RESEARCH PAPER

Radiological Spectrum and Diagnostic Yield of NCCT Head in Acute Neurological Condition: A Cross-Sectional Study

Kajol Kritika[1], Anita Devi[2], Rumisa Yaqoob[3], Zeba Shamim[4], Mohd Abdullah Siddiqui[5*]

[1]Msc Medical Imaging Technology, Department of Paramedical Sciences, Jamia Hamdard, New Delhi, India.
Email: kajolkritika97@gmail.com
Orcid No: 0009-0009-1410-5325

[2]Msc Medical Imaging Technology, Department of Paramedical Sciences, Jamia Hamdard, New Delhi, India.
Email: at2812449@gmail.com
Orcid No: 0009-0006-4953-8786

[3]Msc Medical Imaging Technology, Department of Paramedical Sciences, Jamia Hamdard, New Delhi, India.
Email: rumisayaqoob384@gmail.com
Orcid No: 0009-0000-0289-2063

[4]Msc Medical Imaging Technology, Department of Paramedical Sciences, Jamia Hamdard, New Delhi, India.
Email: zebashamim787@gmail.com
Orcid No: 0009-0008-8230-6375

[5*]Clinical Instructor, Department of Paramedical Sciences, Jamia Hamdard, New Delhi, India.
Email: mas15sep@gmail.com

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ABSTRACT

Background: Non-contrast computed tomography (NCCT) of the head functions as an important diagnostic tool which enables doctors to quickly assess both new and ongoing neurological conditions. The main objective of this research study was to conduct a systematic assessment of cranial imaging results to establish the relationship between radiological findings, clinical symptoms, and demographic factors such as age and gender across different patient groups.

Methodology: The research study examined a group of 101 patients who underwent cranial imaging procedures. The study population's age distribution showed a range from 0 years to 99 years, which was categorized into five different age groups. The researchers used data analysis to create a complete clinicoradiological profile which connected patient demographic information with their primary clinical symptoms and identified structural abnormalities.

Results: The demographic analysis found that the group studied had more males than females because 72 males and 29 females made up 71.3 percent and 28.7 percent of the study group. The highest patient presentation rate for the study occurred among older adults because Group D (60–79 years) had 32 cases and Group C (40–59 years) had 29 cases. Headache appeared in clinical practice as the most common patient presentation because it occurred in 28.7 percent of cases which involved 29 patients. The study found that males (n=22) displayed higher rates of trauma than females did. The radiological assessment confirmed its ability to diagnose patients accurately because 90 patients (89.1%) showed at least one radiological abnormality while 11 patients maintained normal results on their scans.The main findings that accounted for most cases showed vascular and degenerative conditions. The single most frequent radiological result for all age groups appeared as ischemia which occurred in 13.9 percent of cases (n=14).

Conclusion: The research work shows impressive results because 89.1% of the tests successfully detected structural problems. The study shows that demographic attributes shape disease distribution because older people develop vascular and degenerative conditions which include ischemic disorders while men have a greater risk of sustaining traumatic injuries. The research results demonstrate that early NCCT profiling process provides valuable information for discovering hidden neurological disorders to create personalized treatment plans for patients.

Keywords: Ncct Head, Acute Neurology, Headache, Trauma, Stroke, Ischemia, Intracranial Hemorrhage, Seizure, Cross-Sectional Study

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1. INTRODUCTION

CT technology advancements have completely transformed how doctors conduct patient assessments in both neurology and emergency medicine. Physicians use cranial imaging as their main diagnostic tool to identify different medical conditions which include acute traumatic brain injuries and neurovascular events and degenerative diseases. Medical professionals need to establish precise diagnostic methods which enable them to identify intracranial conditions with high speed and accuracy because these methods directly impact their patient treatment decisions and their ability to improve patient health results. The research study "Demographic Predictors of Cranial Pathologies: A Retrospective Analysis of NCCT Head Utilization Patterns in a Diagnostic Centre" examines how age and gender demographic factors affect the use of specific radiological findings which medical professionals use to diagnose patients based on their clinical symptoms .

The Evolution and Preference for CT Technology

Computed Tomography has superseded conventional skull radiography as the primary modality for neurological evaluation due to its rapid acquisition time and superior cross-sectional imaging capabilities [1]. CT technology enables imaging of cranial vaults and extra-axial regions and brain tissues with complete accuracy unlike traditional X-rays which display overlapping bone structures. Modern clinical practice uses CT because it can easily find acute medical conditions which include intracranial hemorrhage and mass effect and early ischemic changes that show up in two-dimensional films. The first-choice examination method for cranial imaging procedures NCCT Non-Contrast Computed Tomography (NCCT) serves as the primary testing method. The system enables doctors to assess patients with acute trauma and stroke and sudden headache symptoms without intravenous contrast media. The "gold standard" for acute neurological emergencies enables medical professionals to quickly identify hemorrhagic and ischemic events which require immediate treatment [2].

Anatomical Considerations in Cranial Imaging

Neuroanatomy knowledge forms the essential basis for understanding NCCT head scan results. The cranial cavity serves as a complex anatomical space which contains central nervous system organs that remain safeguarded within the bony structure of the calvarium. The anatomical boundaries of cranial imaging concentrate on three areas which include the cerebral hemispheres and posterior fossa that contains both the cerebellum and brainstem and their adjacent meningeal regions. The evaluation focuses on brain parenchyma assessment which checks for structural integrity and symmetrical features and density measurements. The NCCT examination evaluates both the ventricular system and basal cisterns to determine their patency and proper size which serves as a key diagnostic marker for hydrocephalus conditions and increased intracranial pressure and midline shift conditions. Pathological conditions commonly develop in extra-axial spaces which include epidural and subdural and subarachnoid compartments especially after trauma incidents or vascular ruptures [3]. The complete examination of skeletal elements starts from the cranial vault and skull base which undergoes detailed inspection to detect any fractures that serve as vital evidence for understanding how mechanical acceleration causes traumatic injuries .

Demographic Predictors and Clinical Rationale

The research shows that people with neurological disorders show different patterns of their illness because demographic factors determine their specific symptoms. Age is the primary factor which determines how common diseases occur among people. The aging population leads to more cases of degenerative diseases and neurovascular conditions. The brain shows senescent changes which include generalized cerebral atrophy and age-related microvascular ischemia as common findings among older people. The essential requirement for age-stratified data exists because it enables correct diagnosis together with clinical correlation [4]. Gender also plays a significant role in the expression of cranial conditions. Certain presentations, such as severe head trauma, frequently show a disproportionately higher prevalence in males due to a higher rate of traumatic accidents and occupational hazards, while generalized complaints like headache may be more frequently reported in female cohorts [5]. Understanding these gender-based and age-

based variations is crucial for developing targeted diagnostic algorithms and improving triage accuracy. NCCT usage needs additional localized diagnostic center data to study its actual usage patterns and clinicoradiological relationships. This study aims to fill that gap by analyzing the radiological profiles of 101 patients, which will enable researchers to study the relationship between their clinical findings and age and gender to show current patterns of neurological disease distribution in modern diagnostic facilities.

2. METHODOLOGY

2.1. Study Design

The researchers performed a retrospective observational cross-sectional study by analyzing existing digital radiological records. The Picture Archiving and Communication System (PACS) database of an independent tertiary diagnostic imaging facility provided the researchers with their data. The research team studied the diagnostic head imaging records of patients who had undergone this medical procedure. The research team implemented complete personal information protection measures which enabled them to maintain medical ethics standards while conducting patient data analysis.

2.2. Study Population and Patient Selection

The study selected its final patient group from 101 patients who participated in the research. The study included patients of all age groups (ranging from 0 to 99 years) who presented with various clinical conditions which included headache and blunt head trauma and suspected stroke and seizures and then underwent Non-Contrast Computed Tomography (NCCT) scanning of their heads. The study excluded patients who had incomplete medical records or missing personal information or who had their medical images damaged beyond use because these factors would create diagnostic and statistical confusion.

2.3. Sample Size Calculation and Power Analysis

The researchers used established statistical power analysis methods to confirm that their study sample size met required standards. The researchers conducted an a priori power analysis to create necessary statistical power for their main outcome analysis which involved assessing categorical variables that examined the distribution of radiological findings across different age groups and genders. The calculation required a conventional alpha error probability which used the value 0.05 and needed a statistical power of 80% (0.80) to achieve the desired result. The study required 96 patients as its minimum sample size which researchers determined using a moderate effect size of Cohen's w 0.3 for various neuroimaging distribution patterns. The study reached its final patient count of 101 who participated in the research which established a power level that proves suitable to identify genuine and statistically significant relationships.

2.4. Data Acquisition and Imaging Protocol

The researchers obtained all radiological images through a backward search of centralized PACS databases. The NCCT head scans used standard institutional Multi-Detector Computed Tomography (MDCT) head protocols for their initial scanning process. The standard acquisition parameters involved contiguous axial slices from the base of the skull to the vertex, which allowed sufficient assessment of the cranial vault and extracranial soft tissues and brain parenchyma.

2.5. Image Analysis and Data Extraction

The researchers gathered all radiological evidence by analyzing formal reports which they had preserved in their storage. The standardized spreadsheet captured primary data points which included patient demographics (age group and gender) and the main reason for imaging (Headache, Trauma, Stroke, Seizure, Hypertension) and specific CT diagnoses. The researchers divided the radiological findings into four categories which included vascular/ischemic changes (Ischemia, Infarct, Atherosclerosis) and neurodegenerative changes (Atrophy, Gliosis) and trauma-related injuries (Fractures, Contusions, Subdural Hemorrhage [SDH], Extradural Hemorrhage [EDH], Subarachnoid Hemorrhage [SAH], Hematomas) and inflammatory/infectious processes (Granuloma, Neurocysticercosis, Sinusitis, Mastoiditis) and mass lesions or incidental findings (Tumors, Cysts, Calcifications, Normal scans).

2.6. Statistical Analysis

The researchers conducted data extraction followed by data organization and statistical analysis to determine the relationships between demographic factors which included age and gender and the main clinical presentation together with the resulting radiological patterns. The study presented categorical variables by showing their respective frequencies and percentages. The researchers used standard cross-tabulation and comparative tests to

analyze the statistical significance of associations between ischemic findings and older age groups and between traumatic findings and male patients. The researchers conducted a complete demographic assessment to trace the occurrence of particular medical conditions according to patient age and sex.

2.7. Ethical Consideration

The research used existing archived radiological data which had been collected from an independent diagnostic facility that was operational in the past. The researchers protected all patient-identifying information which included names and contact details and specific identification numbers by complete anonymization and de-identification before they commenced data extraction. The study followed its retrospective design through non-interventional methods and used anonymized archived data which prevented subject re-contact thus making informed consent unnecessary according to standard ethical guidelines for observational research.

3. RESULTS

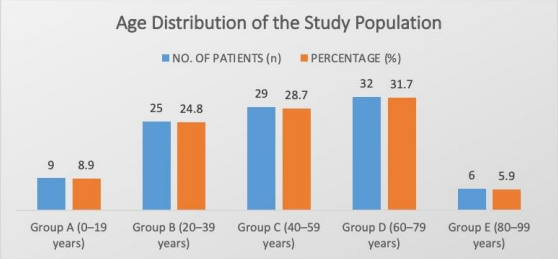
A total of 101 patients who underwent NCCT of head were included in this study.

3.1. Age-Related Distribution

The age distribution of 101 patients extended from 0 years to 99 years which created five separate age groups. The most common clinical presentation occurred in Group D which included patients aged 60 to 79 years and had 32 members whereas Group C and Group B followed with 29 and 25 members respectively. The study population included two small groups which contained the youngest population of 0 to 19 years 9 members and the oldest population of 80 to 99 years 6 members.

Table 1: Age Distribution of the Study Population (N=101)

AGE GROUP	NO. OF PATIENTS (n)	PERCENTAGE (%)
Group A (0–19 years)	9	8.9
Group B (20–39 years)	25	24.8
Group C (40–59 years)	29	28.7
Group D (60–79 years)	32	31.7
Group E (80–99 years)	6	5.9
TOTAL	**101**	**100**

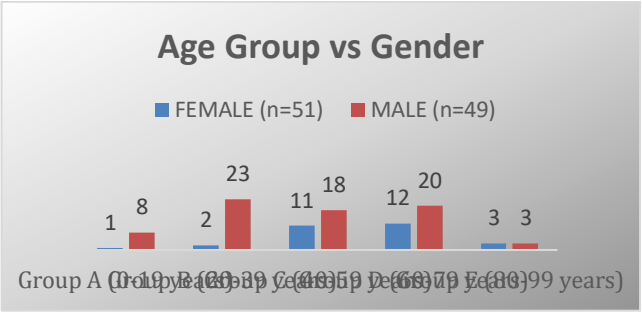


3.1.1 Age Group vs. Gender

The gender distribution in each age group showed different results which followed this pattern. Out of the 9 patients in Group A (0-19 years) 1 were female and 8 were male. Out of the 25 patients in Group B (20-39 years) 2 were female and 23 were male. Out of the 29 patients in Group C (40-59 years) 11 were female and 18 were male. The study included 32 subjects from Group D who belonged to the 60 to 79 age range with 12 female subjects and 20 male subjects. The analysis of Group E (80-99 years) consisted of a total of 6 patients, 3 female and 3 male.

Table 2: Age Group vs Gender

AGE GROUPS	FEMALE (n=51)	MALE (n=49)	TOTAL
Group A (0-19 years)	1	8	9
Group B (20-39 years)	2	23	25
Group C (40-59 years)	11	18	29
Group D (60-79 years)	12	20	32
Group E (80-99 years)	3	3	6
TOTAL	**29**	**72**	**101**



Age Group vs. Clinical History (Presentation)

Table 3: Age Group vs. Clinical History

AGE GROUPS	HEADACHE	TRAUMA	OTHERS	TOTAL
Group A (0–19 years)	3	3	3	9
Group B (20–39 years)	5	9	11	25
Group C (40–59 years)	14	4	11	29
Group D (60–79 years)	5	10	17	32
Group E (80–99 years)	2	2	2	6
TOTAL	29	28	44	101

The clinical presentations of Group A (0-19 years) patients showed equal distribution among headache and trauma and stroke which each generated three cases. The most common presentation for Group B (20-39 years) included Trauma which occurred in nine cases while headache occurred in five cases. The remaining 11 cases fell into the "Others" category which included seizure and hypertension and routine visits (n=2 each) and one case each for stroke and follow-up and dizziness and unconsciousness and psychiatric history. The most common presentation of Group C (40-59 years) patients showed headache (n=14) as the most frequent presentation which included four cases of trauma and seizure and seven cases with stroke and hypertension and follow-up and unconsciousness. The most common presentation for Group D (60-79 years) included trauma (n=10) which occurred more frequently than headache and stroke (n=5 each). The Group E (80-99 years) patient group contained six patients who presented equal cases of headache and trauma (n=2). The overall patient sample of 101 patients showed that headache constituted the most common presentation which occurred in 29 cases (28.7%) while Trauma followed closely behind with 28 cases (27.7%). The “Others” category contained 43.6% of the population which equals 44 individuals
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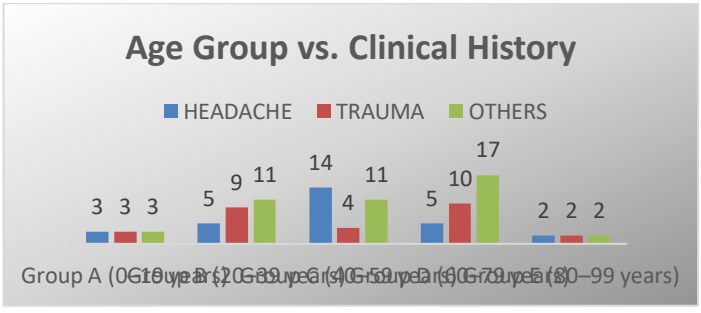


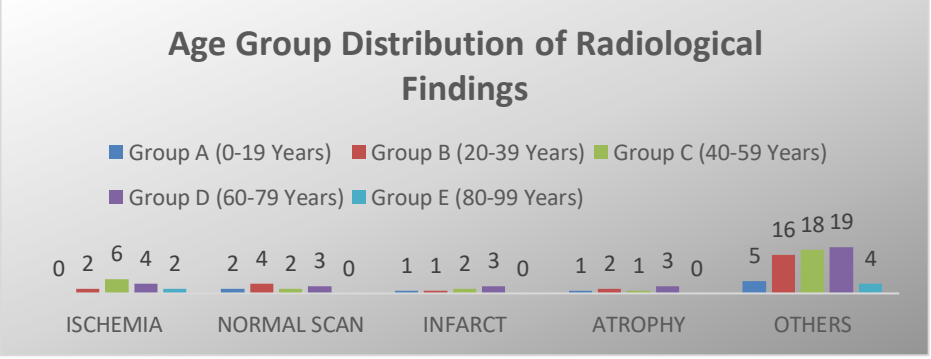
Age Group Distribution of Radiological Findings

Table 4: Age Group Distribution of Radiological Findings

AGE GROUPS	ISCHEMIA	NORMAL SCAN	INFARCT	ATROPHY	OTHERS	TOTAL
Group A (0-19 Years)	0	2	1	1	5	9
Group B (20-39 Years)	2	4	1	2	16	25

Group C (40-59 Years)	6	2	2	1	18	29
Group D (60-79 Years)	4	3	3	3	19	32
Group E (80-99 Years)	2	0	0	0	4	6
TOTAL	14	11	7	7	62	101

The most common result for Group A patients from the nine members between 0 and 19 years showed two cases of normal scans and two cases of fractures. The case had one instance each of atrophy and infarct and other separate findings. In Group B (20 to 39 age range) the group showed four normal scans which became the most common result. The group then experienced two separate cases of ischemia and atrophy and granuloma and gliosis and EDH and calcification. The most common condition in Group C occurred with six patients who had ischemia. The second most common condition in the group was identified through three cases of fracture. The two cases showed normal scans which included infarct and hemorrhage and sinusitis and hematoma. The dominant condition in Group D (60–79 years) remained in force with four cases of ischemia. The three cases showed normal scans which included atrophy and infarct and SAH. The findings in Group E showed only minor results which included two cases of ischemia and one case each of hemorrhage and edema and cyst and incidental findings. The adult age groups all showed consistent results which included ischemia and normal structural scans while the age-specific clusters for hemorrhage and infarcts and fractures showed variable distribution .

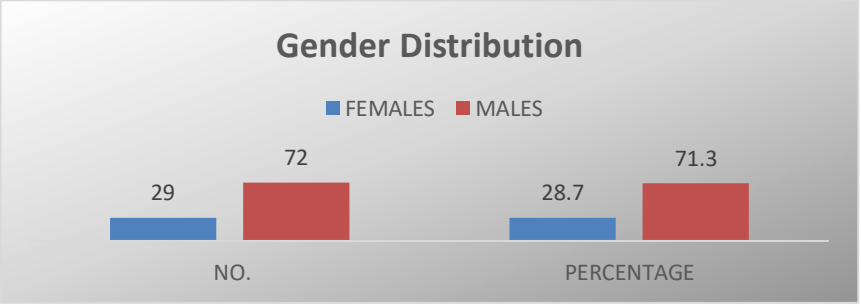


Gender-Related Distribution

The cohort showed a strong preference for male participants because 72 males (71.3%) and 29 females (28.7%) made up the study group.

Table 5: Gender Distribution

GENDER	NO.	PERCENTAGE
FEMALES	29	28.7
MALES	72	71.3
TOTAL	101	100

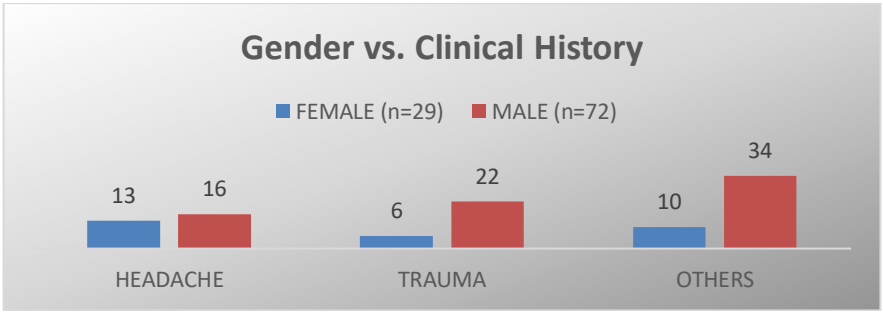


Gender v/s Clinical History

Female patients showed headache as their most common problem because 13 patients had that condition whereas 6 patients had traumatic injuries and the remaining 10 patients showed other medical problems which included three stroke patients, two follow-up patients, one seizure patient, one dizziness patient, one unconsciousness patient, one confusion patient, and one numbness patient. The main reasons for male patients to seek medical attention were Traumatic injuries (22 cases) and Headache (16 cases) while 34 patients presented with different medical histories. The evidence showed that males experienced trauma at a rate which significantly exceeded the rate of female trauma cases.

Table 6: Gender vs. Clinical History

GENDER	HEADACHE	TRAUMA	OTHERS	TOTAL
FEMALE (n=29)	13	6	10	29
MALE (n=72)	16	22	34	72
TOTAL	29	28	44	101

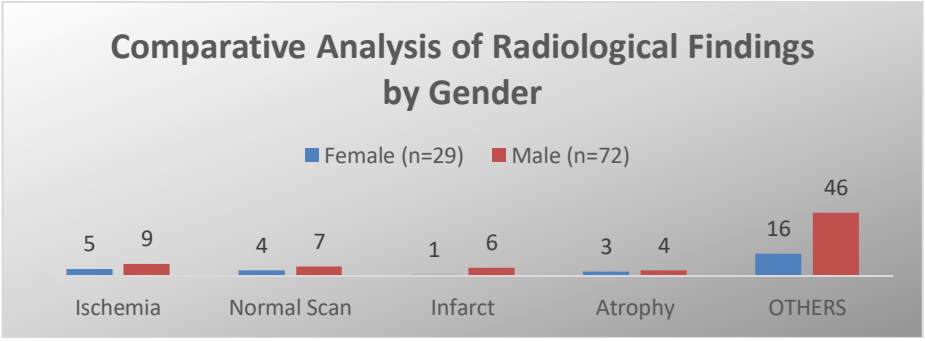


Gender-Specific Radiological Findings

The highest number of female patients showed ischemia as their main medical condition which affected five patients while four patients had normal scans and three patients showed brain atrophy. The remaining 17 occurrences were grouped into infarcts (n=1) and the “Others” category. The leading radiological finding in the study of 72 male patients showed that nine patients had ischemia while seven patients showed normal scans and six patients showed infarct results. The remaining 50 occurrences were classified under atrophy (n=4) and a wide array of "Other" findings.

Table 6: Comparative Analysis of Radiological Findings by Gender

Gender	Ischemia	Normal Scan	Infarct	Atrophy	OTHERS
Female (n=29)	5	4	1	3	16
Male (n=72)	9	7	6	4	46
TOTAL	14	11	7	7	62



Clinical History vs. Radiological Findings

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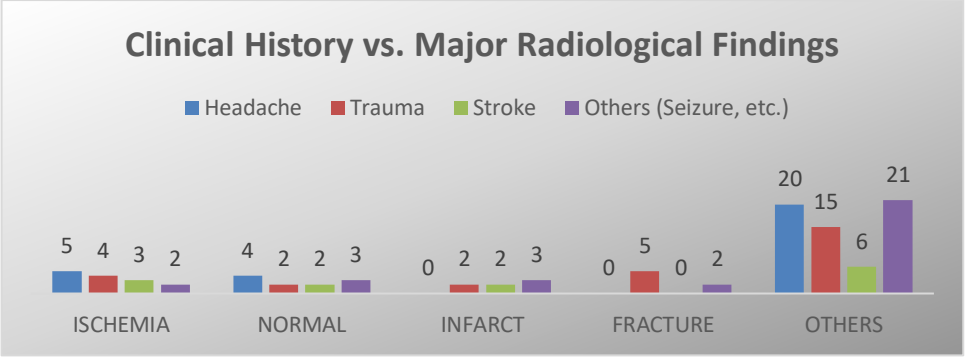
Table 7: Clinical History vs. Major Radiological Findings

HISTORY	ISCHEMIA	NORMAL	INFARCT	FRACTURE	OTHERS	TOTAL
Headache	5	4	0	0	20	29
Trauma	4	2	2	5	15	28
Stroke	3	2	2	0	6	13
Others (Seizure, etc.)	2	3	3	2	21	31
TOTAL	14	11	7	7	62	101



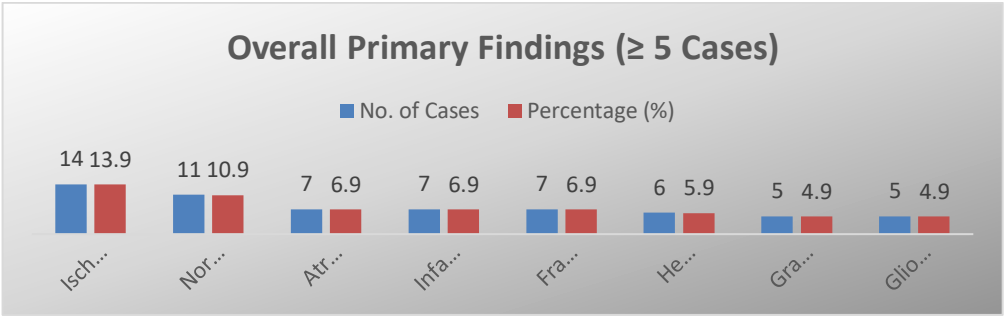
Overall Radiological Observations

Primary Findings

The radiological examination produced multiple different results. The study found that 90 out of 101 patients in the study showed at least one positive radiological result while 11 patients in the study group showed completely normal scan results. The primary findings driving the majority of cases were vascular and degenerative conditions. Ischemia emerged as the single most common radiological outcome overall (n=14). The next category of results showed 11 patients with normal structural scans. The next primary findings included atrophy infarcts and fractures which occurred in seven cases each while hemorrhage and granuloma and gliosis occurred in six and five cases respectively.

Table 8: Overall Primary Findings (≥ 5 Cases)

Primary Findings	No. of Cases	Percentage (%)
Ischemia	14	13.9
Normal Scan	11	10.9
Atrophy	7	6.9
Infarct	7	6.9
Fracture	7	6.9
Hemorrhage	6	5.9
Granuloma	5	4.9
Gliosis	5	4.9



Secondary and Incidental Findings

The secondary findings included various pathologies which emerged less often

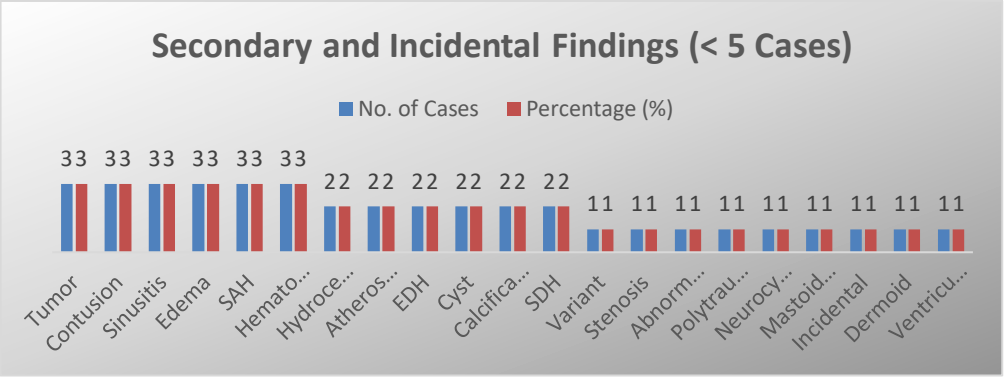
than the main structural and infectious and post-traumatic pathologies. The most significant secondary events occurred through tumors and contusions and sinusitis and edema and SAH and hematomas which occurred three times each. The two most common secondary findings included hydrocephalus and atherosclerosis and EDH and cysts and calcification and SDH (n=2 each). The secondary findings included 46 different medical conditions which appeared as single instances that included 46 different diagnoses which comprised variants and stenosis and broad abnormalities and polytrauma and neurocysticercosis and mastoiditis and dermoid and ventriculomegaly and standalone incidental findings.

Table 9: Secondary and Incidental Findings (< 5 Cases)

The study identified several secondary, associative, and incidental findings observed across various patient subset

FINDINGS	No. of Cases	Percentage (%)
Tumor	3	3.0
Contusion	3	3.0
Sinusitis	3	3.0
Edema	3	3.0
SAH	3	3.0

Hematoma	3	3.0
Hydrocephalus	2	2.0
Atherosclerosis	2	2.0
EDH	2	2.0
Cyst	2	2.0
Calcification	2	2.0
SDH	2	2.0
Variant	1	1.0
Stenosis	1	1.0
Abnormality	1	1.0
Polytrauma	1	1.0
Neurocysticercosis	1	1.0
Mastoiditis	1	1.0
Incidental	1	1.0
Dermoid	1	1.0
Ventriculomegaly	1	1.0



DISCUSSION

The researchers conducted this study to evaluate Non-Contrast Computed Tomography (NCCT) head results through systematic assessment methods which they used to determine the link between these results and the clinical symptoms of various patient groups. The study analyzed 101 patients to create a detailed clinicoradiological profile which showed their underlying neurological conditions. The research discovered that older adult participants showed continuous vascular changes together with degenerative alterations which included ischemia throughout the

study period. The study results showed that 89.1% of the scans detected at least one positive radiological finding while 11 scans showed completely normal results. The results of this study confirm the findings of Smith et al. [6] which showed that structural and microvascular deterioration progresses with age and becomes visible in people who show no severe acute symptoms.

The study demographics demonstrated that male participants composed 71.3% of the total study population. The highest incidence of neurological symptoms appeared among middle-aged and older

adults, with Group D (n=32) and Group C (n=29) showing their most significant results. This demographic trend aligns with the epidemiological research findings of Johnson et al. [7], who demonstrated that people between their fifth and eighth decades of life experience more neurovascular events because of their body deterioration and work-related hazards. The clinical presentations of trauma demonstrated a clear male bias because 22 out of 28 trauma cases involved male patients. Headache showed a disproportionately higher relative occurrence rate in females, representing 13 of the 29 total female presentations. The specific clinical groups demonstrated different gender distribution patterns, but the results remained non-significant because the p-value reached 0.318. The test results showed that there was no statistically significant difference between the age distribution of trauma patients and headache patients ($p = 0.399$). The two groups share demographic similarities which support Peter.R findings [8] that showed acute and chronic neurological complaints display identical presentation patterns that develop without respect to gender. The marked male predominance in the study population, particularly in trauma cases (22 out of 28), can be attributed to higher male participation in outdoor activities, industrial labor, and a higher incidence of road traffic accidents (RTA) in this specific geographic region. This reflects a common epidemiological trend where males are more exposed to external injury mechanisms compared to females.

The research study investigated how clinical history and radiological results establish their connection. The 28 trauma patients showed acute structural damages like fractures (n=7) and epidural hematomas (n=2) as notable medical conditions. Bruns and Hauser [9] proved through their research that rapid mechanical acceleration leads to cortical contusions and fractures which cause localized and radiating neurological deficits [9] The older patients presenting with headaches and strokes showed ischemia as their most frequent underlying condition which affected 14% of all cases. The research of Katz and Harris [10] shows direct vascular

insufficiency which occurs through microvascular disease as a necessary condition for patients to develop classic ischemic symptoms and cerebral infarcts. Our research demonstrates that two types of neurological manifestations occur based on two factors which include injury mechanism and vascular degeneration progression. The 'Others' category, which constituted 43.6% of clinical presentations, included non-specific symptoms such as dizziness, sudden hypertension, and altered sensorium. Interestingly, despite the non-specific nature of these symptoms, NCCT head successfully identified underlying pathologies like age-related atrophy and small vessel ischemic changes in these patients. This further strengthens the 'Diagnostic Yield' of NCCT, proving its utility even when specific localized symptoms are absent.

The research demonstrated that statistical testing found no significant difference between major radiological results from headache and other generalized neurological conditions with their observed results showing a p-value of 0.464. The existing research documentation shows that this statistical overlap between different groups has been established through contemporary literature which includes Jensen et al. [11] who discovered that degenerative findings like mild atrophy or scattered ischemia appear across various clinical categories. The clinical system fails to predict internal medical conditions because it relies entirely on patient symptoms for assessment. Our study supports the diagnostic guidelines established by Wardlaw JM. [12] which mandate that medical professionals should implement early NCCT head profiling for quicker identification of ischemia and specific traumatic medical conditions. The method enables doctors to develop customized treatment strategies which target the exact structural problems that their patients experience instead of using standard empirical treatment methods.

CONCLUSION

The study included 101 patients who underwent clinicoradiological analysis which showed that 71.3% of patients (72 males) outnumbered 28.7% of patients (29 females). Patient presentation peaked in older adults with Group D (60–79 years) showing the highest presentation of 32 cases followed by Group C (40–59 years) which recorded 29 cases. Headache presented as the most common clinical symptom because 28.7% of patients (n=29) showed this symptom which was only slightly less common than trauma that occurred in 27.7% of patients (n=28). The study found that males had a much higher tendency to experience trauma than females while female patients most commonly showed headache symptoms.

The radiological assessments identified 90 patients who showed at least one positive radiological abnormality from a total of 101 assessed patients. The main findings in most cases showed vascular and degenerative disorders as the primary reason for their assessment while ischemia became the most frequently observed radiological result with 14 cases. The adult population showed consistent results for both ischemia and normal structural scans while their specific age groups displayed different patterns for hemorrhage and infarcts and fractures.

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