




# Pattern of Injuries in Children with Epilepsy: A Hospital-Based Case-Control Study

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Int J Ep 2024;10:35–43.

## Abstract

**Objective** The aim of this study is to examine the profile and pattern of injuries in children with epilepsy (CWE) as compared with healthy controls.

**Materials and Methods** This prospective, cross-sectional study conducted over 1 year in a tertiary care pediatric center included consecutive CWE aged 4 to 16 years who had active seizures during the preceding 1 year. A similar number of age- and sex-matched healthy controls were enrolled. Children with acute symptomatic seizures or degenerative neurologic disorders were excluded. Standardized scales were used to assess intelligent quotient, psychopathology, seizure severity, and restriction of daily activities.

**Results** Two hundred and eight CWE (mean age:  $107 \pm 37$  months; range: 3.5–16 years) and an equal number of healthy controls (mean age:  $108 \pm 43$  months; range: 3.5–16 years;  $p = 0.07$ ) were evaluated. The majority of CWE had generalized epilepsy ( $n = 117$ , 59.6%) followed by focal epilepsy ( $n = 84$ , 40.3%). The mean duration of epilepsy was  $47.4 \pm 36.3$  months. The prevalence of injury was significantly greater in CWE ( $n = 118/208$ , 56.7%) compared with controls ( $n = 56/208$ , 26.9%;  $p < 0.001$ ). CWE suffered significantly greater number of 293 injuries in the past 1 year in contrast to 83 injuries in controls ( $p < 0.001$ ). In CWE, the majority of injuries were unrelated to seizures ( $n = 85/118$ , 72%, 211 injuries), while only one-third ( $n = 33/118$ , 27.9%, 82 injuries) suffered seizure-related injuries. The incidence of injuries unrelated to seizures and that of seizure-related injuries were similar (2.48 seizure-related injuries per person per year). Among CWE, a comparison of the injury versus noninjury group showed a significantly longer duration of epilepsy ( $53 \pm 34$  vs.  $40 \pm 38$  months,  $p < 0.007$ ), higher prevalence of underlying structural etiology in generalized epilepsy (34.7 vs. 13.3%,  $p < 0.001$ ), higher mean seizure severity and restriction of daily activity scores, and higher prevalence of hyperactivity (36.4 vs. 18.9%,  $p = 0.006$ ) and intellectual disability (35.6 vs. 10%,  $p < 0.001$ ) in the injury group. Injuries on the head, face, and

## Keywords

- ▶ children with epilepsy
- ▶ injury
- ▶ trauma
- ▶ seizures
- ▶ childhood epilepsy

article published online  
October 24, 2024

DOI <https://doi.org/10.1055/s-0044-1791782>.  
ISSN 2213-6320.

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upper limb were significantly more in CWE as compared with controls, and tongue injuries were found only in CWE ( $p = < 0.05$ ), and were seen significantly more as seizure-related injury ( $n = 7$  vs.  $1$ ,  $p < 0.001$ ) compared with non-seizure-related injuries. The majority of injuries in children with CWE and controls were mild in nature ( $n = 112$ , 53.8% vs.  $n = 54$ , 26%;  $p < 0.001$ ).

**Conclusions** The prevalence of injuries among CWE aged between 4 and 16 years is high and is significantly greater than in healthy controls, although the majority of injuries are mild in severity in both and are non-seizure-related injuries. Longer duration of epilepsy, higher seizure severity, and restriction of daily activities, and higher prevalence of underlying structural etiology, hyperactivity, and intellectual disability are associated with injuries in CWE.

## Introduction

Epilepsy is the most common neurological disorder in children, affecting 0.5 to 1% children globally.<sup>1</sup> It is estimated that nearly 1 out of 150 children is diagnosed with epilepsy during the first 10 years of life.<sup>2</sup> Children with epilepsy (CWE) are considered to be at an increased risk of accidental injuries as compared with the general population, and this risk increases with the duration of epilepsy. A proportion of these injuries is seizure related and differs in children versus adults due to their surroundings and expanse of activity.<sup>3</sup> The risk of injury in epilepsy has received less attention than the risk of death. Seizure-related injuries have been estimated variably from 4 to 70% of CWE.<sup>4–6</sup> The obsolete terms “falling sickness,” or *morbus caduceus* in Latin once ascribed to epilepsy attest to the prominence of falls and injuries in patients suffering from some forms of epilepsy. The commonly reported seizure-related incidents include road traffic accidents, drowning, near drowning, burns, fractures, head injury, dental injury, and soft-tissue injury, especially in adults.<sup>7</sup> The presence of comorbidities such as cognitive impairment and presence of any psychopathology, cognitive side effects of anti-seizure medications (ASM), frequent seizures, specific type of seizures (such as generalized tonic-clonic seizures [GTCS] and atonic seizures), poor socioeconomic status, lack of general safety measures, and poor awareness of the potential harm increase the risk of these injuries.<sup>5,8,9</sup>

Studies addressing this important issue of injuries in people with epilepsy have been conducted predominantly in the adults. A person with epilepsy has a 5% chance per year of visiting an emergency department due to seizure-related injury.<sup>10,11</sup> The risk of accidental injuries leads to people with epilepsy being subjected to employment, recreational, and driving restrictions. These limitations have personal and social consequences, leading to inactivity, isolation, and dependency.<sup>12</sup> Childhood is an accident-prone age. Evidently, CWE also need appropriate precautions and restrictions to reduce injury. The risk of accidental injury in patients with intellectual disabilities or psychopathology is higher.<sup>13</sup> However, without knowing where the actual risks lie, excessive worry by the parents can lead to overprotection and subsequent loss of independence, impaired social development,

and potentially increased psychiatric comorbidities.<sup>14</sup> Conclusive data must be obtained regarding the risk of injury in CWE to establish proper guidelines. Studies using adequate controls are necessary to compare the risk of injuries with the general population.<sup>14</sup> Hence, we undertook this case control study to ascertain the profile and pattern of injuries in CWE seen at our center and compare their injury profile with healthy controls.

## Methods

This cross-sectional, prospective study was conducted over a period of 1 year in a tertiary care pediatric center. The study was approved by the institute’s ethics committee. Consecutive children and adolescents (1) between ages 4 and 16 years, (2) who are diagnosed with epilepsy according to the International League Against Epilepsy criteria,<sup>15</sup> and (3) with history of seizure during the preceding 1 year of interview were enrolled. A similar number of age- and sex-matched children without epilepsy were enrolled as healthy controls from the outpatient clinic and among the healthy siblings. Children with (1) acute symptomatic seizures (e.g., metabolic disturbances, toxic exposure, active central nervous system [CNS] infection, or infestation) or (2) progressive or degenerative neurologic disorders (progressive myoclonic epilepsy, leukodystrophy, etc.) were excluded.

CWE fulfilling the inclusion criteria were enrolled in the study after taking a written informed consent, and assent where applicable, from the parents. Baseline sociodemographic, clinical, and investigation data were noted in a prestructured proforma. Socioeconomic status was evaluated using the modified Kuppuswamy socioeconomic status scale that is based on three parameters: education, occupation, and income of the family members.<sup>16</sup> The scale assigns a score to each of these three categories, with higher scores indicating higher socioeconomic status. CWE and their parents or guardians were asked details regarding their seizure types, frequencies, ASM used and duration of average seizure, accidents, and injuries in the preceding 1 year. In addition, study of available medical records was also done to fill in the missing information. For the purpose of the study, an accident was considered as any event resulting from

**Table 1** Classification of injury severity<sup>10,18,19</sup>

Injury	Mild	Moderate	Severe
Head injury	Amnesia or consciousness impaired for <30 min, no fracture	Consciousness impaired from 30 min–24 h, or skull fracture	Consciousness impaired for >24 h, intracranial hemorrhage, or surgical intervention
Burn	First degree	Second degree	Third degree
Contusion	Discoloration only	Discoloration and swelling	Surgical intervention required
Laceration	Superficial, no sutures	Superficial with sutures	Deep, involving muscle or fascia
Dental injury	Chipped tooth	Loss of tooth	Surgical intervention required
Joint dislocation	Subluxation	Complete dislocation	Fracture and dislocation
Fracture	Nondisplaced	Displaced	Compound
Other	–	–	Surgical intervention required

sudden unexpected cause leading to physical damage requiring medical attention or resulting in financial obligation.<sup>17</sup> Injury was defined as any dysfunction or pain in a body part resulting from an accidental occurrence.<sup>18</sup> The classification of injury severity was done as mild, moderate, and severe as shown in ► **Table 1**.<sup>10,18,19</sup>

Malin's Intelligence Scale for Indian Children (MISIC) was used to calculate the intelligence quotient (IQ).<sup>20</sup> The Strengths and Difficulties Questionnaire (SDQ) was used to assess the psychopathology in CWE. This scale is validated for children 3 to 16 years of age.<sup>21,22</sup> The response alternatives consist of 25 statements in the domains of emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior. Parents are asked to disagree (0), agree to some extent (1), or agree (2). The sum score of 20 items of all domains except prosocial behavior generates a total difficulty score with a range of 0 to 40. A score of at least 14 on the SDQ is considered abnormal. The Hague Seizure Severity Scale was used to assess the severity of seizures.<sup>23</sup> This scale consists of 13 items and answers are scored from 1 to 4. The items represent the following areas: consciousness (4 questions), motor symptoms (2 questions), incontinence (1 question), injuries/pain (3 questions), and overall seizure severity (3 questions). The parent-completed 10-item scale Hague Restrictions in Childhood Epilepsy Scale was used to study the limitation of daily life activities because of the child's epilepsy. The scale addresses eight specific activities of daily life divided into two parts: one for extra supervision needed and one for special precautions taken. Each item has four responses: 1 (most favorable) to 4 (most unfavorable). The total score ranges from 10 (no disabilities) to 40 (most severe disabilities).<sup>24</sup>

### Statistical Analysis

Based on data from published from the West, the reported prevalence of injuries in patients with epilepsy (seizure related or unrelated) ranged from 12 to 35%.<sup>7,9,25,26</sup> There is paucity of data from our population from India and is hugely variable. With a prevalence of 15% and a variation in the expected proportion of 5% on each side, an estimated sample size of 192 gave the study a confidence level of more

than 95%. Qualitative data were analyzed using the  $\chi^2$  test (chi-squared test). Normalcy of the data was checked. If data are normally distributed, *t*-test was applied; otherwise, the Mann–Whitney *U* test was applied. In more than two groups of variables, analysis of variance (ANOVA) test was applied for normally distributed data and Kruskal–Wallis test for skewed data. Pearson's correlation coefficient was used to assess the correlation of factors with injuries in CWE. The statistical analysis was performed using Statistical Package for Social Sciences, version 15 for windows (SPSS Inc., Chicago, IL, United States).

### Results

We included 208 CWE and an equal number of controls. The mean age of the CWE group was  $107 \pm 37$  months (range: 42–192 months) and that of the control group was  $108 \pm 43$  months (range: 42–192 months,  $p = 0.07$ ). For the purpose of analysis, the children were further divided into three age ranges: below 5 years of age, 5 to 10 years, and older than 10 years. The majority of CWE were between 5 and 10 years of age. There was a male preponderance in both the groups: 145 males (69%) among CWE and 132 males (63%) among controls ( $p = 0.1$ ). The population was predominated by the middle socioeconomic group in both CWE ( $n = 134$ , 64.4%) and controls ( $n = 128$ , 61.5%), which represents the common population served by our center (► **Table 2**).

### Epilepsy, Comorbidities, and ASM Characteristics of CWE

The most common seizure types were generalized ( $n = 82$ , 39.4%), focal ( $n = 58$ , 27.9%), and focal to bilateral tonic-clonic ( $n = 22$ , 10.6%; ► **Table 3**). Overall,  $n = 117$  (59.6%) had generalized epilepsy, of which  $n = 53$  (42.7%) had a structural cause, while  $n = 84$  (40.3%) had focal epilepsy, of which  $n = 40$  (47.6%) had a structural cause. The mean duration of epilepsy was  $47.4 \pm 36.3$  months. The majority of CWE were on a single ASM ( $n = 148$ , 71.2%); only 14 children (6.8%) were on three or more drugs. Using standardized scales for assessment, several comorbidities were ascertained in CWE. Although the majority of CWE had an IQ  $\geq 70$  ( $n = 157$ , 75.4%), one-fourth had an IQ less than 69

**Table 2** Comparison of baseline characteristics between children with epilepsy and controls

Variables	Children with epilepsy (n = 208)	Controls (n = 208)	p value
Children with injury	118 (56.7%)	56 (26.9%)	<0.001
Mean ( $\pm$ SD) age	107 $\pm$ 37 mo	108 $\pm$ 43 moths	0.07
<b>Age groups</b>			
< 5 y	27 (13%)	26 (12.5%)	0.06
5–10 y	107 (51.4%)	89 (42.8%)	
> 10 y	74 (35.6%)	93 (44.7%)	
Male gender	145 (69.7%)	132 (63.5%)	0.1
School going	175 (84.1%)	183 (88%)	0.2
Nuclear family	108 (51.9%)	106 (51%)	0.8
<b>Socioeconomic status</b>			
Lower	1 (0.5%)	1 (0.5%)	0.7
Upper lower	52 (25%)	65 (31.3%)	
Lower middle	50 (24%)	61 (29.3%)	
Upper middle	84 (40.4%)	67 (29.3%)	
Upper	21 (10.1%)	14 (6.7%)	
<b>Developmental delay</b>			
None	158 (76%)	–	–
Mild delay	10 (4.8%)		
Significant delay	40 (19.2%)		

Abbreviation: SD, standard deviation.

( $n = 51$ , 24.5%) on the MISIC scale. Of these, almost half of the CWE ( $n = 26$ , 12.5%) had significant intellectual disability with an IQ of less than 55. Besides this, hyperactivity ( $n = 60$ , 28.8%) and behavioral ( $n = 64$ , 30.7%) problems were seen in nearly one-third of CWE.

#### Comparison of Epilepsy, Comorbidities, and ASM Characteristics of CWE with and without Injuries

As stated earlier, there were 118 (56.7%) CWE with injuries, while the rest of them ( $n = 90$ , 43.2%) did not have any injuries ( $\rightarrow$  **Table 4**). On comparing these two groups, the mean age and gender distribution were similar in these groups. The mean duration of epilepsy ( $53 \pm 34$  vs.  $40 \pm 38$  months,  $p < 0.007$ ) and the prevalence of underlying structural etiology among children with generalized epilepsy ( $n = 41$ , 34.7%, vs.  $n = 12$ , 13.3%,  $p < 0.001$ ) was significantly greater in “CWE and injuries.” The mean seizure severity scores and restriction of daily activities were also significantly greater in the injury group as compared with the noninjury CWE group ( $p < 0.05$ ). The comorbidities of hyperactivity (36.4 vs. 18.9%,  $p = 0.006$ ) and intellectual disability (35.6 vs. 10%,  $p < 0.001$ ) were significantly higher in the injury group as compared with the noninjury CWE group.

#### Correlation

Injuries in CWE significantly correlated with the presence of hyperactivity ( $p = 0.003$ ), intellectual impairment (IQ < 70,  $p = < 0.001$ ), developmental delay ( $p = < 0.001$ ), high frequency of seizures ( $p = < 0.001$ ), and structural generalized-onset epilepsy ( $p = 0.001$ ).

#### Injury Profile

There were 118 (56.7%) CWE who had any injury in the past 1 year, whereas only 56 (26.9%) controls had injury in the same time period ( $p < 0.001$ ;  $\rightarrow$  **Table 5**). CWE suffered a total of 293 injuries in the past 1 year in contrast to controls who reported only 83 injuries ( $p < 0.001$ ). Of the 118 CWE, 33 CWE suffered 82 seizure-related injuries in past (2.48 seizure-related injuries per person per year), whereas 85 CWE suffered 211 injuries not related to seizures (2.48 non-seizure-related injuries per person per year).

#### Site of Injuries on the Body

The most common site of injury in CWE was the head ( $n = 54$ , 26%), followed by the lower limb ( $n = 39$ , 18.8%) and the face and upper limb equally ( $n = 38$ , 18.3% each;  $\rightarrow$  **Table 5**;  $\rightarrow$  **Fig. 1**). In comparison, the most common site of injury in the controls was the lower limb ( $n = 31$ , 14.9%), followed by the upper limb ( $n = 22$ , 10.4%), the face ( $n = 10$ , 4.8%), and the head ( $n = 7$ , 3.4%). Injuries on the head, face, and upper limb were significantly more in CWE as compared with controls ( $\rightarrow$  **Table 4**), and tongue injuries were found in only CWE ( $p = < 0.05$ ).

CWE had multiple injuries on body regions: 54 CWE had 88 injuries on the head; 39 had 61 injuries on the lower limb; 38 had 58 injuries on the upper limb; 38 had 53 injuries on the face; 8 had 14 injuries on the tongue; and 9 had 16 dental injuries. The number of head ( $n = 33$  vs. 21,  $p < 0.001$ ), face ( $n = 25$  vs. 13,  $p < 0.001$ ), upper limb ( $n = 29$  vs. 9,  $p < 0.001$ ), and lower limb ( $n = 31$  vs. 8,  $p < 0.001$ ) injuries unrelated to

**Table 3** Epilepsy, comorbidities, and antiseizure medication (ASM) characteristics of children with epilepsy

Variables	Children with epilepsy (N = 208)
<b>Seizure type</b>	
Generalized onset	82 (39.4%)
Focal onset	58 (27.9%)
Focal to bilateral tonic-clonic	22 (10.6%)
Polymorphic	19 (9.1%)
Myoclonic	16 (7.7%)
Atonic	3 (1.4%)
<b>Epilepsy type</b>	
Generalized	53 (25.5%)
Structural	71 (34.1%)
Idiopathic	–
<b>Focal epilepsy</b>	
Structural	40 (19.2%)
Idiopathic	44 (21.1%)
Mean (± SD) duration of epilepsy in months	47.4 ± 36.3 months
Mean (± SD) seizure severity score	27 ± 7.1
Mean (± SD) restriction score	19.2 ± 8
<b>No. of ASM</b>	
Single ASM	148 (71.2%)
Two ASM	46 (22.1%)
≥3 ASM	14 (6.8%)
<b>Comorbidities</b>	
Intellectual impairment (IQ < 69)	51 (24.5%)
Hyperactivity	60 (28.8%)
Behavioral problems	64 (30.7%)
Emotional problems	15 (2.9%)
Conduct impairment	15 (7.2%)
Peer-related problems	7 (3.4%)

Abbreviations: IQ, intelligence quotient; SD, standard deviation.

seizures were significantly higher than seizure-related injuries in CWE. Tongue injuries, on the other hand, were significantly more often seen as seizure-related injuries ( $n = 7$  vs.  $1$ ,  $p < 0.001$ ) in CWE. Two children with injuries on the trunk had seizure-unrelated injury only.

**Type of Injuries**

The most common types of injuries in CWE were abrasions ( $n = 55$ , 26.4%), lacerations ( $n = 45$ , 21.6%), head injury ( $n = 36$ , 17.3%), contusions ( $n = 19$ , 9.1%), and burns ( $n = 12$ , 5.8%; ►Table 5; ►Fig. 1). In comparison, the most common injuries in the control group were abrasions ( $n = 36$ , 17.3%), lacerations ( $n = 12$ , 5.7%), and contusions ( $n = 10$ , 4.8%). All these injuries in CWE, namely head injury, burns,

lacerations, and abrasions were significantly more in CWE as compared with controls ( $p = < 0.05$ ; ►Table 4).

CWE had recurrent injury types: 36 CWE had 61 head injuries, 19 had 26 contusions, 45 had 65 lacerations, and 59 had 111 abrasions. The number of head injuries ( $n = 21$  vs.  $15$ ,  $p > 0.5$ ), contusions ( $n = 11$  vs.  $8$ ,  $p > 0.5$ ), lacerations ( $n = 29$  vs.  $16$ ,  $p > 0.5$ ), and abrasion injuries ( $n = 42$  vs.  $13$ ,  $p < 0.001$ ) unrelated to seizures were higher than seizure-related injuries in CWE. Dental injuries in CWE ( $n = 9$ , 4.3%), on the other hand, were seen only as seizure-related injury.

**Severity of Injuries**

The majority of injuries in children with CWE and controls were mild in nature ( $n = 112$ , 53.8% vs.  $n = 54$ , 26%,  $p < 0.001$ ; ►Table 5 and ►Fig. 1). Severe injury was not seen in controls, whereas it was seen in two CWE. Overall, mild and moderate injuries were statistically more in CWE as compared with controls. Seizure-related injuries were mild in 31/33 cases (93.9%), moderate in 8/33 cases (24.2%), and severe in CWE. None of the cases who had seizure-related injuries in the past 1 year at the time of interview.

**Place of Injury**

CWE got injured most commonly in their homes, followed by sports field and streets, as opposed to controls who got maximally injured in the sports field and streets (►Table 5 and ►Fig. 1).

**Activities during Injury**

In CWE, injuries occurred while sitting at a place in 15 (7.2%) featuring 19 events (of these, 8 were seizure related, while 11 were non-seizure related); while working in 2 (1%) and both unrelated to seizures; while studying in 4 (1.9%) featuring 4 events (half were seizure related); while playing in 83 (39.9%) leading to 186 events (of these, 20 were seizure related, while 63 were non-seizure related); while performing activities of daily living in 4 (1.9%) featuring 4 events (only 1 was a seizure-related injury); while watching television in 4 (1.9%) featuring 4 events (half were seizure related); and while performing other activities in 41 (19.7%) cases featuring in 76 injuries (of these, 16 were seizure-related injuries, whereas 25 CWE had injuries unrelated to seizures).

**Discussion**

Our study highlights important aspects of the profile and pattern of injury in CWE and provides a comparative analysis with healthy controls. CWE are considered to be at an increased risk of accidental injuries as compared with the general population. Our study provides important data in this regard that the prevalence of injuries in CWE is 56% and is more than double that of controls (27%). The total number of injuries suffered by CWE in 1 year was more than three times the number in the controls in our study, making the population of CWE extremely vulnerable to harm. CWE also had significant injuries both related and unrelated to seizures, although the majority of injuries were mild to moderate in severity in both CWE and controls. The prevalence of

**Table 4** Comparison of epilepsy, comorbidities, and ASM characteristics of CWE with and without injuries

Variables	Injured (N = 118)	Not injured (N = 90)	p value
Mean ( $\pm$ SD) age in months	109 $\pm$ 38	104 $\pm$ 39	0.3
Male gender	85 (72%)	60 (66.7%)	0.4
<b>Epilepsy type</b>			
<b>Generalized</b>			
Structural	41 (34.7)	12 (13.3)	<0.001
Idiopathic	34 (28.8)	37 (41.1)	0.06
<b>Focal epilepsy</b>			
Structural	21 (17.8)	19 (21.1)	0.5
Idiopathic	22 (18.6)	22 (24.4)	0.3
Mean ( $\pm$ SD) duration of epilepsy	53 $\pm$ 34 mo	40 $\pm$ 38 mo	0.007
Mean ( $\pm$ SD) seizure severity score	27.9 $\pm$ 7.1	25.7 $\pm$ 6.9	0.03
Mean ( $\pm$ SD) restriction score	20.7 $\pm$ 8.3	17.3 $\pm$ 7.2	0.003
No. of children on ASM monotherapy	76 (64.4%)	72 (80%)	0.07
Children with associated hyperactivity	43 (36.4%)	17 (18.9%)	0.006
Children with intellectual disability (IQ < 70)	42 (35.6%)	9 (10%)	<0.001

Abbreviations: ASM, antiseizure medication; CWE, children with epilepsy; IQ, intelligence quotient; SD, standard deviation.

injuries in CWE has been variable in national and international studies, estimated to be 12.6 to 35%, and sometimes as high as 70%,<sup>4-6,14,27-29</sup> probably owing to the type of cohort being studied and differences in the environment they are exposed to. Although some studies with a small number of patients have found no difference in the median number of injuries between cognitively normal CWE and controls,<sup>14,27</sup> such data may underestimate the burden of injuries due to the small sample size or inclusion of cognitively normal children or predominantly adult population. A large, prospective, multicentric study of 951 QWE and adults with epilepsy and 904 matched controls from referral centers of eight European countries, 21% patients and 14% controls reported an accident and one-fourth of these were seizure related in people with epilepsy.<sup>6</sup> Higher injury rates have been noted in studies involving multihandicapped patients,<sup>30</sup> children with severe epilepsies,<sup>30</sup> abnormal cognition, associated behavior problems,<sup>14</sup> or children under emergency care in an institutional setup<sup>28,31</sup> in contrast to those done in the general population,<sup>27</sup> and cognitively normal CWE without any handicap or comorbidity.<sup>10,28</sup> Additionally, in our study, non-seizure-related injuries were seen in nearly three-fourths (72%) of CWE, and only one-third (27.9%) suffered seizure-related injuries. The incidence of both types of injuries was similar (2.48 seizure-related injuries per person per year). Studies have variably attributed the prevalence of seizure-related injuries from 12 to 35%, similar to our estimates.<sup>3,6,10,14,25</sup> Studies done in children with new-onset epilepsy,<sup>14,25</sup> or cognitively normal CWE,<sup>14</sup> had lower seizure-related injuries than those done in combined adults and children.<sup>10</sup> It can be understandably assumed that children with older and more severe forms of epilepsy, especially with comorbidities, may have more injuries than newly diagnosed cases. Our study included

all consecutive children with active epilepsy and with abnormal cognition; therefore, these data are more representative of the sample population of CWE. Since the majority of CWE had non-seizure-related injuries, this may suggest that these children are at more risk of injuries and this component be kept in mind while planning their long-term management and parents should be made aware of these risks.

We also studied the profile of injuries in terms of severity, part of the body injured, and place and type of injury. The most common site of injury was the head in one-fourth of CWE, followed by the lower limb, face, and upper limb in nearly one-fifth cases each. Injuries on the head, face, and upper limb were significantly more in CWE as compared with controls, and tongue injuries were found only in CWE and were seen more significantly as seizure-related injuries compared with non-seizure-related injuries. This comprehensive information is very useful in identifying the potential risks and planning mitigation measures. Head injuries have been seen in up to 24 to 55% of all injury events in studies in adults.<sup>3,10,31</sup> The most common types of injuries in CWE were abrasion seen in one-fourth of the cohort, followed by lacerations and head concussions in nearly one-fifth each, followed by contusions and burns in a lesser number. All these common injuries in CWE, namely head injury, burns, lacerations, and abrasions, were significantly more in CWE as compared with controls and were seen more in injuries unrelated to seizures than seizure-related injuries in CWE, except for dental injuries, which were seen solely as seizure-related injuries. Contusions and lacerations have been noted to be the most common type of seizure-related injury in CWE, and an underlying structural etiology as well as use of a higher number of ASMs increased the risk of these seizure-related accidents.<sup>19</sup> A study on seizure-related injuries in 122 children younger than 18 years and with newly

**Table 5** Pattern of injury in children with epilepsy and controls

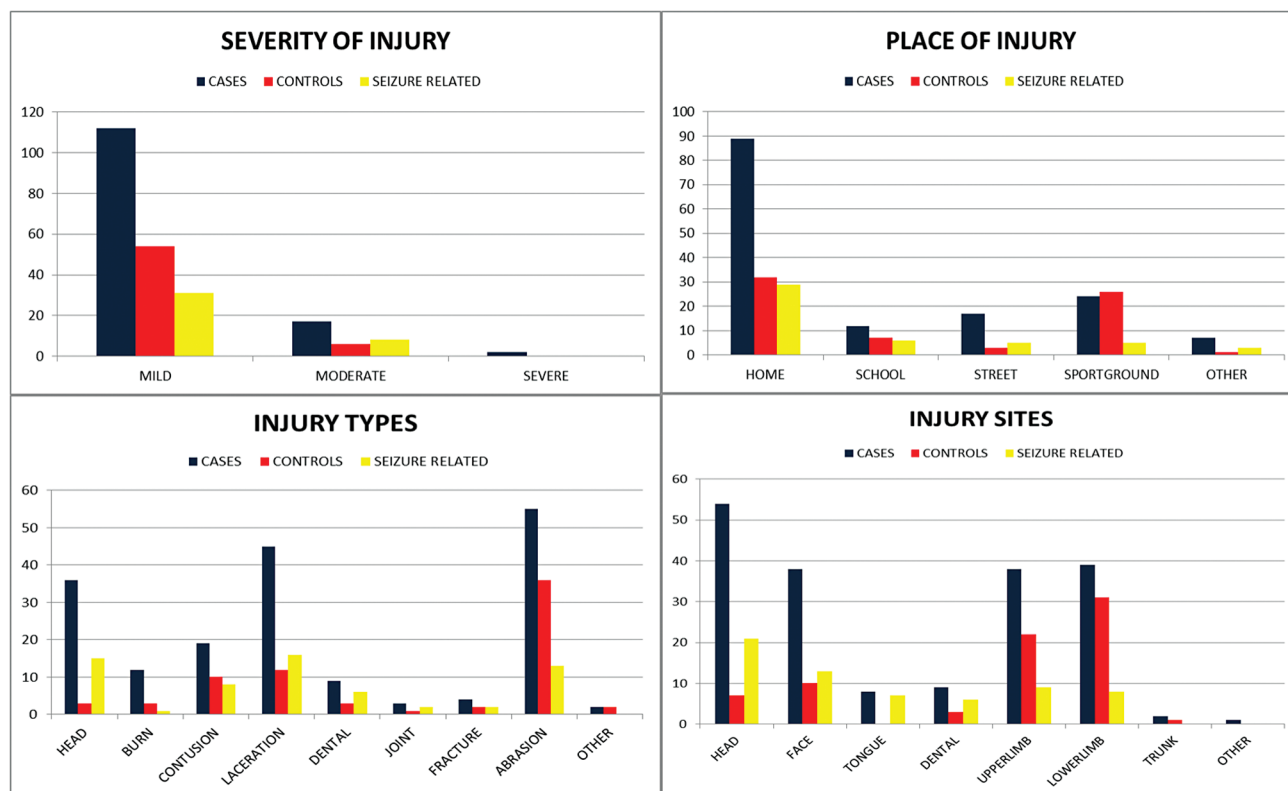
Variables	Children with epilepsy (n = 208)		Controls (n = 208)	p value
	Total	Seizure related		
Children with injury	118 (56.7%)	33 (15.9%)	56 (26.9%)	< 0.001
<b>Site of injury</b>				
Head	54 (26%)	21 (10.1%)	7 (3.4%)	< 0.001
Face	38 (18.3%)	13 (5.8%)	10 (4.8%)	0.001
Tongue	8 (3.8%)	7 (3.4%)	–	0.004
Dental	9 (4.3%)	6 (2.9%)	3 (1.4%)	0.8
Upper limb	38 (18.3%)	9 (4.3%)	22 (10.4%)	0.02
Lower limb	39 (18.8%)	8 (3.8%)	31 (14.9%)	0.3
Trunk	2 (1%)	–	1 (0.5%)	0.5
Rest of the body	1 (0.5%)	–	–	0.5
<b>Type of injury</b>				
Head injury <sup>a</sup>	36 (17.3%)	15 (7.2%)	3 (1.4%)	< 0.001
Burn	12 (5.8%)	1 (0.5%)	3 (1.4%)	0.01
Contusion (hematomas)	19 (9.1%)	8 (3.8%)	10 (4.8%)	0.08
Laceration (cuts)	45 (21.6%)	16 (7.7%)	12 (5.7%)	< 0.001
Dental	9 (4.3%)	9 (4.3%)	3 (1.4%)	0.07
Joint dislocation	3 (1.4%)	2 (1.0%)	1 (0.5%)	0.3
Fracture	4 (1.9%)	2 (1.0%)	2 (1%)	0.4
Abrasion	55 (26.4%)	13 (6.3%)	36 (17.3%)	0.02
Any other injury	2 (1%)	–	2 (1%)	1.0
<b>Severity of injury</b>				
Mild	112 (53.8%)	31 (14.9%)	54 (26%)	< 0.001
Moderate	17 (8.2%)	8 (3.8%)	6 (3.8%)	0.01
Severe	2 (1%)	–	–	0.1
<b>Place of injury</b>				
Home	89 (42.7%)	29 (13.9%)	12 (5.8%)	< 0.001
School	12 (5.8%)	6 (2.8%)	12 (5.8%)	0.3
Streets	17 (8.2%)	5 (2.4%)	15 (7.2%)	0.3
Sports field	24 (11.5%)	5 (2.4%)	20 (9.6%)	0.4
Any other place outside home	7 (3.4%)	3 (1.4%)	5 (2.4%)	1.0

<sup>a</sup>Concussion or other intracranial injuries with or without loss of consciousness.

diagnosed epilepsy showed seizure-related injuries in only 9% of the cases consisting of soft-tissue injury in 90% and dental injuries in 72% cases occurring at home.<sup>26</sup> Similar to our study, most of the injuries were of minor nature and did not require medical attention. There are variable data on this in the literature, probably due to the difference in the population studied, type and severity of epilepsy evaluated, and difference in the environment these patients are exposed to, including cultural differences. A predominance of concussion injuries to the head has been seen in larger studies combining both adults and children.<sup>6</sup>

CWE were injured more at home in our study. This may be due to less time spent in outdoor activities and limitation of activities and schooling based on the associated comorbidities

and severity of epilepsy. Domestic and street accidents have been noted in people with epilepsy across the studies.<sup>6,25</sup> Domestic accidents followed by street and work accidents prevailed in both CWE and controls in a large study of 951 cases, which resulted in contusions, wounds, and abrasions.<sup>32,33</sup> The majority of the studies report a predominance of trivial injuries that do not form a basis for imposing unnecessary restrictions, similar to our study where mild to moderate injuries were most commonly seen and did not require any medical attention.<sup>29,31,34</sup> Interestingly, younger CWE were more supervised and had higher restriction scores in our study, compared with younger healthy controls or older CWE (above 10 years of age). Younger controls are more prone to injuries because of their exploratory nature and less



**Fig. 1** Graphical representation of the severity, place, type, and site of injury in children with epilepsy versus healthy controls.

efficient protective reflexes, while older CWE often have a predominance of GTCS and are more likely to be unsupervised at home, which make them vulnerable to injury.<sup>26,29</sup> Nearly half (45%) of the children in our study who were above 10 years of age had GTCS type of seizures. In contrast to adults who are prone to burns, especially during cooking and fractures due to falls, children have more abrasions and contusions.<sup>35</sup>

In conclusion, our study supports the hypothesis that CWE are at increased risk of injuries as compared with controls. The prevalence of injuries among CWE aged between 4 and 16 years is significantly high compared with healthy controls, although the majority of injuries are mild in severity in both and “non-seizure related” in type. CWE suffered more injuries at home; thus, it demands a lot of attention and care even while these children are at home. The incidence of seizure- and non-seizure-related injuries per person per year in CWE was similar. Longer duration of epilepsy, higher seizure severity and restriction of daily activities, higher prevalence of underlying structural etiology, hyperactivity, and intellectual disability are associated with injuries in CWE.

The study was limited by recall bias as it was based on 1-year recall of injuries by patients and their guardians, along with review of available medical records. The majority of patients required a single ASM for seizure control, although generalized-onset seizures were seen in an equal proportion with focal-onset seizures. Thus, a possibility of poor recall or misclassification in a minor proportion cannot be excluded. A prospective, population-based study for a longer duration would help in better risk assessment. Nevertheless, a con-

sideration of these injuries is important to plan long-term care in CWE. Prevention of injuries in such children is an important aspect in improving their quality of life.

**Funding**  
None.

**Conflict of Interest**  
None declared.

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