

# Chi-Square Test of Association

Association of CT Scan Findings and Glasgow Coma Scale scores as Initial Evaluation

## Descriptive Analysis

Table 1. Frequency and percentage distribution of the results obtained from data collection.

Variable	Frequency	Percentage
<b>AGE GROUPS</b>		
Children (3 – 16 yo)	7	4%
Young Adults (17 – 30 yo)	13	7%
Middle-Aged Adults (31 – 45 yo)	15	8%
Old Adults (>45 yo)	156	82%
<b>SEX</b>		
Female	103	54%
Male	88	46%
<b>MECHANISM OF INJURY</b>		
Fall (Unwitnessed, Slip, From standing height, Mauling)	141	74%
Multi Vehicular Accident	30	16%
Blunt/Head Trauma	20	10%
<b>GCS SCORE</b>		
Mild (13-15)	142	74%
Moderate (9-12)	38	20%
Severe (3-8)	11	6%
<b>CLINICAL FINDINGS (Primary)</b>		
None	140	73%
Loss of Consciousness	13	7%
Headache	13	7%
Weakness	11	6%
Dizziness	9	5%
Nausea and Vomiting	5	3%
<b>CT SCAN RESULTS</b>		
Positive	70	37%
Negative	121	63%
<b>CT SCAN FINDINGS</b>		
No Findings	121	63%
Brain Contusion	39	20%
Subdural Hematoma	26	14%
Skull Fracture	18	9%
Secondary Brain Injuries and Herniation	10	5%
Subarachnoid Hemorrhage	9	5%
Intraventricular Hemorrhage	3	2%
Subdural Hygroma	2	1%

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### Association of CT Scan Findings and Glasgow Coma Scale scores as Initial Evaluation

The summary in Table 1 characterizes the sample concerning injury demographics, mechanisms, and outcomes. The majority of individuals are classified as older adults aged over 45 years (82%), with a slightly higher prevalence of females (54%). Falls, including unwitnessed incidents, slips, and falls from standing height, represent the predominant mechanism of injury (74%). Regarding injury severity, most cases exhibit mild GCS scores between 13 and 15 (74%), with fewer classified as moderate with scores between 9 and 12 (20%) or severe with scores of less than 8 (6%).

Clinically, 73% of patients present without primary findings, while a minority experience symptoms such as loss of consciousness, headache, or dizziness. CT scans reveal positive findings in 37% of cases, with the most common abnormalities being brain contusion (20%), subdural hematoma (14%), and skull fractures (9%). Despite this, 63% of scans show no abnormalities.

### Objective 1: To describe the demographics of patients with trauma-induced brain injury in VMHC.

Table 2 presents the demographic distribution of the study population, categorized by age groups and sex. The largest proportion of the population (82%) falls within the "Old Adults" category (aged >45 years), with a greater representation of females (46%) compared to males (36%). Middle-aged adults (31–45 years) represent 8% of the sample, with equal contributions from both sexes (4% each). Young adults (17–30 years) constitute 7% of the total, with females (3%) slightly outnumbered by males (4%). Children (3–16 years) account for the smallest proportion, at 4%, with males (3%) comprising a larger share than females (1%). This distribution highlights the predominance of older adults and females in the study population, providing insights into the demographic trends observed. With a p-value of 0.5044, the data shows no significant association between age groups and sex.

**Table 2. Frequency and percentage distribution of age group by sex (n = 191).**

AGE GROUPS	SEX		TOTAL
	Female	Male	
Children (3 – 16 yo)	2 (1%)	5 (3%)	7 (4%)
Young Adults (17 – 30 yo)	6 (3%)	7 (4%)	13 (7%)
Middle-Aged Adults (31 – 45 yo)	8 (4%)	7 (4%)	15 (8%)
Old Adults (>45 yo)	87 (46%)	69 (36%)	156 (82%)
<b>TOTAL</b>	<b>103 (54%)</b>	<b>88 (46%)</b>	<b>191 (100%)</b>
Female Age Range: 14 – 99 yo	Female Mean Age: 67±20 yo	Female Median Age: 72 yo	Chi-Square p-value: 0.5044
Male Age Range: 4 – 92 yo	Male Mean Age: 60±21 yo	Male Median Age: 65 yo	
	Overall Mean Age: 64±21 yo	Overall Median Age: 69 yo	

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**Objective 2. To describe the demographics according to the causes of head injury in VMHC.**

The table below provides a comprehensive analysis of the patients demographic distribution and associated injury mechanisms. Falls (Unwitnessed, Slip, From standing height, Mauling) emerge as the most prevalent injury mechanism, accounting for 74% of all cases, with a slightly higher frequency among females (43%) compared to males (31%). Conversely, MVA and blunt/head trauma are more common among males, at 10% and 5%, respectively, compared to females at 5% and 6%.

Age-related trends are similarly notable. Older adults (>45 years) comprise the largest age group (82%), experiencing the majority of falls (65%) and substantial proportions of MVA and blunt/head trauma cases. In contrast, injuries among children (3–16 years) and young adults (17–30 years) are less frequent, collectively accounting for 11% of the sample across all injury mechanisms.

Statistical analysis using chi-square tests indicates significant differences in the distribution of injury mechanisms across sex ( $p = 0.0463$ ,  $V = 0.20$ ) and age groups ( $p < 0.0001$ ,  $V = 0.28$ ), confirming a meaningful association between demographic characteristics and injury patterns. Sex was found to be strongly associated with the mechanism of injury, while age group was found to be strongly associated based on their Cramer's V values. These findings underscore the need for targeted strategies to mitigate injury risks, particularly among older adults. It is important to take note that children were excluded from the analysis because of data issue particularly a zero occurrence in MVA.

**Table 3. Frequency and percentage distribution of mechanism of injury by sex and age groups (n=191).**

GROUPS	MECHANISM OF INJURY			TOTAL
	FALL	MVA	BLUNT/HEAD TRAUMA	
SEX				
Female	82 (43%)	10 (5%)	11 (6%)	103 (54%)
Male	59 (31%)	20 (10%)	9 (5%)	88 (46%)
AGE GROUPS				
Children (3 – 16 yo)	4 (2%)	-	3 (2%)	7 (4%)
Young Adults (17 – 30 yo)	6 (3%)	6 (3%)	1 (1%)	13 (7%)
Middle-Aged Adults (31 – 45 yo)	6 (3%)	8 (4%)	1 (1%)	15 (8%)
Old Adults (>45 yo)	125 (65%)	16 (8%)	15 (8%)	156 (82%)
TOTAL	141 (74%)	30 (16%)	20 (10%)	191 (100%)

Sex Chi-Square p-value: 0.0463 ( $V = 0.20$ )

Age Groups Chi-Square p-value: <0.0001 ( $V = 0.28$ )

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**Objective 3. To determine the distribution of patients according to severity of head injuries based on GCS scores**

Table 4 summarizes the distribution of Glasgow Coma Scale (GCS) scores across sex and age groups of the patients. Mild injuries (GCS 13–15) are the most common, representing 74% of the total, while moderate (GCS 9–12) and severe (GCS 3–8) injuries account for 20% and 6%, respectively.

By sex, females make up 54% of the population, with 42% having mild injuries, 9% moderate, and 3% severe. Males comprise 46% of the population, with 32% classified as mild, 10% as moderate, and 3% as severe. Older adults (>45 years) dominate the sample at 82%, with 59% categorized as mild, 17% moderate, and 5% severe. Middle-aged adults (31–45 years) account for 8% of the total, followed by young adults (17–30 years) at 7% and children (3–16 years) at 4%. Most injuries in younger age groups are mild.

Chi-square tests reveal nonsignificant differences in GCS score distributions by sex ( $p = 0.5200$ ). Because of nonoccurrence, age group is not valid to be tested against GCSs core classification.

**Table 4. Frequency and percentage distribution of classification based on GCS score by sex and age groups (n=191).**

GROUPS	GCS Score			TOTAL
	MILD (13 - 15)	MODERATE (9 - 12)	SEVERE (3 - 8)	
SEX				
Female	80 (42%)	18 (9%)	5 (3%)	103 (54%)
Male	62 (32%)	20 (10%)	6 (3%)	88 (46%)
AGE GROUPS				
Children (3 – 16 yo)	7 (4%)	-	-	7 (4%)
Young Adults (17 – 30 yo)	11 (6%)	1 (1%)	1 (1%)	13 (7%)
Middle-Aged Adults (31 – 45 yo)	11 (6%)	4 (2%)	-	15 (8%)
Old Adults (>45 yo)	113 (59%)	33 (17%)	10 (5%)	156 (82%)
TOTAL	142 (74%)	38 (20%)	11 (6%)	191 (100%)

Sex Chi-Square p-value: 0.5200

Age Groups Chi-Square p-value: NA

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### Objective 4. To determine the prevalence of CT scan abnormalities according to demographics

Table 5 summarizes the frequency and percentage distribution of CT scan findings, categorized by sex and age groups. Positive findings were observed in 37% of the 191 individuals, while 63% showed negative results. Stratification by sex reveals comparable proportions of positive findings between females (18%) and males (19%). Similarly, the distribution of negative findings was relatively balanced, with females accounting for 36% and males for 27%.

In terms of age group analysis, older adults (>45 years) accounted for the majority of the population (82%) and exhibited the highest proportion of positive findings (31%) and negative findings (51%). Children (3–16 years), young adults (17–30 years), and middle-aged adults (31–45 years) collectively accounted for the remaining 18% of the population. Positive findings were relatively infrequent among these groups, at 1%, 2%, and 3%, respectively.

Statistical analysis using chi-square tests revealed no significant differences in CT scan findings by sex ( $p = 0.3277$ ) or age group ( $p = 0.9070$ ). These results suggest that the distribution of CT scan findings is not influenced by either sex or age group in this population.

**Table 5. Frequency and percentage distribution of CT scan findings by sex and age groups (n=191).**

GROUPS	CT SCAN FINDINGS		TOTAL
	Positive	Negative	
SEX			
Female	34 (18%)	69 (36%)	103 (54%)
Male	36 (19%)	52 (27%)	88 (46%)
AGE GROUPS			
Children (3 – 16 yo)	2 (1%)	5 (3%)	7 (4%)
Young Adults (17 – 30 yo)	4 (2%)	9 (5%)	13 (7%)
Middle-Aged Adults (31 – 45 yo)	5 (3%)	10 (5%)	15 (8%)
Old Adults (>45 yo)	59 (31%)	97 (51%)	156 (82%)
TOTAL	70 (37%)	121 (63%)	191 (100%)

Sex Chi-Square p-value: 0.3277

Age Groups Chi-Square p-value: 0.9070

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### Objective 5. To describe the causes of head injury of patients in relation to their GCS scores in VMMC

The table below provides a breakdown of the GCS scores by mechanism of injury for the 191 cases. Falls constitute the predominant injury mechanism, accounting for 74% of cases, with 53% classified as mild injuries, 15% as moderate, and 5% as severe. Multi-vehicular accidents represent 16% of injuries, predominantly mild (12%), with a smaller share categorized as moderate (4%) and severe (1%). Blunt/head trauma makes up 10% of cases, all of which are either mild (9%) or moderate (1%).

Across all mechanisms, mild injuries dominate the distribution, comprising 74% of all cases, followed by moderate (20%) and severe (6%) injuries. The Chi-square test ( $p = 0.4221$ ) indicates no statistically significant differences in the distribution of GCS scores across the mechanisms of injury. These findings underline the prevalence of mild injuries across injury mechanisms and the critical role of falls as the leading cause of trauma in this population.

**Table 6. Frequency and percentage distribution of classification based on GCS score by mechanism of injury (n=191).**

MECHANISM OF INJURY	GCS Score			TOTAL
	MILD (13 - 15)	MODERATE (9 - 12)	SEVERE (3 - 8)	
Fall	102 (53%)	29 (15%)	10 (5%)	<b>141 (74%)</b>
Multi-Vehicular Accident	22 (12%)	7 (4%)	1 (1%)	<b>30 (16%)</b>
Blunt/Head Trauma	18 (9%)	2 (1%)	-	<b>20 (10%)</b>
<b>TOTAL</b>	<b>142 (74%)</b>	<b>38 (20%)</b>	<b>11 (6%)</b>	<b>191 (100%)</b>

*Chi-Square p-value: 0.4221*

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### Objective 6. To describe the clinical findings in relation to GCS score in VMMC

The absence of clinical findings is most prevalent across all GCS categories, constituting 73% of the total population. Loss of consciousness is significantly associated with severe injuries, representing 5% of the total cases but disproportionately occurring among those with severe GCS scores. Headache is more common in mild (5%) and moderate (2%) categories, while dizziness and weakness predominantly appear in moderate cases (3% and 4%, respectively). Nausea and vomiting are rare across all categories, collectively accounting for only 3% of the population.

**Table 7. Distribution of clinical findings based on GCS score (n=191).**

CLINICAL FINDINGS	GCS Score			TOTAL
	MILD (13 - 15)	MODERATE (9 - 12)	SEVERE (3 - 8)	
None	121 (63%)	19 (10%)	-	140 (73%)
Loss of Consciousness	3 (2%)	1 (1%)	9 (5%)	13 (7%)
Headache	9 (5%)	4 (2%)	-	13 (7%)
Weakness	3 (2%)	8 (4%)	-	11 (6%)
Dizziness	4 (2%)	5 (3%)	-	9 (5%)
Nausea and Vomiting	2 (1%)	1 (1%)	2 (1%)	5 (3%)
<b>TOTAL</b>	<b>142 (74%)</b>	<b>38 (20%)</b>	<b>11 (6%)</b>	<b>191 (100%)</b>

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**Objective 7. To identify the CT scan findings in all the spectrum of GCS scores of patients.**

The most frequent observation was negative, comprising 63% of cases, with the majority seen in the mild GCS category (56%). Positive findings were observed in 37% of the population, with the most common abnormalities being brain contusion (20%), subdural hematoma (14%), and skull fractures (9%). Other findings, including secondary brain injuries and herniation (5%), subarachnoid hemorrhage (5%), intraventricular hemorrhage (2%), and subdural hygroma (1%), occurred less frequently.

The distribution of CT scan findings demonstrates distinct patterns across GCS categories. Brain contusions were most frequently identified in the mild GCS category (10%), while subdural hematomas were relatively evenly distributed among mild and moderate GCS scores. Skull fractures were more prevalent in the moderate category (4%). Rare findings such as subarachnoid hemorrhage, intraventricular hemorrhage, and subdural hygroma were observed exclusively in mild or moderate GCS cases, collectively accounting for less than 5% of the total dataset.

Chi-square tests show that presence of brain contusion, subdural hematoma, and skull fracture or absence of any findings are significantly associated with the GCS score classification ( $p < 0.0001$ ). P-values are marked as "NA" for CT scan findings that either did not occur or accounted for at most 5% of the data. This limitation reflects the low frequency of these findings, which precluded statistical testing.

**Table 8. Frequency and percentage distribution of classification based on GCS score and CT scan findings (n=191).**

CT SCAN FINDINGS	GCS Score			TOTAL	p-value
	MILD (13 - 15)	MODERATE (9 - 12)	SEVERE (3 - 8)		
Negative	107 (56%)	13 (7%)	1 (1%)	<b>121 (63%)</b>	<0.0001
Brain Contusion	20 (10%)	11 (6%)	8 (4%)	<b>39 (20%)</b>	<0.0001
Subdural Hematoma	8 (4%)	13 (7%)	5 (3%)	<b>26 (14%)</b>	<0.0001
Skull Fracture	6 (3%)	8 (4%)	4 (2%)	<b>18 (9%)</b>	<0.0001
Secondary Brain Injuries and Herniation	4 (2%)	4 (2%)	2 (1%)	<b>10 (5%)</b>	NA
Subarachnoid Hemorrhage	-	6 (3%)	3 (2%)	<b>9 (5%)</b>	NA
Intraventricular Hemorrhage	2 (1%)	1 (1%)	-	<b>3 (2%)</b>	NA
Subdural Hygroma	1 (1%)	-	1 (1%)	<b>2 (1%)</b>	NA