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Original Article

Association of Computed Tomography (CT) Brain Findings With Neurological Symptoms in Non-Traumatic Patients

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ABSTRACT

The clinical setting (e.g., emergency department vs. outpatient clinic), patient characteristics, and the reason for performing the scan are all important factors that influence the rate of brain pathology revealed by Computerized Tomography (CT) scans. A large number of CT scans, particularly those performed for chronic symptoms such as headaches, are normal, although they are highly sensitive for detecting serious pathology. The highest prevalence was observed in loss of consciousness (47.7%) among the patients. The second highest prevalence was reported in vision problems (45.0%). The Third highest prevalence was reported in Headache (33.9%). The highest prevalence was observed in infarction/ischemic stroke (23.9%) among the participants. The second highest prevalence was reported for brain tumor/mass lesion and cerebral atrophy/degenerative changes (13.8%). The Third highest prevalence was reported in Hemorrhage/Hematoma and Encephalomalacia/Chronic parenchymal Damage (11.0%). Hemorrhage/Hematoma showed a statistically significant association with acute neurological deficit ($p = 0.044$). All other findings were not statistically significant because their p-values are greater than 0.05. Cerebral Atrophy/Degenerative Changes ($p = 0.032$) and Calcification ($p = 0.047$) showed a statistically significant association with fever. All other Findings did not show a statistically significant association with fever. In this study, loss of consciousness and vision problems were the most frequently reported symptoms. Among CT findings, infarction/ischemic stroke was the most common abnormality, followed by brain tumor and cerebral atrophy. Further research should also compare CT with other imaging modalities such as MRI for more detailed evaluation of neurological conditions. Longitudinal Study should be used for better statistical analysis. Keywords: Computerized Tomography, brain tumor, infarction, Headache, fever, Hemorrhage.

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INTRODUCTION

Neurological symptoms such as headache, loss of consciousness, visual disturbance, slurred speech, movement abnormality, and focal neurological deficit are frequent reasons for urgent neuroimaging, particularly when clinicians need to rapidly differentiate benign presentations from potentially life-threatening intracranial disease. Although headache alone is highly prevalent worldwide and is often benign in origin, its acute presentation in clinical practice still requires careful triage because intracranial hemorrhage, ischemic events, mass lesions, hydrocephalus, and other structural abnormalities may present with overlapping symptoms (1-3). In this context, computed tomography (CT) of the brain remains one of the most widely used first-line imaging modalities because it is fast, accessible, and highly useful for the early detection of hemorrhage, infarction, mass effect, hydrocephalus, and other clinically significant intracranial abnormalities that may require immediate intervention (4,5).

Despite its established diagnostic utility, the yield of CT brain imaging varies substantially according to patient population, clinical setting, and indication for referral. Previous studies have shown that while a

substantial proportion of brain CT examinations performed for neurological complaints identify significant abnormalities, many scans remain normal, particularly in patients presenting with chronic or nonspecific symptoms. The likelihood of positive findings appears to increase in the presence of red-flag neurological features, but the strength of association between individual symptoms and specific CT abnormalities has not been consistently defined across different populations and care settings (4-6). This variation creates an important clinical challenge, particularly in resource-constrained environments, where optimizing the selection of patients for CT imaging can improve diagnostic efficiency, reduce unnecessary imaging, and support earlier recognition of serious disease.

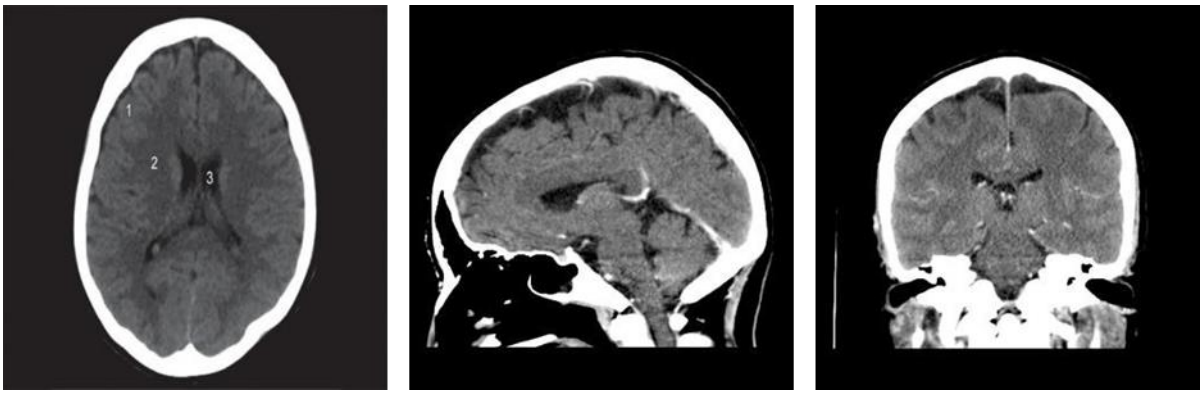

Figure 1 Standard anatomical planes of computed tomography (CT) brain imaging demonstrating axial, coronal, and sagittal views. The axial plane provides horizontal cross-sectional visualization of cerebral structures, the coronal plane illustrates frontal sectional anatomy, and the sagittal plane displays midline and lateral brain structures, facilitating comprehensive three-dimensional anatomical assessment (Bhargava 2019; Srivanasan et al.).

The interpretation of neurological symptoms is further complicated by the fact that similar complaints may arise from markedly different pathological processes. For example, loss of consciousness may be associated with stroke, intracranial hemorrhage, infection, or diffuse cerebral dysfunction, whereas headache and visual complaints may reflect either benign disorders or significant structural pathology. Advances in CT acquisition and multiplanar reconstruction have improved the anatomical characterization of intracranial disease and enhanced its value in acute assessment, yet the diagnostic importance of particular symptom patterns in non-traumatic patients still requires more context-specific evaluation (7,8). Existing literature has largely emphasized overall CT positivity rates or focused on selected complaints such as headache, rather than systematically examining how a broader spectrum of neurological symptoms relates to the pattern of CT brain findings in routine non-traumatic clinical practice (2,4,6).

This gap is particularly relevant in symptomatic non-traumatic patients, in whom imaging decisions are often guided by a combination of clinical suspicion, comorbidity burden, and local diagnostic availability rather than by standardized symptom-based prediction models. A clearer understanding of which neurological complaints are more frequently associated with abnormalities such as infarction, hemorrhage, tumor, cerebral atrophy, encephalomalacia, hydrocephalus, vascular abnormalities, or calcification may improve the clinical interpretation of CT requests and strengthen decision-making in radiology and emergency settings. Therefore, the present study was undertaken to determine the distribution of CT brain abnormalities in non-traumatic symptomatic patients and to evaluate the association between specific neurological symptoms and CT brain findings in this population.

MATERIALS AND METHODS

This cross-sectional observational study was conducted in the Radiology Department of Central Park Teaching Hospital, Al-Amin Diagnostic Center, and Faizi Hospital among non-traumatic patients referred for CT brain examination because of neurological complaints. The study population comprised symptomatic patients whose CT brain examinations demonstrated abnormal findings relevant to the clinical presentation. A non-probability sampling approach was used, and eligible patients were enrolled

from the participating imaging centers after assessment against the predefined selection criteria. Written informed consent was obtained before inclusion, and all procedures were carried out in accordance with institutional ethical standards and the principles of confidentiality, voluntary participation, and participant anonymity.

Patients of either sex aged 1 to 90 years were considered eligible if they presented with one or more neurological or related complaints prompting CT brain evaluation, including headache, dizziness, mild confusion, balance disturbance, papilledema, weakness, seizures, ringing in the ear, visual problems, or memory problems. Pregnant women, patients with a history of head trauma, patients presenting after sudden fall, and patients with normal CT findings were excluded from the study. Restricting the sample to non-traumatic patients with abnormal CT findings allowed the analysis to focus specifically on the association between presenting symptoms and radiologically detectable intracranial pathology within the target clinical group.

Data were collected using a structured proforma designed for uniform recording of demographic, clinical, and imaging information. The recorded variables included age group, sex, CT examination type, history of diabetes mellitus, history of hypertension, duration of symptoms, presenting symptoms, and final CT brain findings. Age was categorized into four groups: 0-20 years, 21-40 years, 41-60 years, and 61-80 years. CT examinations were classified as contrast-enhanced or non-contrast studies. Diabetes mellitus and hypertension were recorded as present or absent. Duration of symptoms was grouped as less than 6 months and less than 1 year. Clinical symptoms were documented as categorical variables and included acute neurological deficit, nasal swelling, scalp swelling, vision problem, loss of consciousness, movement disorder, slurred speech, fever, and headache. CT brain findings were classified into brain tumor or mass lesion, infarction or ischemic stroke, hemorrhage or hematoma, cerebral atrophy or degenerative changes, encephalomalacia or chronic parenchymal damage, edema or hydrocephalus, vascular abnormalities, calcification, and sinus or extra-cranial pathology.

The CT procedure was performed according to routine departmental practice. Patients were positioned supine on the CT table, which moved through the gantry during image acquisition. Cross-sectional images of the brain were obtained, with contrast administered in selected cases when clinically indicated. Patients were instructed to remain still during scanning, and image acquisition was supervised by trained radiology personnel. The imaging data were subsequently reviewed and categorized according to the prespecified diagnostic groupings used in the study proforma. Standardizing data capture in this manner helped minimize classification variability across study sites.

Several procedural steps were applied to improve internal consistency and reduce avoidable bias. Only patients meeting the same eligibility criteria were included across all participating centers, traumatic cases were excluded to reduce etiological heterogeneity, and all variables were collected using a common recording format. Data were checked for completeness before entry, and only complete observations were included in the final analysis. Categorical grouping of symptoms, comorbidities, CT modality, and CT findings was defined before analysis to support reproducibility and reduce post hoc analytical drift. Because the study was observational and based on non-probability sampling, the findings were interpreted as associations rather than causal effects. Potential confounding by age, sex, diabetes, and hypertension was explored descriptively through cross-tabulation, while inferential testing focused on categorical associations within the available dataset.

All data were entered, cleaned, and analyzed using SPSS version 24.0. Descriptive statistics were used to summarize participant characteristics and the frequency distribution of symptoms and CT brain findings. Categorical variables were presented as frequencies and percentages. The chi-square test was applied to assess associations between categorical variables, including associations between demographic or clinical factors and CT modality, as well as between individual CT findings and presenting symptoms. A p-value of less than 0.05 was considered statistically significant. The analytical

workflow involved prior checking of collected data before statistical entry in order to preserve data integrity and reduce entry-related error.

RESULTS

A total of 109 non-traumatic symptomatic patients were included. Females were slightly more represented than males (54.1% vs 45.9%), and the study population was predominantly middle-aged to older, with 46.8% aged 41-60 years and 39.4% aged 61-80 years. Non-contrast CT was the more frequently performed modality (62.4%), while hypertension (44.0%) was more common than diabetes mellitus (32.1%). Symptom duration was nearly evenly distributed between less than 6 months (52.3%) and less than 1 year (47.7%).

Table 1. Demographic and Clinical Characteristics of the Study Population (N = 109)

Variable	Category	n	%
Sex	Male	50	45.9
	Female	59	54.1
Age group (years)	0-20	6	5.5
	21-40	9	8.3
	41-60	51	46.8
	61-80	43	39.4
CT type	CT brain non-contrast	68	62.4
	CT brain contrast	41	37.6
Diabetes mellitus	Present	35	32.1
	Absent	74	67.9
Hypertension	Present	48	44.0
	Absent	61	56.0
Duration of symptoms	Less than 6 months	57	52.3
	Less than 1 year	52	47.7

Neurological symptom profiling showed that loss of consciousness was the most frequent presentation (47.7%), followed by vision problems (45.0%), headache (33.9%), slurred speech (31.2%), and fever (30.3%). Acute neurological deficit, nasal swelling, and scalp swelling were comparatively uncommon.

Table 2. Prevalence of Presenting Clinical Symptoms (N = 109)

Symptom	n	%
Loss of consciousness	52	47.7
Vision problem	49	45.0
Headache	37	33.9
Slurred speech	34	31.2
Fever	33	30.3
Movement disorder	26	23.9
Nasal swelling	14	12.8
Acute neurological deficit	10	9.2
Scalp swelling	9	8.3

Among CT abnormalities, infarction/ischemic stroke was the most frequent finding (23.9%). Brain tumor/mass lesion and cerebral atrophy/degenerative change each accounted for 13.8%, followed by hemorrhage/hematoma and encephalomalacia/chronic parenchymal damage at 11.0% each. Calcification was least frequent at 3.7%.

Table 3. Distribution of CT Brain Findings (N = 109)

CT brain finding	n	%
Infarction/ischemic stroke	26	23.9
Brain tumor/mass lesion	15	13.8
Cerebral atrophy/degenerative changes	15	13.8
Hemorrhage/hematoma	12	11.0
Encephalomalacia/chronic parenchymal damage	12	11.0
Edema/hydrocephalus	11	10.1
Sinus and extra-cranial pathology	10	9.2
Vascular abnormalities	6	5.5

CT brain finding	n	%
Calcification	4	3.7

Age was not significantly associated with CT type (p = 0.195), diabetes (p = 0.033 was significant), duration of symptoms (p = 0.966), or sex distribution (p = 0.522), while the age–hypertension association was borderline but not statistically significant when the tabulated value was retained (p = 0.056). Gender was not significantly associated with CT type, hypertension, diabetes, or symptom duration. These results indicate that the main inferential signal in the dataset came from symptom–finding relationships rather than from broad demographic cross-tabulations.

Table 4. Demographic and Clinical Cross-Tabulations Reported in the Dataset

Comparison	p-value	Interpretation
Age group vs CT type	0.195	Not significant
Age group vs hypertension	0.056	Not significant
Age group vs diabetes mellitus	0.033	Significant
Age group vs duration of symptoms	0.966	Not significant
Age group vs sex	0.522	Not significant
Sex vs CT type	0.939	Not significant
Sex vs hypertension	0.248	Not significant
Sex vs diabetes mellitus	0.697	Not significant
Sex vs duration of symptoms	0.955	Not significant

To improve inferential clarity, crude odds ratios were derived from the reported aggregated counts for each symptom–finding pair. Acute neurological deficit showed the clearest clinically relevant relationship with hemorrhage/hematoma, where 30.0% of patients with acute neurological deficit had hemorrhage/hematoma and the odds were more than fourfold higher than in those without that symptom (OR 4.29, 95% CI 0.94-19.52; p = 0.044). No other finding was significantly associated with acute neurological deficit. Nasal swelling showed higher proportions for brain tumor/mass lesion (28.6%) and sinus/extra-cranial pathology (21.4%), but these did not reach significance.

Table 5A. Association of Acute Neurological Deficit and Nasal Swelling With CT Findings

Symptom	CT finding	Symptom-positive cases with finding, n/N (%)	Crude OR (95% CI)	p-value
Acute Neurological deficit	Brain tumor/mass lesion	2/10 (20.0)	1.65 (0.32-8.66)	0.540
	Infarction/ischemic stroke	2/10 (20.0)	0.78 (0.16-3.93)	0.760
	Hemorrhage/hematoma	3/10 (30.0)	4.29 (0.94-19.52)	0.044
	Cerebral atrophy/degenerative changes	0/10 (0.0)	0.26 (0.01-4.66)	0.185
	Encephalomalacia/chronic parenchymal damage	2/10 (20.0)	2.23 (0.41-11.96)	0.341
	Edema/hydrocephalus	1/10 (10.0)	0.99 (0.11-8.63)	0.992
	Vascular abnormalities	0/10 (0.0)	0.68 (0.04-13.04)	0.423
	Calcification	0/10 (0.0)	1.01 (0.05-20.11)	0.517
	Sinus and extra-cranial pathology	0/10 (0.0)	0.41 (0.02-7.44)	0.292
Nasal swelling	Brain tumor/mass lesion	4/14 (28.6)	3.05 (0.82-11.42)	0.085
	Infarction/ischemic stroke	1/14 (7.1)	0.22 (0.03-1.73)	0.116
	Hemorrhage/hematoma	1/14 (7.1)	0.59 (0.07-4.94)	0.621
	Cerebral atrophy/degenerative changes	2/14 (14.3)	1.05 (0.21-5.24)	0.951
	Encephalomalacia/chronic parenchymal damage	1/14 (7.1)	0.59 (0.07-4.94)	0.621
	Edema/hydrocephalus	2/14 (14.3)	1.59 (0.31-8.27)	0.577
	Vascular abnormalities	0/14 (0.0)	0.47 (0.03-8.89)	0.333
	Calcification	1/14 (7.1)	2.36 (0.23-24.40)	0.459
	Sinus and extra-cranial pathology	3/14 (21.4)	3.43 (0.77-15.22)	0.089

Vision problems and loss of consciousness were the two most prevalent symptoms and showed the broadest spread across imaging abnormalities. Among patients with vision problems, infarction/ischemic stroke was present in 24.5%, sinus/extra-cranial pathology in 14.3%, and brain tumor/mass lesion plus hemorrhage/hematoma in 12.2% each, but none of these associations reached statistical significance. In patients with loss of consciousness, infarction/ischemic stroke again dominated (23.1%), followed by brain tumor/mass lesion and encephalomalacia/chronic parenchymal damage at 15.4% each, without significant association. Headache also showed no significant association

with any CT finding, although encephalomalacia/chronic parenchymal damage (OR 2.13) and edema/hydrocephalus (OR 1.72) displayed numerically higher odds than several other findings.

Table 5B. Association of Vision Problem, Headache, and Loss of Consciousness With CT Findings

Symptom	CT finding	Symptom-positive cases with finding, n/N (%)	Crude OR (95% CI)	p-value
Vision problem	Brain tumor/mass lesion	6/49 (12.2)	0.79 (0.26-2.40)	0.679
	Infarction/ischemic stroke	12/49 (24.5)	1.07 (0.44-2.58)	0.888
	Hemorrhage/hematoma	6/49 (12.2)	1.26 (0.38-4.17)	0.710
	Cerebral atrophy/degenerative changes	5/49 (10.2)	0.57 (0.18-1.79)	0.330
	Encephalomalacia/chronic parenchymal damage	3/49 (6.1)	0.37 (0.09-1.45)	0.141
	Edema/hydrocephalus	4/49 (8.2)	0.67 (0.19-2.45)	0.972
	Vascular abnormalities	3/49 (6.1)	1.24 (0.24-6.43)	0.798
	Calcification	2/49 (4.1)	1.23 (0.17-9.09)	0.836
	Sinus and extra-cranial pathology	7/49 (14.3)	3.17 (0.77-12.97)	0.095
Headache	Brain tumor/mass lesion	5/37 (13.5)	0.97 (0.31-3.08)	0.957
	Infarction/ischemic stroke	6/37 (16.2)	0.50 (0.18-1.39)	0.180
	Hemorrhage/hematoma	3/37 (8.1)	0.62 (0.16-2.43)	0.488
	Cerebral atrophy/degenerative changes	6/37 (16.2)	1.35 (0.44-4.15)	0.594
	Encephalomalacia/chronic parenchymal damage	6/37 (16.2)	2.13 (0.64-7.14)	0.213
	Edema/hydrocephalus	5/37 (13.5)	1.72 (0.49-6.06)	0.395
	Vascular abnormalities	2/37 (5.4)	0.97 (0.17-5.57)	0.974
	Calcification	1/37 (2.7)	0.64 (0.06-6.36)	0.700
	Sinus and extra-cranial pathology	4/37 (10.8)	1.33 (0.35-5.05)	0.671
Loss of consciousness	Brain tumor/mass lesion	8/52 (15.4)	1.30 (0.44-3.87)	0.638
	Infarction/ischemic stroke	12/52 (23.1)	0.92 (0.38-2.23)	0.856
	Hemorrhage/hematoma	6/52 (11.5)	1.11 (0.33-3.68)	0.866
	Cerebral atrophy/degenerative changes	6/52 (11.5)	0.70 (0.23-2.11)	0.520
	Encephalomalacia/chronic parenchymal damage	8/52 (15.4)	2.41 (0.68-8.54)	0.163
	Edema/hydrocephalus	5/52 (9.6)	0.90 (0.26-3.16)	0.875
	Vascular abnormalities	4/52 (7.7)	2.29 (0.40-13.07)	0.339
	Calcification	1/52 (1.9)	0.35 (0.04-3.50)	0.354
	Sinus and extra-cranial pathology	3/52 (5.8)	0.44 (0.11-1.79)	0.239

Movement disorder, slurred speech, fever, and scalp swelling showed more selective patterns. Movement disorder was numerically most frequent with infarction/ischemic stroke (23.1%) and edema/hydrocephalus (15.4%), but none of the associations were significant. Slurred speech occurred most often with infarction/ischemic stroke (20.6%), and edema/hydrocephalus plus encephalomalacia/chronic parenchymal damage each contributed 14.7%, again without significant association. Fever yielded the second major inferential signal in the dataset: cerebral atrophy/degenerative changes were inversely associated with fever (3.0%; OR 0.14, 95% CI 0.02-1.10; p = 0.032), whereas calcification showed a positive association (9.1%; OR 7.50, 95% CI 0.75-74.99; p = 0.047). Scalp swelling was uncommon overall, and although 44.4% of those with scalp swelling had infarction/ischemic stroke, this pattern did not achieve statistical significance (p = 0.130).

Table 5C. Association of Movement Disorder, Slurred Speech, Fever, and Scalp Swelling With CT Findings

Symptom	CT finding	Symptom-positive cases with finding, n/N (%)	Crude OR (95% CI)	p-value
Movement disorder	Brain tumor/mass lesion	2/26 (7.7)	0.45 (0.09-2.13)	0.303
	Infarction/ischemic stroke	6/26 (23.1)	0.94 (0.33-2.68)	0.915
	Hemorrhage/hematoma	4/26 (15.4)	1.70 (0.47-6.20)	0.414
	Cerebral atrophy/degenerative changes	3/26 (11.5)	0.77 (0.20-2.98)	0.706
	Encephalomalacia/chronic parenchymal damage	3/26 (11.5)	1.07 (0.27-4.30)	0.921
	Edema/hydrocephalus	4/26 (15.4)	1.97 (0.53-7.37)	0.305
	Vascular abnormalities	1/26 (3.8)	0.62 (0.07-5.60)	0.671
	Calcification	1/26 (3.8)	1.07 (0.11-10.72)	0.956
	Sinus and extra-cranial pathology	2/26 (7.7)	0.78 (0.16-3.93)	0.764
Slurred speech	Brain tumor/mass lesion	5/34 (14.7)	1.12 (0.35-3.57)	0.847
	Infarction/ischemic stroke	7/34 (20.6)	0.76 (0.29-2.04)	0.590
	Hemorrhage/hematoma	3/34 (8.8)	0.71 (0.18-2.81)	0.624

Symptom	CT finding	Symptom-positive cases with finding, n/N (%)	Crude OR (95% CI)	p-value
	Cerebral atrophy/degenerative changes	2/34 (5.9)	0.30 (0.06-1.40)	0.108
	Encephalomalacia/chronic parenchymal damage	5/34 (14.7)	1.67 (0.49-5.71)	0.406
	Edema/hydrocephalus	5/34 (14.7)	1.98 (0.56-7.02)	0.282
	Vascular abnormalities	2/34 (5.9)	1.11 (0.19-6.37)	0.907
	Calcification	2/34 (5.9)	2.28 (0.31-16.92)	0.408
	Sinus and extra-cranial pathology	3/34 (8.8)	0.94 (0.23-3.88)	0.932
Fever	Brain tumor/mass lesion	7/33 (21.2)	2.29 (0.75-6.95)	0.137
	Infarction/ischemic stroke	6/33 (18.2)	0.62 (0.22-1.73)	0.360
	Hemorrhage/hematoma	4/33 (12.1)	1.17 (0.33-4.20)	0.807
	Cerebral atrophy/degenerative changes	1/33 (3.0)	0.14 (0.02-1.10)	0.032
	Encephalomalacia/chronic parenchymal damage	5/33 (15.2)	1.76 (0.52-6.01)	0.363
	Edema/hydrocephalus	3/33 (9.1)	0.85 (0.21-3.43)	0.819
	Vascular abnormalities	2/33 (6.1)	1.16 (0.20-6.68)	0.867
	Calcification	3/33 (9.1)	7.50 (0.75-74.99)	0.047
	Sinus and extra-cranial pathology	2/33 (6.1)	0.55 (0.11-2.73)	0.458
Scalp swelling	Brain tumor/mass lesion	1/9 (11.1)	0.77 (0.09-6.62)	0.810
	Infarction/ischemic stroke	4/9 (44.4)	2.84 (0.70-11.47)	0.130
	Hemorrhage/hematoma	0/9 (0.0)	0.37 (0.02-6.81)	0.271
	Cerebral atrophy/degenerative changes	2/9 (22.2)	1.91 (0.36-10.22)	0.442
	Encephalomalacia/chronic parenchymal damage	1/9 (11.1)	1.01 (0.12-8.87)	0.992
	Edema/hydrocephalus	1/9 (11.1)	1.12 (0.13-9.94)	0.916
	Vascular abnormalities	0/9 (0.0)	0.77 (0.04-14.66)	0.450
	Calcification	0/9 (0.0)	1.13 (0.06-22.60)	0.541
	Sinus and extra-cranial pathology	0/9 (0.0)	0.45 (0.02-8.37)	0.320

Overall, the revised inferential pattern shows that most symptom–finding pairs were not statistically significant, but three findings stood out. First, acute neurological deficit clustered most strongly with hemorrhage/hematoma. Second, fever showed a divergent pattern, being negatively associated with cerebral atrophy/degenerative change and positively associated with calcification. Third, several near-significant trends were observed for nasal swelling with brain tumor/mass lesion and sinus/extra-cranial pathology, as well as for vision problem with sinus/extra-cranial pathology. These near-threshold relationships may be clinically relevant but should be interpreted cautiously in view of the modest sample size and wide confidence intervals.

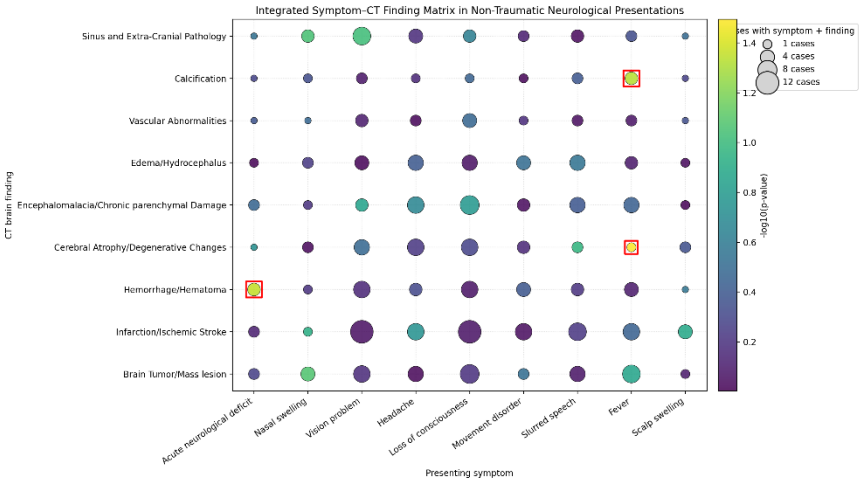

Figure 2 Integrated matrix shows that the largest symptom–finding burdens

The integrated matrix shows that the largest symptom–finding burdens were concentrated around infarction/ischemic stroke with vision problems and loss of consciousness, each contributing 12 co-occurring cases, while encephalomalacia/chronic parenchymal damage also showed a relatively high burden with loss of consciousness (8 cases). Statistical concentration was sparse, with only three highlighted associations reaching significance: hemorrhage/hematoma with acute neurological deficit (3/10, 30.0%; p = 0.044), cerebral atrophy/degenerative changes with fever showing a low co-occurrence pattern (1/33, 3.0%; p = 0.032), and calcification with fever (3/33, 9.1%; p = 0.047). Several near-threshold

patterns remained visible, particularly brain tumor/mass lesion with nasal swelling (4/14, 28.6%; p = 0.085), sinus/extra-cranial pathology with nasal swelling (3/14, 21.4%; p = 0.089), and sinus/extra-cranial pathology with vision problems (7/49, 14.3%; p = 0.095), suggesting localized structural or extra-cranial processes may explain selected symptom clusters more often than chance alone.

DISCUSSION

The present study evaluated the association between CT brain findings and neurological symptoms in non-traumatic patients undergoing imaging assessment in routine clinical practice. The overall pattern of findings indicates that the symptomatic population was predominantly middle-aged and older, with most participants clustered in the 41-60 and 61-80 year age groups, and with a slight female predominance. Non-contrast CT was used more often than contrast-enhanced CT, which is consistent with its role as the initial imaging modality in patients presenting with acute or undifferentiated neurological complaints because of its speed, accessibility, and established diagnostic utility in detecting hemorrhage, infarction, hydrocephalus, and mass effect (4,5). The symptom distribution in this cohort showed that loss of consciousness and visual problems were the leading presenting complaints, while infarction/ischemic stroke was the most frequent CT abnormality. This combination suggests that in this non-traumatic clinical setting, CT imaging was used most often in patients in whom vascular and structural intracranial pathology was reasonably suspected on clinical grounds.

The predominance of infarction/ischemic stroke as the most common CT finding is clinically important and aligns with the recognized role of CT in the early workup of acute neurological presentations, particularly where rapid exclusion of hemorrhage and identification of major ischemic change are essential for management decisions (4,5). The observed prevalence of brain tumor/mass lesion and cerebral atrophy/degenerative change as the next most common findings also indicates that CT in symptomatic non-traumatic patients captures a broad spectrum of pathology extending beyond acute vascular disease. Compared with earlier studies cited in the manuscript, the present work supports the general observation that CT yield varies considerably depending on indication and patient mix, with abnormal findings becoming more frequent in populations selected on the basis of neurological symptoms or clinical concern rather than nonspecific screening alone (1,4,6). At the same time, the relative prominence of loss of consciousness and visual symptoms in this dataset differs from studies in which headache was the dominant indication, underscoring that local referral patterns and case mix strongly shape diagnostic yield (2,3,6).

One of the most clinically relevant findings in the present analysis was the statistically significant association between hemorrhage/hematoma and acute neurological deficit. Although the number of affected cases was modest, the direction of the association is biologically and clinically plausible, because acute intracranial bleeding often manifests with sudden focal deficit, altered consciousness, or abrupt neurological deterioration. The crude odds ratio also suggested materially higher odds of hemorrhage among patients presenting with acute neurological deficit, even though the confidence interval was wide, reflecting limited precision. This result reinforces the importance of urgent imaging in patients presenting with focal or abrupt neurological compromise and is in keeping with the established emergency value of CT for detecting acute intracranial hemorrhage (4,6). From a clinical standpoint, this is one of the most interpretable findings of the study because it links a high-risk symptom complex with a time-sensitive radiological diagnosis.

The fever-related findings require more cautious interpretation. The analysis showed statistically significant associations involving cerebral atrophy/degenerative changes and calcification in relation to fever, but these should not be overinterpreted as direct causal relationships. In practical terms, cerebral atrophy may be an incidental or age-related imaging feature that coexists with febrile presentation rather than being caused by it, whereas calcification may represent chronic or unrelated structural change variably identified during evaluation of patients presenting with systemic or neurological

symptoms. The statistical significance observed here may therefore reflect sparse cell counts, compositional effects, or chance findings arising from multiple comparisons rather than a strong underlying biological relationship. This is particularly relevant given the low prevalence of calcification and the wide confidence interval around its odds estimate. Accordingly, these results are best viewed as exploratory signals that warrant re-evaluation in larger datasets rather than as definitive symptom-imaging correlations.

Several non-significant but potentially interesting trends were also visible. Nasal swelling showed higher proportions of brain tumor/mass lesion and sinus or extra-cranial pathology, while vision problems demonstrated a numerically higher burden of infarction/ischemic stroke and sinus/extra-cranial pathology. Although these relationships did not meet the conventional threshold for significance, they are clinically coherent. Visual symptoms may result from vascular events, raised intracranial pressure, or compressive lesions, and extra-cranial or sinonasal disease may occasionally present with local symptoms that prompt neuroimaging. Likewise, loss of consciousness was frequently observed in patients with infarction, tumor, and encephalomalacia/chronic parenchymal damage, but the absence of statistical significance indicates that the symptom was broadly distributed across several pathologies rather than selectively linked to one lesion type in this sample. This pattern highlights an important practical point: some neurological complaints are highly prevalent but diagnostically nonspecific, whereas others, such as acute focal deficit, may carry greater predictive value for particular urgent intracranial abnormalities.

The demographic analyses add further context to the findings. Age showed a significant association with diabetes mellitus and a near-significant relationship with hypertension, reflecting the expected concentration of vascular comorbidity in middle-aged and older patients. However, age and sex were not significantly associated with CT type or most other broad clinical variables. This suggests that in the present cohort, symptom-driven and clinical decision pathways may have influenced imaging more strongly than demographic characteristics alone. Nevertheless, the age structure of the study population remains relevant when interpreting the overall burden of infarction and cerebral atrophy, both of which are more commonly encountered in older adults. The predominance of participants aged above 40 years may therefore have contributed to the observed distribution of CT abnormalities.

The findings should also be interpreted in light of several methodological constraints. First, the study was cross-sectional and observational, so it can identify associations but cannot establish temporality or causality. Second, non-probability sampling limits generalizability and may have introduced selection bias. Third, the exclusion of patients with normal CT findings enriched the sample for radiological abnormality and therefore increased the apparent prevalence of positive findings while reducing the ability to compare predictors of normal versus abnormal scans. Fourth, the analysis relied primarily on chi-square testing, and the available dataset did not permit more robust multivariable adjustment for confounding. Fifth, many symptom–finding cells were small, which widened confidence intervals and increased the chance of unstable estimates. Finally, because numerous pairwise associations were explored, some statistically significant findings may represent false-positive results in the absence of a prespecified correction strategy for multiple testing. These limitations do not invalidate the descriptive contribution of the study, but they do mean that the inferential findings should be interpreted as preliminary.

Despite these constraints, the study contributes useful evidence from a non-traumatic symptomatic population and has practical relevance for radiology and acute care settings. It emphasizes that infarction/ischemic stroke is a major abnormality encountered in such patients, that loss of consciousness and visual symptoms are frequent triggers for imaging, and that acute neurological deficit remains an especially important warning feature for hemorrhagic pathology. These findings support the continued role of CT as an accessible first-line modality in the early evaluation of non-traumatic neurological presentations, particularly where rapid risk stratification is required and MRI is

less readily available (4,5). Future studies should include both normal and abnormal CT examinations, apply larger multicenter samples, and use multivariable modeling to clarify which combinations of symptoms and comorbidities independently predict clinically significant intracranial pathology. Such work would help move from descriptive association toward more robust imaging decision support in symptomatic neurological patients.

CONCLUSION

CT brain imaging remains a valuable first-line diagnostic tool in non-traumatic patients presenting with neurological complaints. In this study, loss of consciousness and visual problems were the most frequent presenting symptoms, while infarction/ischemic stroke was the most common radiological abnormality, followed by brain tumor/mass lesion and cerebral atrophy/degenerative changes. Among the evaluated symptom–finding relationships, hemorrhage/hematoma showed a significant association with acute neurological deficit, whereas fever showed significant associations with cerebral atrophy/degenerative changes and calcification, although the latter findings should be interpreted cautiously because of small cell counts and limited precision. Overall, the results indicate that CT provides clinically meaningful diagnostic information in symptomatic non-traumatic patients and may be particularly important in the early evaluation of patients with acute focal neurological manifestations.

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