
What is your cumulative GPA?	<3.0	1	25.0	2	50.0	1	25.0	
	3.0–3.49	2	15.4	11	84.6	0	0.0	0.089
	3.50–3.9	10	18.5	41	75.9	3	5.6	
	4.0–4.49	17	20.0	54	63.5	14	16.5	
	4.5–5	7	7.3	73	76.0	16	16.7	
"Did you complete a radiology course during the medical college?	No	20	15.2	109	82.6	3	2.3	0.000*
	Yes	17	14.2	72	60.0	31	25.8	
Confidence		5.057 (2.20)						

reported being in the clinical year. 44.0% of the students were at Buraydah College of Medicine. Considering the GPA, more than two-thirds of the students fall between a GPA of 4.5–5 and 4–4.49. Less than half of the respondent completed radiology courses during their medical college (47.6%) (Table 1). In terms of knowledge, the mean of correct answers was 10.79 out of 21 questions per student, i.e., average level of knowledge (SD=3.4) (Figure 1). The category of knowledge scores between (0–6), (7–14), and (15–21) was labeled as below average, average, and above average respectively.

For each question, the confidence of the correct answer was assessed; the mean confidence rate of all questions was 5.54 (SD=2.09). In addition, students with above-average knowledge were older than those in the younger age group who had below-average knowledge (p=0.007). In terms of above-average knowledge, male students had 18.2% while female students had 11% (p=0.268). A higher percentage of students with above-average knowledge was found among students during

Table 3 Comparison of Mean Knowledge Score of The Study Participants Based On Subspeciality

General Variables and subspecialties in Radiology	Mean	Standard Deviation	Minimum	Maximum
Age	23.03	1.52	20.00	29.00
Correct answers	10.80	3.41	2.00	21.00
Confidence	5.54	2.09	1.00	10.00
General Radiology	.94	.62	.00	2.00
Neurology	2.04	1.17	.00	4.00
Cardiothoracic	2.96	1.52	.00	6.00
Abdominal	3.16	1.39	.00	6.00
Musculoskeletal	.34	.48	.00	1.00
Head and Neck	1.02	0.598	0.00	2.00

their internship year compared to those during their clinical years (p=0.001). Higher knowledge was found among students of Unaizah College of Medicine. Completing the radiology course was associated with better knowledge, where 25.8% of those who reported completing the course had above-average knowledge compared with 2.3% among those who did not complete the course (p=0.0001). Finally, this study assessed the confidence of each group. This study found that the higher the level of knowledge of the correct answers, the higher the confidence, as the students who got above average answers had mean confidence (7.62/10) compared with 5.24 in students with average knowledge and 5.057 in students with below-average knowledge (p=0.001) (Table 2).

In terms of analysis per subspeciality, there is medium to high knowledge in abdominal radiology, neurology, and head and neck, while low knowledge of students in Musculoskeletal radiology (Table 3).

Discussion

The study included 252 clinical-phase medical students and interns, most of whom were female and in their clinical years. They scored an average of 10.79 out of 21 on a knowledge test, indicating an average level of knowledge. Older students tended to have higher knowledge levels than younger ones with below-average knowledge. Male students showed a slightly higher proportion of above-average knowledge compared to females. A substantial association was found between completing radiology courses during medical studies and higher knowledge levels. The stark contrast in knowledge between those who completed such courses and those who did not underscores the critical role of formal radiology education in enhancing understanding among medical students.

In the literature, many studies were conducted to assess the competency of reading chest X-rays among practicing physicians, including residents and fellows[10–12] however, fewer studies focused on medical students.[13,14] In the current study, it was found that only 13.5% of the medical students had above-average knowledge of CT images, with mean correct answers of 10.80 per student (accuracy rate of 53.9 %). Additionally, a previous study reported that the medical students' accuracy rate generally ranged between 12.5% and 25.3% considering interrupting life-threatening conditions on X-ray.[7] This low accuracy reported in our study and some previous studies indicated the need to improve medical colleges' radiological curricula rotations. The ineffective training in radiographic interpretation could lead to difficulties in interpreting the patients' radiographs among medical practitioners; therefore, there is a need to focus on the radiology course during the medical training. [13,15]

Moreover, the current study showed that students in the internship year and those who completed radiological courses had a significantly higher level of knowledge. In addition, the current study did not find any significant correlation between the student's GPA and their accuracy in interrupting the CT scans. This is similar to the results of Samara et al., who reported that the total score of the students did not significantly relate to the GPA.[7] This result indicates that the low accuracy of interrupting CT

scans is not related to the academic performance of the students during medical school.

Furthermore, the study revealed an intriguing relationship between knowledge levels and confidence in identifying radiological findings. Students with above-average knowledge exhibited significantly higher confidence in their answers compared to those with average or below-average knowledge. This suggests that increased proficiency correlates positively with self-assurance in this domain. Many previous studies showed that higher confidence is associated with the ability to make correct decisions, and at the same time, higher knowledge is associated with higher confidence.[16–18]

Integrating the appropriate radiological training courses among medical students during their education has long been a source of debate.[9] This debate may be because of the increase in the use of diagnostic imaging over the previous few decades, which is expected to continue. According to different studies, it has been found that medical students feel that training helps them increase their ability to diagnose common abnormalities.[19]

Understanding the nuances of radiological education within medical curricula is pivotal. Tailoring educational strategies to strengthen radiology courses, potentially through increased exposure, hands-on training, or interactive learning methods, may significantly impact students' radiological proficiency and confidence.

This study had some limitations, including the dependence on a self-reported questionnaire, which may be associated with some personal bias as some participants may report higher GPAs than their real GPA, which may cause a non-significant difference in their knowledge depending on their GPA. Moreover, the non-probability convenience sampling technique makes it hard to collect a sample that is fully representative of the population being studied, as getting responses only from the participants who are most accessible to contact and recruit leaves many respondents.[20] On the other hand, the current study has the advantage of being the first to assess the competency of reading CT images among medical students in the Qassim region of Saudi Arabia.

In conclusion, the high percentage of incorrect responses reported by the current study reflects a strong deficit in the baseline CT knowledge among clinical-phase medical students. If more than half of the students are expected to identify these images correctly, other interventions are necessary to ensure better radiographic education. Notably, completion of a radiology course correlated positively with higher radiological knowledge. Importantly, a strong correlation existed between higher knowledge levels and increased confidence in correctly identifying radiological findings. These findings underscore the importance of targeted educational strategies to enhance radiology education among medical students, potentially boosting both knowledge acquisition and confidence levels in this critical field.

This study argues that the current standards for radiographic education among clinical-phase medical students should be re-evaluated and include radiology in different courses.

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