



## Epidemiology of childhood injury-related deaths: review of mortality data at the Cape Coast Teaching Hospital



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### Abstract

**Introduction:** globally, about 950,000 children under 18 years die annually from injuries. Injury has the potential to cause prolonged hospitalization, disability or death in children. This study aimed to determine the pattern characteristics and demographic factors associated with childhood (0-16 years) injury deaths reported at the Cape Coast Teaching Hospital in the Central Region of Ghana. **Methods:** we conducted a retrospective review of records of 795 injury-related deaths in the pathology department of the Cape Coast Teaching Hospital from January 2012 to December 2018. Variables documented included demographic characteristics, date of death, causes injury death, and principal sites of injury. Data entry and analyses were done with Microsoft Excel version 2016. Descriptive statistics such as rates, and frequencies were used to describe data. **Results:** a total of 140 injury deaths were among children of age 2 months to 16 years, representing 17.6% of all injury-related deaths from 2012 to 2018. Death rates calculated were 12.4 per 100,000(overall) and 1.7 per 100,000 (annual) of children 16 years and below. Most deaths (63.6%) occurred among boys with almost even distribution across three age groups (1-4year (30%), 5-9years (26.4%), and 10-14years (27.9%)). Road traffic injuries (42.9%) and drowning (30%) were the two leading causes of injury deaths. Pedestrian deaths accounted for 75% of the Road Traffic Injuries. Most of the children died from traumatic head injuries (34.3%). **Conclusion:** there is a significant proportion of injury deaths among children below 16 years, mostly as pedestrian knockdowns and from drowning. We recommend a broad stakeholder consultation to review and draft childhood injury prevention and control guidelines for adoption by the Country.

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## Introduction

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Injury morbidity and mortality have disproportionately affected children in poorer nations worldwide [1-7]. Childhood injury is recognized by the World Health Organization and partners as a major public health problem that requires urgent attention [2]. Injury and violence are major killers of children throughout the world, responsible for approximately 950 000 deaths of children under 18 years each year [2]. About 830 000 of these children die from an unintentional injury [1]. Falls, road traffic accidents, and drowning are the most common external causes of childhood injury burden while about 95% of childhood injuries occur in low and middle- income countries [1-3,5,8]. Childhood injuries are strongly related to social determinants in African and Southeast Asian Regions of the World, as they record the highest prevalence of paediatric injuries, 53.1 per 100,000 and 49 per 100,000 respectively. Literature suggests that the older the children are, the more injuries they are likely to sustain, with an increasing share in injury-related mortality and morbidity [1,2,9]. The Global Burden of Disease data indicates a cumulative increase in childhood injuries from 2% in children under 1year to 24% in children 15-19years [1]. The injury morbidity and mortality burden is greater among boys compared to girls [1,2,5,9]. The rate of road traffic injuries as an example is 14 per 100,000 in boys and 9 per 100,000 in girls [2].

Rich countries have developed childhood injury prevention and control strategies and these strategies have been integrated into their existing injury prevention and control programs, while others have been piloted in selected developing countries worldwide [6,7,10]. The outcome of these interventions have improved the injury burden, and identified country-specific risk factors that have helped develop programs to reduce paediatric injuries. Though

these injury prevention strategies were designed based on evidence from epidemiological research suggesting a higher incidence of injury burden in LMICs including Africa, there is still little knowledge about country-specific incidence [1-3,8]. Similar to other developing countries, little is known of paediatric injury deaths in Ghana. To date, only three studies on paediatric injury deaths can be found on searching the literature and these are from two out of sixteen administrative regions in Ghana, two in Ashanti and one in Greater Accra [11-13]. In Ghana, the population is largely a growing one and children of age 0-16 years constitute about 40% of the entire population [14]. This group is thus very important for the country's economic and political development and should be well natured and protected. In this regard, childhood injuries need to be understood in the local context to identify the pattern, external causes and demographic characteristics of injury deaths. This study aimed to determine the pattern, characteristics and demographic factors associated with children (0-16 years) at Cape Coast Teaching Hospital using data from a single referral center in the Central Region.

## Methods

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A retrospective descriptive study was conducted involving a review of autopsy reports and Coroners' requests of all paediatric deaths (0 to 16 years) at the autopsy suite of the pathology department of the Cape Coast Teaching Hospital (CCTH) in Central Region, Ghana from the 1<sup>st</sup> of January 2012 to the 31<sup>st</sup> of December 2018. We first retrieved records of all injury-related deaths documented at the autopsy suite and selected those that occurred in children 16 years and below. All cases with complete information on the date of autopsy, the age, gender, referral source, the external causes of morbidity and mortality coded according to the

International Classification of Diseases 10<sup>th</sup> Edition (ICD10) [15], were reviewed and entered into Microsoft Excel version 2016. Data analysis was performed using SPSS version 21 and Microsoft Excel version 2016. We analyzed the records for age and sex distribution, circumstances surrounding the injury, rates of injury, and principal sites of injury. The rates of injury death were calculated as the number of cases divided by the population (using the projected mid-period population, i.e. 2015) in each age group and specific external causes of injury. A chi-square test of association was performed for age and gender versus causes of death, where statistical significance were considered at p-value less than 0.05. Ethical approval for the study was obtained from the Ethical Review Committee (ERC) of the Cape Coast Teaching Hospital (Ref: CCTHERC/EC/2019/064).

## Results

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A total of 140 injury deaths were found among children of ages 2 months to 16 years, representing 17.6% (140/795) of all injury-related deaths reported at CCTH in seven years. The deaths peaked in 2016 (2.2 per 100,000 children) above the annual rate of 1.7 per 100,000 children in the Central region (Figure 1). Most deaths (63.6%) occurred among males, with a male to female ratio of 1.7:1. Deaths were almost evenly distributed among the age groups (1-4 year (30%), 5-9 years (26.4%), and 10-14 years (27.9%)) and the least was recorded among children under 1 year (3.6%). The age-specific death rates of childhood deaths per 100,000 were higher for the three age brackets: 1-4 years (14.9), 10-14 years (12.1), and 5-9 years (11.2). The lowest (6.1 per 100,000 children) was found among children under 1 year (0-11 months). No significant association was found between the age of death from injury and gender ( $X^2=3.87$ ,  $p=0.423$ ) (Table 1). Transportation-related causes (42.9%) and drowning (30%)

were the two leading causes of paediatric injury deaths (Table 2). Pedestrian knockdown accounted for 75% of the transport-related deaths (Figure 2). By gender, an almost equal proportion of transport-related deaths occurred among both gender, with greater proportion of assaults (5/6 cases) and drowning (32/42 cases) occurring among girls and boys, respectively. Most of the transport-related deaths occurred among children 10-15 years (20 cases), and drowning (16 cases) and assault (5 cases) deaths were highest among the ages 1-4 years. Higher rates of paediatric injury deaths was seen in relation to transport-related deaths (5.3 per 100,000) and drowning (3.7 per 100,000). A significant association was found between the circumstances surrounding the injury and gender ( $X^2=23.38$ ,  $p=0.025$ ), and the age of death from injury ( $X^2=71.034$ ,  $p=0.017$ ) (Table 2). A greater proportion of childhood deaths resulted from traumatic head injuries (34.3%), while multiple bony and soft tissue (10.7%) and spine injuries (7.1%) also contributed significantly to the overall injury deaths (Figure 3).

## Discussion

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This study describes the trend and causes of injury deaths among children of age 16 years and below using autopsy data from a teaching hospital in the Central region of Ghana. Our findings highlight the need to assess paediatric injury prevention and control strategies in the region and in Ghana, towards addressing the rather important but hidden mortality burden of paediatric injuries. Our reported rate of 12.4 per 100,000 (overall) and 1.7 per 100,000 (annual) of injury deaths in children 2 months to 16 years between 2012 to 2018 is much lower than previously reported among children under 5 years worldwide [2]. The 2008 WHO report estimated a world injury death rate of 38.8 per 100,000 children under 20 years, while another Global study by

Adeloye *et al.* reported 80.5 per 100 000 in children under 5 years [2,8]. A much higher rate (53.1 per100 000 children under 20 years) was reported for African Low and Middle-Income Countries (LMICs) [1,2]. Similar studies in Kumasi and Accra Ghana did not estimate the death rate, hence, we could not compare our findings with previous reports [12,13]. However, our proportion of paediatric injury deaths (17.6%) could be compared to the 17% reported among adolescents of ages 10 to 19 years by Ohene *et al.* at Korle-Bu Teaching Hospital (KBTH) in Accra Ghana. It is however much higher than the reported proportion 9% of deaths from injury among 10 to 30-year-olds by Mock from a district hospital in Ghana [13,16]. The different sources of data used by various studies could be linked to the observed disparities in reported rates and proportions, also the world data combines multiples sources from HICs and LMICs which may either underestimate or overestimate the burden of paediatric injury deaths [1,2,8].

As reported by previous studies, disaggregation by gender and age showed that boys and older children were more likely affected by injury-related deaths than their age matched girls and younger counterparts [1,2,8,12,13]. Contrary to the age distribution, as reported by Ruiz-Casares from WHO data our finding suggests that children of ages 1 to 4 years (30%) were most affected, with a death rate of 14.9 100,000 [17]. This aspect of our findings could be explained by the greater proportion of drowning-related deaths among this group of children. Transport-related injuries and drowning were the leading causes of death among our study population, with an estimated death rate of 5.3 per100, 000 and 3.7 per100, 000, respectively among children aged 0-16 years. Our findings are comparable to the WHO report in 2008 and 2018 which tipped traffic injuries and drowning as the leading causes of childhood injury deaths [1,2]. Adeloye and colleagues also reported similar findings from a systematic review [8]. Consistently,

transport-related injury deaths have been documented by WHO and individual studies to be the major cause of injury deaths in children, and predominately skewed in older children [2,6,8,10,12,18,19].

As reported by previous studies in Ghana and South Africa, pedestrian knockdowns contribute greatly to the paediatric injury deaths, contributing 75% of all transport-related causes of death [9,12]. Similarly, a hospital-based study conducted in Kumasi by Abantanga *et al.* reported 63.5% of paediatric injury deaths were from pedestrian knockdowns [12]. Consistent with previous findings that boys and older children were more affected by fatal injuries, most of the transport-related injury deaths occurred among boys aged 10 to 14 years [10,12]. Although our study provided no evidence to explain the observed patterns, documented findings suggest that lack of supervision at road crossing, street hawking (where children are engaged in selling goods along busy moving traffic ), increased number of vehicles and motorcycles on our road and streets, and poor vehicle and road maintenance culture coupled with low enforcement of road safety regulations are the major contributing factors, especially in developing countries [1,2,8,9,20]. With the rise in pedestrian knockdowns as indicated by our study that, we are of the view that street- and road-crossing skills together with various road signs should be taught in basic schools. There should also be improved supervision for children crossing roads and the Driver and Vehicle Licensing Authority (DVLA) should organize routine refresher training for drivers on road signs and marking. The Police Motor Traffic and Transport Department (MTTD)/National Road Safety Commission (NRSC) should improve the enforcement of road safety regulations and intensify public education on road safety and injury prevention and control. We advocate for a broad stakeholder consultation to review and draft injury

prevention and control guidelines for adoption in the Country.

In this study, drowning was the second leading cause of paediatric injury deaths and was predominantly among boys within the age groups of 1 to 4 years. Although not presented, our data showed that most of the drowning deaths in children occurred in rivers and man-made holes instead of the Sea. Our findings were contrary to what Ohene *et al.* reported. Their findings showed that drowning was the leading cause of deaths among adolescents aged 10 to 19 years in Greater Accra [13]. Similarly, drowning has been reported to be a leading cause of paediatric deaths in several Asian countries, where most drowning deaths occurred in open water bodies like in most LMICs unlike and in swimming pools in HICs [1]. Although transport-related injuries were the topmost cause of death in our study, the proportion of children who died from drowning is alarming and this calls for urgent attention. The Greater Accra and Central regions border the Atlantic Ocean with its associated lagoons, estuaries and beaches which pose greater risk of drowning. Also, along the sea are several rural communities with fishing as a major economic activity. These communities are characterized by low economic status, relatively high teenage parenting, low supervision for children and low educational status. Factors like these have been identified and reported by the WHO in their 2008 report to be underlying risk factors for drowning deaths in developing countries [2]. We, therefore, need a holistic approach that involves the political, social, education and health sectors to address these potential causes of drowning deaths in the Southern regions of Ghana. We can adopt administrative controls and WHO strategies which have been successfully implemented in other developed and developing countries [1-3,21]. These strategies include but are not limited to promoting aquatic safety education, providing supervision near recreational water bodies, covering water

hazards (e.g. man-made holes. Wells, etc.), requiring isolation fencing (four-sided) around swimming pools, wearing personal flotation devices, among others. Another concern was paediatric injury deaths from assaults, we observed that five out of the six (83%) assault-related deaths occurred among younger girls of ages 1 to 4 years. Our finding indicates that if assaults should occur, the female child is more likely to be victim. Close monitoring, enforcement of laws on childhood rights and child abuse and public education could be potential strategies to address child assaults in our communities.

Traumatic head injury was the commonest cause of paediatric injury deaths in our study population, accounting for 34.3% excluding those who presented with multiple injuries (10.7%) but had head injuries. Similarly, previous studies have reported head injuries as major causes of injury deaths especially from transport-related injuries [22-25]. A prospective study in Accra reported that 32.5% of all accident victims (of ages 3 days to 101 years) presenting to the accident center of KBTH suffered various levels of head injury [26]. Another hospital-based study among children (of ages 0 to 14 years) in Kumasi also reported that 43.2% of the deaths occurred as a result of head injury [11]. Consistent with our findings, both studies identify head injury as the leading cause of injury-related admissions and deaths, in Accra and Kumasi respectively. Although a previous study by Alessandro *et al.* had reported that the use of helmets has the potential to reduce the mortality rate from 37%-40% among pedal and motor cyclists [27], this we believe are significant in adult population. Our findings suggest that occurrence of head injury-related deaths in children are mainly pedestrian knockdowns. [1,2,8,9,20,27]. A mix of improved supervision at road crossings, teaching road crossing skills in basic school and development/adoption of injury prevention and control guidelines for the Country is recommended

**Strength, limitation and for further research:** this study highlights the pattern and the leading causes of fatal injuries among children of age 0 to 16 years from a single teaching hospital in the Central region, which is probably the first of its kind in the region. It has provided broad targets for prevention and provided baseline data for further studies in the region and beyond. However, the available data maybe an underestimation of the region wide picture, considering that a proportion of childhood injury deaths that occurred in the region were not brought to the facility for autopsy to be performed. While the study has provided broad targets for prevention, future research needs to examine the risk factors associated with each of the leading causes of childhood death in the detail. In addition standardized data collection tools should be developed to prospectively collect data in the communities of the Central Region.

## Conclusion

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Injury death is a major public health problem among children of age 16 years and below, with the older age group and boys more likely to die from these injuries. Road traffic accidents as pedestrians and drowning are the leading causes of injury deaths. Traumatic head injuries were the most common causes of injury deaths among children involved in motor-vehicle crashes in the Central Region. Identifying and tackling the risk factors associated with the two leading causes of childhood injury deaths is recommended. We are also advocating for a broad stakeholder consultation to review the state of childhood injuries, and draft injury prevention and control guidelines for adoption in the Country.

### What is known about this topic

- Injuries have the potential to cause prolonged hospitalization, disability or death in children;

- Falls, road traffic accidents, and drowning are the most common causes of global burden of childhood injury;
- Limited data is available on childhood injury deaths in Ghana.

### What this study adds

- Childhood injury deaths were mainly pedestrian due to knockdown in road traffic accidents and drowning;
- Majority of the children involved in road traffic accidents died from traumatic head injuries and multiple bony and soft tissue damage;
- Injury deaths were predominant in boys and children under five years.

## Competing interests

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The authors declare no competing interests.

## Authors' contributions

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Martin T. Morna, Anthony Baffour Appiah, and Allison Berdtson: Conception and the design of study; Patrick Kafui Akakpo and Leonard Derkyi-Kwarteng: data documentation; Anthony Baffour Appiah: data collection and analysis; Anthony Baffour Appiah, Ganiyu Adebisi Rahman and Patrick K. Akakpo: data interpretation. Anthony Baffour Appiah, Martin T. Morna, Richard Baidoo, Allison Berdtson, Patrick Kafui Akakpo, Ganiyu Adebisi Rahman and Richard Baidoo: initial draft, content analysis of, and editing manuscript. All authors read and approved the final version of this manuscript.

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## Tables and figures

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**Figure 3:** anatomic causes of childhood injury deaths by gender, CCTH, 2012-2018

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**Table 1:** age and sex distribution of childhood injury death, CCTH, 2012-2018

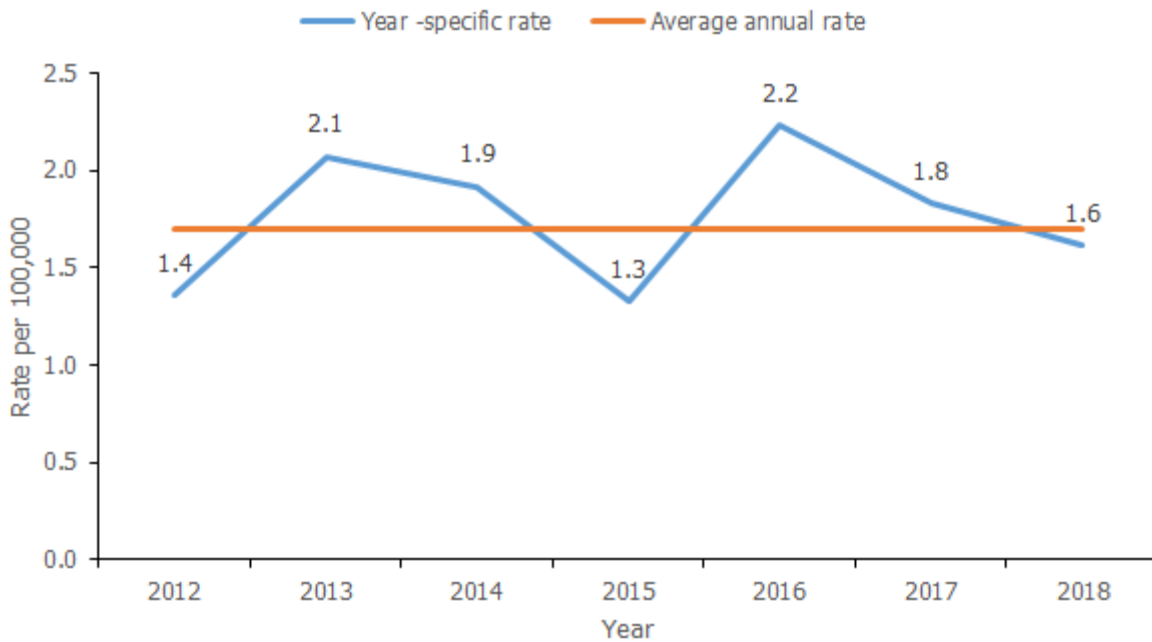
Age group (years)	Boys N=89 (%)	Girls N=51 (%)	Total number children N=140	Proportion of children (%)	*Mid-year population (Pop.1129,315)	Rate per 100,000 children
<1	2 (2.2)	3 (5.9)	5	3.6	82,534	6.1
1-4	23 (25.8)	19 (37.3)	42	30.0	282,617	14.9
5-9	26 (29.2)	11 (21.6)	37	26.4	329,469	11.2
10-14	27 (30.3)	12 (23.5)	39	27.9	320,990	12.1
15years+	11 (12.4)	6 (11.8)	17	12.1	113,705	9.7

\*Mid-year population represented the estimated population of children in Central region as of 2015;Chi-square test of association: Age vs gender (X<sup>2</sup>=3.87, p=0.423)

**Table 2:** top five circumstances surrounding childhood injury deaths by age and gender, CCTH, 2012-2018

Causes	Gender		Age group (years)					All ages	Proportion of all deaths (%)	Rate
	Girls	Boys	<1	1-4	5-9	10-14	15+			Pop. 1,129,315
Transport-related	28	32	4	15	15	20	6	60	42.9	5.3
Drowning	10	32	0	16	10	9	7	42	30.0	3.7
Trapped	4	4	0	2	3	1	2	8	5.7	0.7
Burns	2	4	1	1	2	2	0	6	4.3	0.5
Assault	5	1	0	5	1	0	0	6	4.3	0.5
Others	2	16	0	3	6	7	2	18	12.9	1.6

Chi-square test of association: circumstances surrounding childhood injury deaths vs gender ( $X^2=23.38$ ,  $p=0.025$ ), and age ( $X^2=71.034$ ,  $p=0.017$ )



**Figure 1:** incidence of childhood injury deaths per 100,000, CCTH, 2012-2018

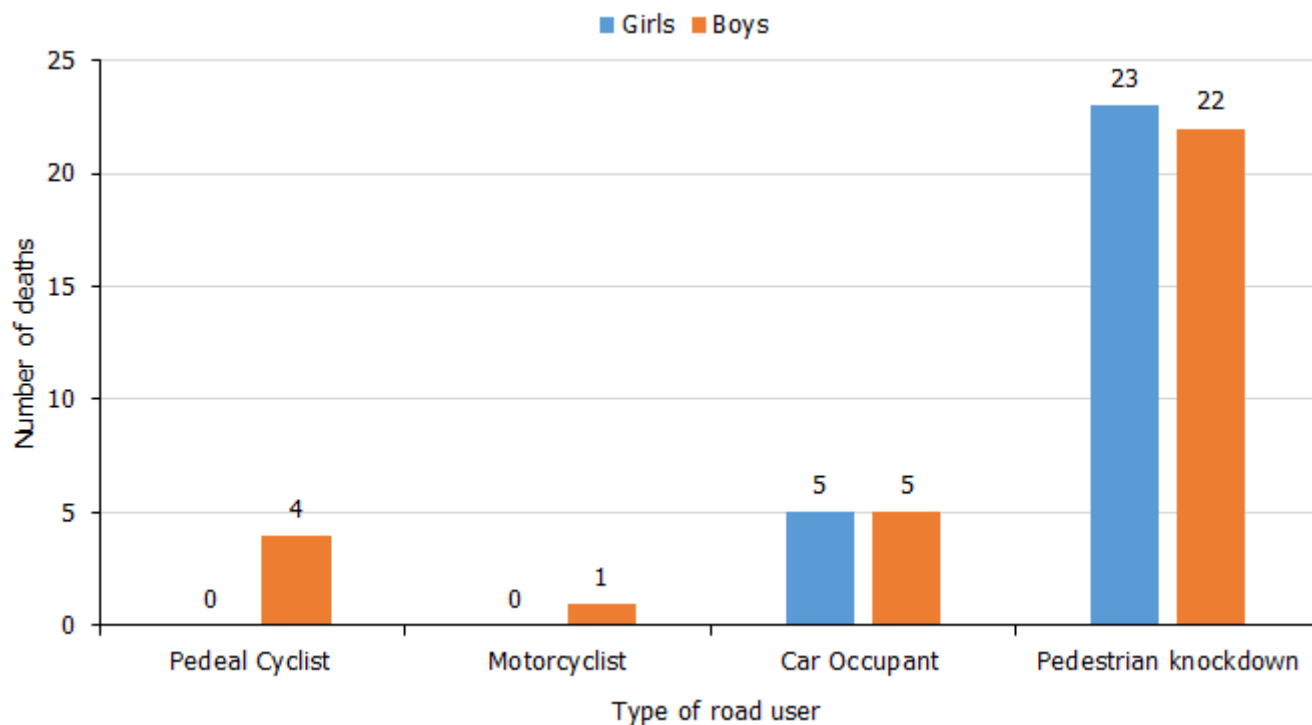


Figure 2: transport-related causes of childhood injury deaths by gender, CCTH, 2012-2018

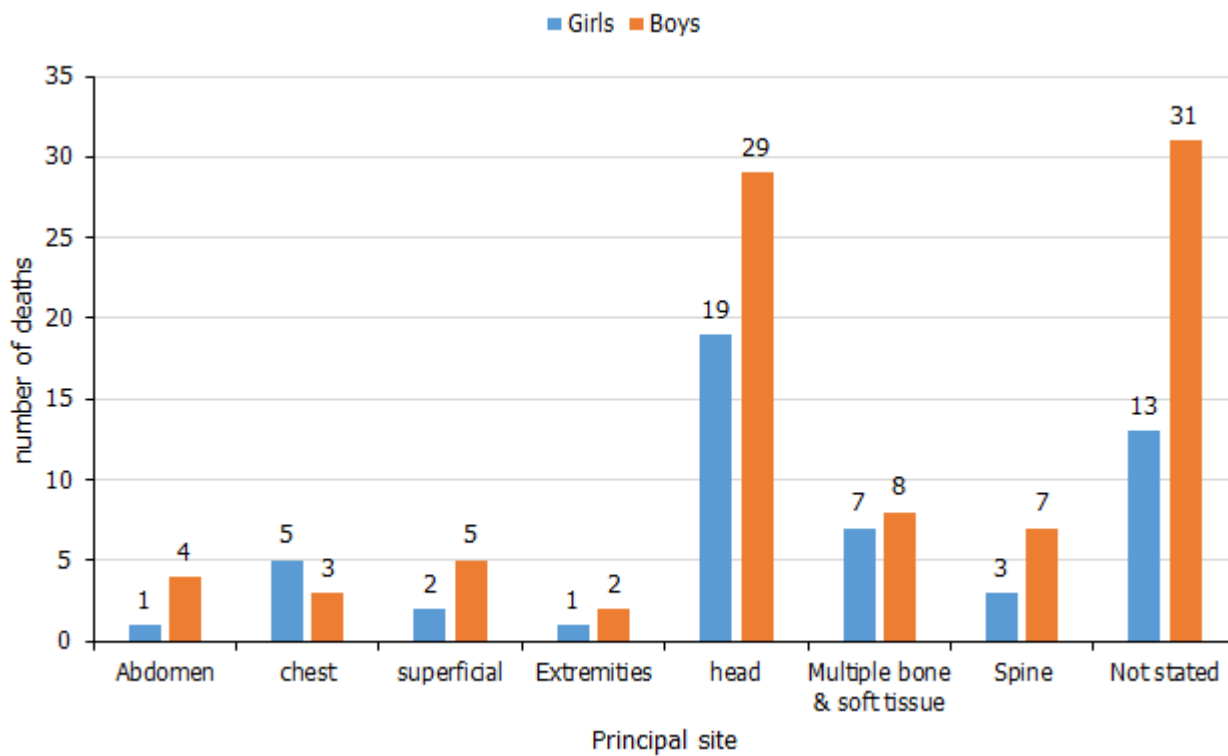


Figure 3: anatomic causes of childhood injury deaths by gender, CCTH, 2012-2018