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CLINICAL DIAGNOSIS AND CLASSIFICATION OF ROAD HEAD INJURY WITH THE HELP OF COMPUTERIZED TOMOGRAPHY IN THE REGION OF FAISALABAD, PAKISTAN

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ABSTRACT

Background: *Road head injury is a significant health concern impacting millions worldwide. It is prevalent in young and middle-aged, populations According to the World Health Organization Pakistan is the second country in the world to have high rates of road head injury. About 22 percent of Pakistanis were affected by road head injuries. The rural population of Faisalabad city is suffering from road head injury.*

Objective: *The purpose of this study compared the prevalence of accidental head injury, and the kinds of brain hemorrhage identified through the CT scan in different areas of district Faisalabad.*

Methods *This descriptive cross-sectional study included 200 patients of all age group with the history of accident and diagnosed with head injury by computed tomography. GE Revolution CT machine was used, and procedure is performed by technologist and reporting have been done by radiologist. The data was collected on questionnaire. Data analysis was performed using software R.*

Results: *A total of 200 cases of brain head injury has been included by obtaining consent. The prevalence of head injuries varied by age group, with the highest prevalence in the 35–40 age range, indicating that individuals in this age group are disproportionately affected in comparison to other age groups Hemorrhage type distribution based on clinical findings, illustrating the frequency of various hemorrhage types in the patient population. The findings highlight specific patterns, such as the interplay between swelling (Edema) and structural displacement (Midline Shift), which are critical for understanding the complex relationships between head injury conditions. These insights can inform targeted diagnostic and therapeutic strategies.*

Conclusion: *This study found out that males were more than females in road head injury. The age range of old has the tallest bar in blue curve histogram indicated that 35 to 40 years age group is the most prevalent in the sample. There are less people who are very young (less than ten years old) and older (more than eighty years old). We investigated the different kinds of head injury and correlation among them. Skull Fracture and Hemorrhage showed the moderate negative correlation. Skull fractures may reduce the likelihood of brain bleeding. Similarly. Edema and Midline Shift showed the moderate positive correlation. It triggered a shift in brain position due to swelling. However, skull fracture and hematoma have not shown any correlation among them.*

Keywords*: Road head injury, CT scan, Prevalence, World Health Organization*

INTRODUCTION

In teenagers and young adults, road traffic accidents (RTA) are the primary cause of polytrauma, or head injuries (1). In 25% of cases of acute trauma victims, head injuries result in instant death (2). RTA is the cause of almost half of head trauma cases, which accounts for 70% of brain injury-related deaths. Few people remain in a vegetative state among the critically damaged patients, whereas the rest survive with significant disabilities. Patients with head injuries tend to do worse as they become older (3). Since computed tomography (CT) is accurate, dependable, safe, and widely accessible, it has emerged as the preferred diagnostic method for head trauma (4). Roughly 40% of all injuries are of the traumatic brain injury (TBI) variety, which is one of the most prevalent. Globally, it is estimated that 69 million people get traumatic brain injury annually (5)(2). CT was first introduced in 1971 and has since grown to be a widely used diagnostic imaging modality, with more than 70,000,000 exams conducted in the US each year (6). In fact, there are many reasons to undertake CT-based assessments, such as the assessment of aortic dissection, fractures, sinusitis, pulmonary embolism, cerebrovascular illness, and other malignancies (7). The reason that ordering clinicians choose CT is mostly because of its speed and accuracy in diagnosing a wide range of disorders (8). Patients with long-term TBI often suffer from cognitive and functional impairments and may develop conditions like epilepsy, requiring continuous medical treatment and long-term supportive care (9). The use of CT has increased in popularity, with hospital surveillance often the norm. There seems to be a medico-legal argument behind keeping the level high: if it is not possible to miss something significant on CT, you better have done one before admitting them (10). When assessing head injuries, especially trauma, medical professionals now prefer CT scans over traditional skull X-rays. CT scans are faster, more accessible, and much better at identifying bone and brain injuries such as fractures and bleeding. They also have fewer restrictions on metallic foreign bodies and are less expensive than MRIs (11). Head trauma is common across all age groups, especially in people aged 18 to 30. Road traffic accidents are the leading cause, accounting for about 50% of traumatic brain injuries, while falls contribute to 20-30% of cases (12). The objective of this study was to explain the significance of CT scan in the identification and classification of brain injuries. Moreover, to analyze the prevalence of brain hemorrhage identified through CT scans.

2. Methods

All patients with traumatic brain injuries were admitted between May 2024 to December 2024 in the Allied Hospital Faisalabad, Pakistan and their data gathered retrospectively. The sample of this study was 200 patients calculated by open epi software. All patients diagnosed with head injury by computed tomography (CT) will be included in the study. GE Revolution CT machine was used, and procedure is performed by technologist and reporting have been done by radiologist. The data was collected on questionnaire that covered all aspects of patient with history of road head injury and CT findings needed for research.

3. Results

The study covered a total of 200 RTA patients between May 2024 and December 2024. When the gender distribution of clinical head injury patients is analyzed, as shown in **Figure 1 (a)**. The male experiences head injury cases have been detected more than females. The gender distribution graph indicated that males are more susceptible to brain injuries.

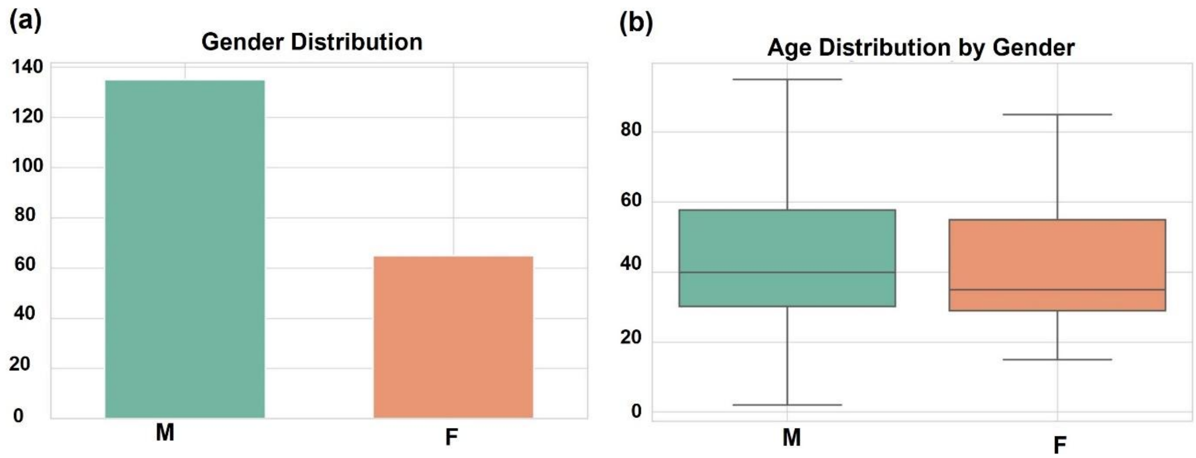

Figure 1: (a) Gender distribution, **(b)** The age distribution by gender.

The gender-specific age distribution also shows that there are notable differences in the occurrence of head injuries between age groups males and females as shown in **Figure 1 (b)**. All age groups of both males and females were included. However, the maximum age proportion was notably (30–59, years) in males and (25–55, years) females.

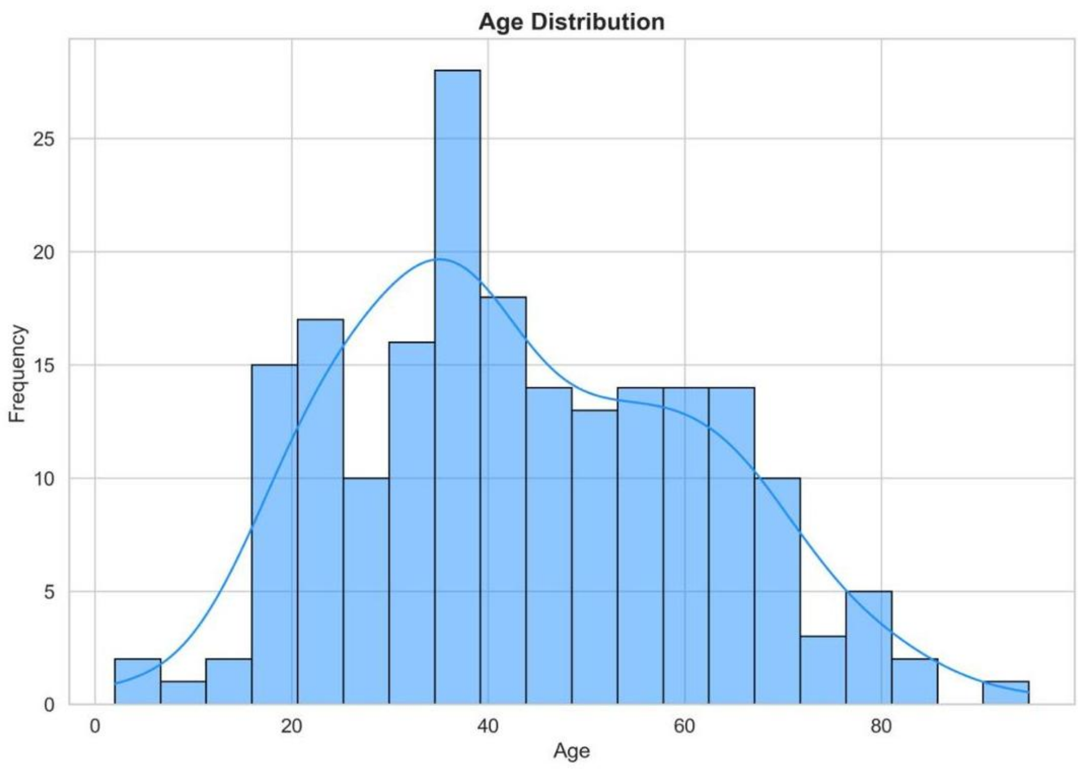

Figure 2: Histogram with a density curve showing the age distribution.

The age distribution of clinical head injury patients is depicted by a histogram with a density curve as shown in **Figure 2**. The x-axis displays age, broken down into boxes like 0–10, 10–20, and so forth, and the y-axis showed the frequency of people in each age range. For the age group of 35 to 40, the tallest bar represents the highest concentration of patients in this group. The density curve provides a smoothed visualization of the age distribution, highlighting trends and central tendencies in the dataset. The result displayed that the prevalence of head injuries varies by age group, with the highest prevalence in the 35–40 age range, indicating that individuals in this age group are disproportionately affected in comparison to other age groups. The density curve also showed the general trend in the age distribution, indicating a central tendency towards middle-aged individuals. These findings highlight the need for age-specific preventive measures and focused clinical interventions to address the burden of head injuries in high-risk age groups.

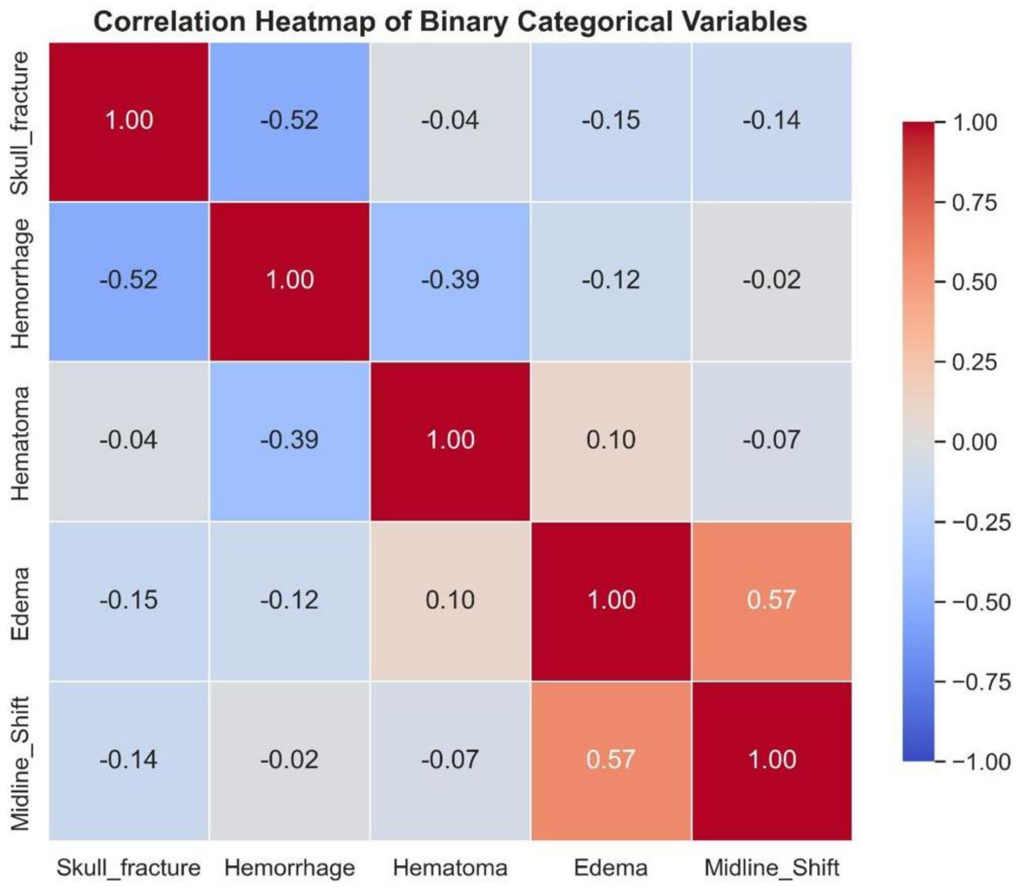

Figure 3: This heatmap showed five binary medical problems connected to head injuries. Skull Fracture, Hemorrhage, Hematoma, Edema, and Midline Shift-correlate with one another. Perfect self-correlation is represented the strong positive relationship, whereas the relationship between various conditions is depicted by off-diagonal values. Positive correlations are denoted by red color with diagonal value (1.00). Blue colors denote negative correlations (-1.00), when one happens, the other is unlikely. The white or light gray displayed suggested no relationship (0.00).

The heatmap analysis of correlations between clinical head injury conditions revealed significant relationships among key variables as shown in **Figure 3**. A moderate negative correlation was observed between Skull Fracture and Hemorrhage (-0.52), suggesting that the presence of a skull fracture reduced the correlation brain bleeding. Conversely, Edema and Midline Shift showed a moderate positive correlation (0.57), indicating that swelling in the brain is often associated with displacement of the brain's position. Weak correlations, such as between Skull Fracture and Hematoma (-0.04), suggest minimal interaction between these variables. The findings highlight specific patterns, such as the interplay between swelling (Edema) and structural displacement (Midline Shift), which are critical for understanding the complex relationships between head injury conditions. These insights can inform targeted diagnostic and therapeutic strategies.

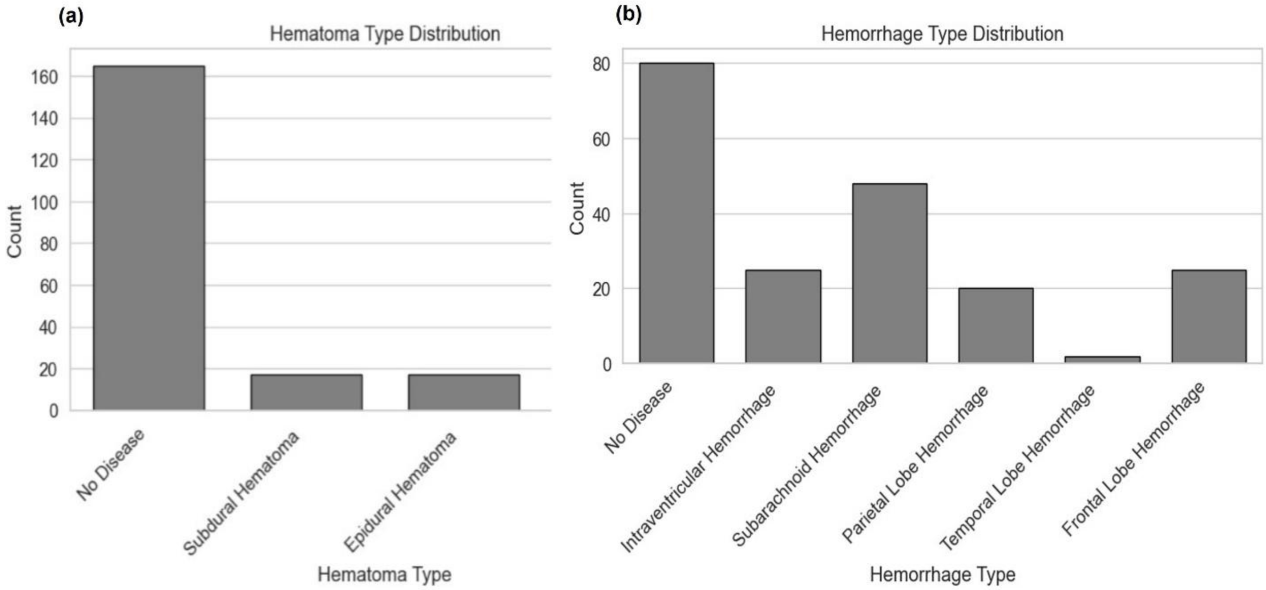

Figure 4: (a) The frequency of hematoma type distribution. **(b)** Hemorrhage type distribution.

Hematoma type distribution graph showed the disease or no disease patients' response. According to **Figure 4 (a**) the hematoma types included 166 patients no disease and disease patients have similar prevalence around 17 number subdural hematoma and epidural hematoma patients. Hemorrhage type distribution graph showed the response in disease or no disease patients. According to **Figure 4 (b**) 80 patients were included in no disease and in disease patient of different hemorrhage types. These types were included intraventricular hemorrhage 25 patients, subarachnoid hemorrhage 48 patients, parietal lobe hemorrhage 20 patients, temporal lobe hemorrhage 3 patients, frontal lobe hemorrhage 24 patients. However, the highest prevalence of hemorrhage type is subarachnoid hemorrhage.

4. Discussion

The CT scan has been transformed the field of neuroradiology for head injury and had a major impact on management techniques. We have confirmed that young men are the most impacted by head injury using CT imaging. Furthermore, our results displayed that the overall mortality rate among injury patients varies according to the type of head injury that was sustained. According to previous studies, 64% of patients in traffic accidents suffered head injuries. The head injury from traffic accidents is associated with productive years of life (13). In our study, the maximum age proportion showed (30–59, years) in males and (25–55, years) females. However, the head trauma was more common in men than in women, most likely because of men's increased exposure to outdoor activities and traffic in Pakistan. These results are consistent with Bharti et al., who found that men were involved in 85% of head injury cases (13).Because they are more likely to be exposed to traffic and work-related risks during their prime years, this age group probably makes up the majority. Moreover, our results confirmed that the prevalence of head injuries varied by age with the highest prevalence in the 35–40 age range. The clinical data's distribution patterns of hematoma and hemorrhage types presented important information about the clinical manifestations of head injuries. The variation in hematoma types is consistent with earlier research showing that intracranial hematomas frequently depend on the site and severity of trauma, indicating that injury mechanisms may disproportionately contribute to hematoma subtypes (14). In our study we found that the prevalence of hematoma types included 166 patients no disease and disease patients have similar count in subdural hematoma and epidural hematoma patients. The frequency of hemorrhage types also focused diagnostic approaches by reflecting the intricate relationship between trauma severity and vascular integrity (15). The research on pathophysiology of traumatic brain injuries also confirmed the relatively strong association between brain displacement (Midline Shift) and swelling (Edema) emphasizes the significance of prompt intervention to control intracranial pressure (16). In contrast, the probability of vascular damage is supported by the negative correlation between skull fracture and hemorrhage (17). Many researcher reported that the incidence of traumatic subarachnoid hemorrhage ranges from 12% to 44% (18,19). The epidural hematomas were most commonly found in the temporo-parietal area (4). Moreover, the epidural hematomas also had a skull fracture around in the 90% of patients (20). The linear fractures are frequently associated with epidural hematomas. Similarly, the epidural hematomas and subdural hematomas were found same count in 20% of cases. Mortality has been associated to epidural hematoma in 24% patients and global cerebral edema in 50% patients (21,22). These findings highlight the clinical value of classifying different types of head injuries to improve diagnosis and treatment plans. Future studies should examine the biological connections between trauma mechanisms and hematoma and hemorrhage subtypes, as well as how sophisticated imaging methods can enhance subtype identification and outcome prediction. Personalized medicine strategies for treating head injuries will be improved by combining these findings with patient-specific data.

5. Conclusion

CT scan has been used for precise examination of brain injuries from road accidents. Because CT scans are quick, accurate, and non-invasive, they are now the main imaging method used to evaluate brain injuries. CT scans have become crucial for diagnosing and treating head injuries sustained in road accidents. They provide vital information that directs treatment choices and aids in accurately predicting patient outcomes. In road head injury were examined mostly in males than females. The age range of 35 to 40 years old has the tallest bar in blue curve histogram, indicating that this is the most prevalent age range in the sample. There are less people who are very young (less than ten years old) and older (more than eighty years old). We analyzed the different kinds of head injury and correlation among them. Skull Fracture and Hemorrhage showed the moderate negative correlation. Skull fractures may reduce the likelihood of brain bleeding. Similarly. Edema and Midline Shift showed the moderate positive correlation. It caused a shift in brain position due to swelling. However, skull fracture and hematoma have not shown any correlation among them.

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