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Incidental Findings on Emergency Department Computed Tomography Scans in Patients Aged 40 Years and Older

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Abstract

Background/Objectives: Computed tomography (CT) is widely used in emergency departments to support rapid diagnosis. However, its increasing use has also led to more frequent detection of findings unrelated to the patient's presenting complaint. These incidental findings often lead to additional investigations, patient anxiety, and higher healthcare costs. The objective of this study is to evaluate the frequency, anatomical distribution, and clinical significance of incidental findings detected on CT scans.

Methods: This retrospective single-center study included patients aged 40 years and older who underwent CT imaging as part of their emergency department and had incidental findings. Age, sex, CT examination type, anatomical site of incidental findings, and their clinical significance were collected. Incidental findings were categorized as mild, moderate, or severe according to the level of clinical intervention required. Statistical analysis was used to examine associations between incidental finding severity and patient demographics.

Results: Out of the 68 included patients, 39(57.4%) were male and 29(42.6%) were female, with a mean age of 58.2 ± 14.3 years. The pelviabdominal region was the most common anatomical site of incidental findings, and the kidneys were the most frequently affected organ. Most incidental findings were classified as moderate in clinical significance. No statistically significant association was found between incidental finding severity and age or sex ($p > 0.05$).

Conclusions: Incidental findings on emergency department CT scans were most commonly moderate in significance and frequently involved the pelviabdominal region, particularly the kidneys. These findings highlight the importance of standardized reporting and clear follow-up pathways.

Keywords: CT; Incidental findings; Emergency department

Introduction

Imaging techniques play a major role in the management of many patients, and the quality and accessibility of imaging examinations have improved considerably, with computed tomography (CT) becoming an essential diagnostic instrument in medicine since its introduction in 1972 [1,2]. Current CT scanners are capable of producing submillimeter resolution images of the whole body within seconds, and the increased availability and utilization of CT scans in the emergency department (ED) have been well documented [2,3]. CT is widely accepted as a primary diagnostic modality and provides valuable clinical information for the detection, differentiation, and demarcation of

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disease, despite exposing patients to ionizing radiation [4]. Advances in CT technology have significantly improved image resolution and enhanced radiologists' ability to detect subtle abnormalities, leading to an increased identification of unexpected findings on imaging studies [5,6]. These findings, commonly referred to as incidental findings, are defined as abnormalities unrelated to the patient's chief complaint and not pertinent to immediate patient care in the emergency department [5,7]. Incidental findings are predominantly detected in patients older than 40 years [8], and their clinical significance varies, with some requiring further investigation while others do not [6]. The prevalence of incidental findings on CT scans performed in the emergency department is substantial. The incidental finding rate has been reported to be approximately 36% for thoracoabdominal CT scans and up to 45% for total-body CT scans, with most findings located in the abdomen [9]. Other studies have reported prevalence estimates ranging from 26% to 38.3% for thoracic CT scans and 28.3% to 38.6% for abdominal and pelvic CT scans in the ED setting [10]. While incidental findings may allow for the serendipitous detection of serious illness at an asymptomatic stage and potentially improve survival and reduce mortality [11-13], they also pose significant challenges.

Incidental findings may prompt additional diagnostic testing, increasing radiation exposure, healthcare costs, false-positive rates, and patient anxiety [14-16]. Furthermore, the absence of convincing evidence from controlled studies contributes to uncertainty regarding the prognostic significance and appropriate management of many incidental findings [14]. Failure to appropriately manage these findings may place patients' health at risk and expose clinicians to significant medicolegal consequences [17]. Radiologists and clinicians face challenges in balancing the risks and benefits of further investigation, communicating findings effectively, and developing appropriate follow-up plans [15]. Trauma and emergency presentations represent a substantial burden on the healthcare system in Saudi Arabia, with over 308,000 trauma-related emergency cases reported nationwide in 2018, contributing to the high demand for CT imaging in emergency departments [18]. Despite the extensive global literature examining incidental findings on emergency CT scans, studies from Saudi Arabia remain limited and are largely restricted to organ-specific or modality-focused investigations, with no published data addressing incidental findings in the broader context of emergency CT imaging [19-21]. Therefore, investigating incidental findings on CT scans performed in the emergency department in Saudi Arabia is essential to address this gap in the literature. The aim of this study is to evaluate the prevalence of incidental findings on CT scans performed in the emergency department in Riyadh city, Saudi Arabia, and to determine the distribution of these findings according to clinical significance, categorized based on the level of intervention required, in patients older than 40 years.

Materials and Methods

This retrospective, observational, single-center study was conducted in the emergency department of a tertiary care hospital in Riyadh, Saudi Arabia. The study was initiated after obtaining ethical approval from the Institutional Review Board at Princess Nourah bint Abdulrahman University (IRB number: H-01-R-059). Due to the retrospective nature of the study, the requirement for informed consent was waived, and patient confidentiality was maintained through data anonymization prior to analysis. Adult patients aged 40 years or older who underwent computed tomography (CT) imaging as part of their emergency department evaluation between January 2013, and December 2016 were eligible for inclusion. There were no restrictions regarding the clinical indication for CT imaging. Patients with incomplete medical records or unavailable CT reports were excluded from the analysis. Data were collected from electronic medical records and radiology reports. Extracted variables included demographic data (age and sex), type of CT examination performed, clinical indication for the emergency CT scan, anatomical region imaged, and the presence of incidental findings along with their corresponding diagnoses as documented in the radiology reports. Incidental findings were defined as imaging abnormalities unrelated to the patient's presenting complaint or the primary indication for the CT examination. Based on the emergency physician's clinical assessment and documentation, incidental findings were classified into three categories according to clinical severity: mild findings requiring no further investigation or immediate clinical intervention; moderate findings requiring outpatient follow-up or additional diagnostic evaluation; and severe findings requiring urgent intervention, specialist referral, or immediate clinical management.

All CT examinations were performed using a 256-slice GE Revolution CT scanner (GE Healthcare, Chicago, USA). Imaging protocols varied according to the clinical indication and included CT scans of the head, chest, abdomen, pelvis, spine, and extremities. Both contrast-enhanced and non-contrast CT studies were included. Image acquisition and interpretation were performed as part of routine clinical care by board-certified radiologists.

Statistical Analysis

Statistical analyses were conducted using SPSS software version 29 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation (SD) or median and interquartile range, as appropriate. Categorical variables were presented as frequencies and proportions. Associations between categorical variables were assessed using the Chi-square test, or Fisher's exact test when expected cell counts were small. A p-value of less than 0.05 was considered statistically significant.

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Results

A total of 68 patients with documented incidental findings on emergency department computed tomography (CT) scans were included in the analysis. Of these, 39 patients were male (57.4%) and 29 were female (42.6%). The overall mean age of the study population was 58.2 ± 14.3 years, with an age range of 40 to 99 years. The largest proportion of patients fell within the 40-50-year age group (n = 24, 35.3%), followed by the 51-60-year group (n = 22, 32.4%). Older age groups were less represented, with 7 patients (10.3%) aged 61-70 years, 8 patients (11.3%) aged 71-80 years, and 7 patients (10.3%) aged over 80 years (Table 1).

Table 1: Sample demographics n=68.

Variable	No. (%)	Mean	SD
Gender			
Male	39 (57.4)		
Female	29 (42.6)		
Age group (years)			
40-50	24 (35.3)	58.2	14.3
51-60	22 (32.4)		
61-70	7 (10.3)		
71-80	8 (11.3)		
>80	7 (10.3)		

The anatomical distribution of incidental findings across age groups and genders is presented in Table 2. Overall, the pelviabdominal region was the most frequently involved anatomical site, accounting for most incidental findings across all age groups. Pelviabdominal incidental findings were most prevalent among patients aged 40-50 years (58.3%) and remained the dominant site in older age groups, including patients aged 61-70 years (71.4%) and those older than 80 years (57.1%).

Musculoskeletal incidental findings represented the second most common category and were observed consistently across all age groups and both sexes. These findings were particularly frequent among patients aged 40-50 years (25%) and 51-60 years (31.8%). The widespread occurrence of musculoskeletal findings across age categories highlights their common incidental detection during emergency CT imaging (Figure 1).

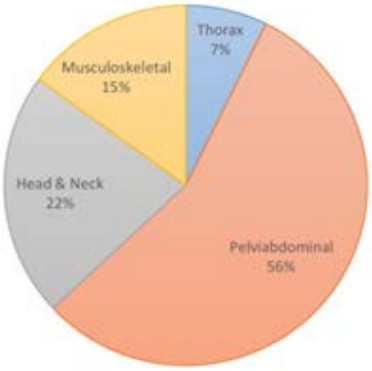

Figure 1: Distribution of incidental findings according to anatomical location for the total sample n=68.

Incidental findings involving the head and neck region were less common and demonstrated age-related variability. Such findings were identified in four patients (16.7%) aged 40-50 years and four patients (18.2%) aged 51-60 years but were not observed in patients aged 61-70 years. In older age groups, head and neck incidental findings were detected in two patients (25%) aged 71-80 years and one patient (14.3%) aged over 80 years. Thoracic incidental findings were relatively uncommon in the study population. These

Table 2: Distribution of incidental findings according to anatomical site.

Anatomical site frequency n (%)					
Variable	**Pelviabdominal**	**Head & Neck**	**Musculoskeletal**	**Thorax**	**p-value**
Age group (years)					
40-50	14	4	6	0	
	58.30%	16.7	25.00%	0.00%	
51-60	8	4	7	3	
	36.40%	18.2	31.80%	13.60%	
61-70	5	0	1	1	
	71.40%	0.00%	14.30%	14.30%	
71-80	4	2	2	0	
	50.00%	25.00%	25.00%	0.00%	
>80	4	1	2	0	0.666
	57.10%	14.30%	28.60%	0.00%	
Gender					
Male	19	8	10	2	
	48.70%	20.50%	25.60%	5.10%	
Female	16	3	8	2	0.727
	55.20%	10.30%	27.60%	6.90%	

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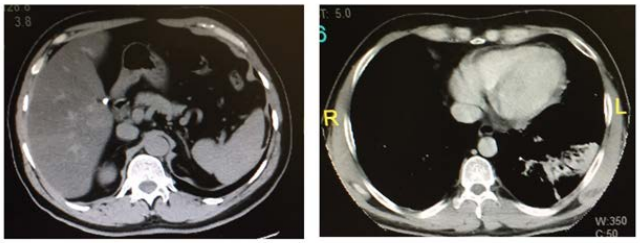
findings were absent in most age groups, with the exception of three cases (13.6%) in patients aged 51-60 years and one case (14.3%) in those aged 61-70 years. No statistically significant association was observed between anatomical site of incidental findings and age group (p = 0.666) or gender (p = 0.727). The frequency of incidental findings according to specific organ involvement is detailed in Table 3. The kidneys were the most affected organ, accounting for 11.8% of all incidental findings. This was followed by the adrenal glands, brain, and lumbar spine, each contributing 10.3% of the total findings. A wide range of additional organ systems demonstrated lower-frequency incidental findings, each accounting for 1.5-2.9% of the total.

Table 3: Frequency of incidental findings according to organ site.

Organ	Frequency	Percent
Kidney	8	11.8
Adrenal	7	10.3
Brain	7	10.3
Lumbar spine	7	10.3
Sinus	6	8.8
Small intestine	5	7.4
Colon	3	4.4
Skin	3	4.4
Urinary bladder	3	4.4
Appendix	2	2.9
Aorta	1	1.5
Breast	1	1.5
Cervical spin	1	1.5
Chest wall	1	1.5
Gall bladder + liver	1	1.5
Liver	1	1.5
Lung	1	1.5
Ovaries	1	1.5
Pancreas	1	1.5
Poses muscle	1	1.5
Skull	1	1.5
Sternum	1	1.5
Stomach	1	1.5
Testicle	1	1.5
Thoracic spine	1	1.5
Thyroid	1	1.5
Vertebral artery	1	1.5

When classified according to clinical significance, most incidental findings were categorized as moderate (47%), indicating the need for outpatient follow-up or further diagnostic evaluation. Mild incidental findings accounted for 14% of cases, while severe findings requiring urgent intervention or specialist referral represented the smallest proportion at 7%. Figures 2a and b are representative examples of incidental findings detected on emergency department CT scans.



(a) (b)

Figure 2: Representative incidental findings detected on pelviabdominal CT scans performed in the emergency department. (a) Non-contrast pelviabdominal CT of a 56-year-old male patient demonstrating an incidental gallbladder stone and hepatic steatosis (fatty liver). (b) Contrast-enhanced pelviabdominal CT with intravenous and oral contrast of a 57-year-old male patient demonstrating an incidental collapse and consolidation of the left lower lung lobe within the field of view.

The distribution of incidental findings by severity across age groups is summarized in Table 4. Moderate findings were the predominant category in all age groups, particularly among patients aged 51-60 years (86.4%) and 71-80 years (87.5%). Mild findings were more frequently observed in the youngest (40-50 years) and oldest (>80 years) age groups, whereas severe findings were infrequent across all age categories. No statistically significant association was found between age group and severity of incidental findings (p = 0.218). Similarly, the distribution of severity categories did not differ significantly between male and female patients (p = 0.837).

Table 4: Distribution of incidental findings according to anatomical site.

Severity n (%)				
Variable	**Mild**	**Moderate**	**Severe**	**p-value**
Age group (years)				
40-50	8	13	3	
	33.30%	54.20%	12.50%	
51-60	1	19	2	
	4.50%	86.40%	9.10%	
61-70	1	5	1	
	14.30%	71.40%	14.30%	
71-80	1	7	0	
	12.50%	87.50%	0	
>80	3	3	1	0.218
	42.90%	42.90%	14.30%	
Gender				
Male	9	26	4	
	23.10%	66.70%	10.30%	
Female	5	21	3	0.837
	17.20%	72.40%	10.30%	

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Discussion

This retrospective study evaluated the prevalence, anatomical distribution, and clinical significance of incidental findings detected on computed tomography (CT) scans performed in the emergency department among patients aged 40 years and older. Our findings demonstrate that incidental findings are common in this age group and predominantly involve the pelviabdominal and musculoskeletal regions, with the majority categorized as moderate in clinical significance. These results align with the growing body of evidence indicating that incidental findings represent a frequent and clinically relevant consequence of increased CT utilization in emergency settings. The predominance of pelviabdominal incidental findings observed in this study is consistent with prior reports highlighting the abdomen and pelvis as the most common anatomical regions for incidental detection. Evans et al. reported pooled prevalence estimates of incidental findings of 28.3% for abdominal and pelvic CT scans in emergency department populations, exceeding those observed in head or neck imaging [10]. Similarly, Thompson et al. found that abdominal and pelvic CT scans had the highest rates of incidental findings among all CT types performed in the emergency department [5]. The high frequency of pelviabdominal findings in our cohort may reflect both the wide anatomical coverage of these scans and the increased prevalence of age-related degenerative or subclinical pathology in patients over 40 years. Musculoskeletal incidental findings were the second most common category in our study and were consistently detected across all age groups and both sexes. This pattern mirrors findings from trauma-focused and general emergency CT studies, where degenerative spinal changes, vertebral abnormalities, and osseous lesions are frequently reported as incidental findings, particularly in older adults [22]. The consistent detection of musculoskeletal incidental findings across age groups underscores their ubiquitous nature and highlights the importance of distinguishing clinically relevant pathology from age-related or benign changes. Organ-specific analysis revealed that the kidneys were the most frequently involved organ, followed by the adrenal glands, brain, and lumbar spine. Renal and adrenal incidental findings have been repeatedly reported as common in emergency CT imaging, particularly in studies focusing on abdominal CT and renal colic protocols [23,24]. These findings are often benign but may require further evaluation depending on imaging characteristics, patient risk factors, and existing guidelines. The frequent detection of renal and adrenal incidental findings in our cohort reinforces the need for standardized reporting and follow-up recommendations to support appropriate clinical decision-making. In terms of clinical significance, most incidental findings in our study were classified as moderate, indicating a need for outpatient follow-up or additional diagnostic evaluation. This distribution is comparable to earlier studies reporting that a substantial proportion of incidental findings fall into an intermediate category that does not require immediate intervention but warrants further assessment. Messersmith et al. reported that approximately half of incidental findings detected on emergency abdominal CT scans were of moderate or serious concern, emphasizing the potential downstream impact on healthcare utilization and patient management [24]. Kelly et al. similarly demonstrated that indeterminate incidental findings accounted for a meaningful proportion of detected lesions and frequently triggered additional investigations and specialist referrals [25].

Notably, no statistically significant association was observed between age group or gender and the severity of incidental findings in our cohort. While several studies have reported an increased prevalence of clinically significant incidental findings with advancing age [5,23], our findings suggest that, within a population already aged 40 years and older, severity distribution may be relatively consistent across age categories. This observation may reflect the relatively small sample size or the broad categorization of severity used in this study, and it highlights the need for larger, multicenter investigations to further explore demographic predictors of clinically significant incidental findings. Beyond prevalence and severity, the detection of incidental findings raises important clinical and system-level considerations. Incidental findings encompass a broad clinical spectrum, ranging from benign abnormalities requiring no intervention to potentially significant findings that may warrant further evaluation or management. The heterogeneity of these findings is illustrated in Figure 3, which presents representative cases identified on pelviabdominal CT scans performed in the emergency department, demonstrating both common benign hepatobiliary abnormalities and potentially clinically relevant extra-abdominal findings, such as thoracic pathology detected incidentally within the scan field of view. This variability underscores the challenges faced by emergency physicians and radiologists in determining appropriate reporting, communication, and follow-up strategies. Multiple studies have demonstrated that incidental findings are frequently under-documented and inadequately communicated to patients, leading to missed opportunities for appropriate follow-up and potential medico-legal risk [5,22,24]. Although follow-up practices were not evaluated in the present study, the high proportion of moderate incidental findings highlights the importance of clear documentation, structured reporting, and defined care pathways to ensure continuity of care beyond the emergency department. Importantly, this study addresses a notable gap in the literature by providing data from Saudi Arabia, where published evidence on incidental findings in emergency CT imaging remains limited and largely organ specific. Given the high utilization of CT imaging in emergency departments and the aging population, understanding the local prevalence and characteristics of incidental findings is essential for informing clinical practice,

resource allocation, and guideline development within the regional healthcare context.

Conclusion

Incidental findings on computed tomography scans performed in the emergency department are common among patients aged 40 years and older, with the pelviabdominal and musculoskeletal regions most frequently affected. Most incidental findings identified in this study were of moderate clinical significance, indicating a need for further evaluation or follow-up, while severe findings requiring urgent intervention were relatively uncommon. No significant associations were observed between age or gender and the severity of incidental findings. These findings highlight the clinical relevance of incidental findings in emergency CT imaging and emphasize the importance of standardized classification, documentation, and follow-up strategies to optimize patient care and minimize unnecessary investigations. Further large-scale, multicenter studies in the regional context are warranted to better define the outcomes, management pathways, and healthcare impact of incidental findings detected in emergency department imaging.

Author Contribution

Author Contributions: R.S.A.: conceptualization, methodology, formal analysis, investigation, and writing—original draft preparation. E.A.: conceptualization, methodology, formal analysis, investigation, and writing the original draft preparation. S.A.: methodology, formal analysis, investigation, and writing the original draft preparation. A.A.: methodology, formal analysis, investigation, and writing the original draft preparation. A.S.A.: data curation, writing, review and editing, visualization, and funding acquisition. A.F.A.: data curation, writing, review and editing, and visualization. S.K.A.: data curation, writing, review and editing, and visualization. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Princess Nourah bint Abdulrahman University (IRB No. H-01-R-059).

Informed Consent Statement

Due to the retrospective nature of the study, the requirement for informed consent was waived. Patient confidentiality was maintained through anonymization of data prior to analysis.

Data Availability Statement

If required, data can be obtained from the corresponding author.

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Conflicts of Interest

The authors declare no conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript:

CT	Computed Tomography
ED	Emergency Department
IRB	Institutional Review Board
SD	Standard Deviation

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