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## The Status and Magnitude of Fall-Related Injuries in High Schools in Kenya

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### Authors' contributions

*This work was carried out in collaboration between all authors. Author PNW principal investigator and wrote the first draft. Author JTM designed and managed the training, sampling and data collection procedure. Author EG managed the statistics in the study. Author EM managed the literature searches and formatting the manuscript. All the authors read and approved the final manuscript.*

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### ABSTRACT

An accident is an unintended happening, sometimes resulting from negligence that may result in injury, loss of life or damage to property. Accidents are especially common among children within home or school environments. Schools are supposed to be safe centers of academic and exercise for children of all ages. However, in some cases, accidents cannot be avoided and children can be hurt. Accidents are also costly to schools due to insurance premiums and litigations. It is therefore important for us to

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understand the types and magnitude of accidents students may face. Equally important are the legal and financial implications that accidents may add to school authorities. This study was conducted to establish the major causes of injuries and the potential liabilities among the high school students in Kenya. Descriptive survey research design was carried out, where a total of 137, 778 students in 287 high schools were disproportionately selected from all the eight provinces in Kenya to provide the data. The schools' principals, nurses and other healthcare personnel from the selected schools were also interviewed and requested to provide health records with the information on injury occurrence among their students. The study established that District schools had the highest number of injuries (4.24 in every 100 students) per year though there was no significant difference between the category of school and rates of injury occurrence ( $\chi^2 = 0.066$ ;  $df = 3$ ;  $p > 0.05$ ). However there was significant statistical difference in mean number of injuries between boys and girls ( $t = 4.34$ ;  $df = 3$ ;  $p < 0.05$ ). The study recommends evaluation of the implementation of safety policy and general safety management structures in schools in order to cope effectively with injury challenges in the twenty first century.

*Keywords: Falls; injury; student; school; accident; healthcare.*

## 1. INTRODUCTION

An accident is an unintended happening, sometimes resulting from negligence that may result in injury, loss of life or damage of property [1]. Injury is a leading cause of death and disability worldwide [2]. A fall is an event which results in a person coming to rest inadvertently on the ground or floor or other lower level [3]. Globally, falls are the 2<sup>nd</sup> leading causes of unintentional injury after road traffic accidents with about 280,000 deaths and 19.5 million DALYs reported in year 2000. In Africa, the median incidence of falls among children and youth aged less than 22 years was 41 per 100,000 population in year 2005 [4]. Injury morbidity and mortality in low and middle income countries such as Kenya is not recognized as a major public health issue by local authorities due to lack of robust data on the injury burdens [5].

There are about 1.5 million regular high schools students attending schools in about 6,500 schools all over Kenya [6]. Multiple studies have examined accidental injuries occurrences with most of them focusing on specific body sites and sports related activities [7]. The published literature on incidence and patterns of falls related injuries among children and youths relates largely to high income countries where about 10% of the world's children live [8]. Most of published studies of non-fatal injury in low-income and middle income countries are hospital based and may fail to capture data on those who are unable to access Medicare or treated in facilities that do not report directly to hospital database [9].

Falls and fall related injuries are major issues for health and care providers [10]. Given that the majority of falls do not come to the attention of any medical service, incidence figures for falls in community setting are largely dependent on self reported recall of events [11].

In Kenya, the Ministry of Education has published the safety standards manual to underscore the Government commitment to the safety and overall welfare of learners. The school safety standard manual has 10 safety standards with the first three emphasizing on schools to provide environment that natures safety in their physical structure and infrastructure [12]. The aim of this paper is to report on causes of falls that lead to injury in selected schools in Kenya.

## 2. METHODS

A descriptive survey was carried out in 287 high schools in 8 Provinces in Kenya. The schools in Kenya are categorized as National, Provincial, District (the three referred to as Public Schools) and Private schools. Seven National Schools, 92 Provincial, 85 District and 103 Private schools were disproportionately selected from the 8 Provinces.

### 2.1 Ethics and Consent

Approval for this work was obtained from the Ethics Committee, Board of Post Graduate Studies, Jomo Kenyatta University. Consent to access schools and collect data was sought from National Council of Science and Technology (NCST) [13]. Every head of institution (Principal) was briefed on research details before commencement of data collection and asked to provide informed consent. Emphasis to participate or withdraw from the study was made. Where the school had healthcare givers such as nurses, the consent to access them was sought from the principal and the school's health records were accessed.

### 2.2 Sampling and Data Collection Method

A stratified random sampling procedure was used in the study to ensure each category of schools were equitably selected. Each of the eight provinces was taken as a stratum. The number of schools sampled per category in each province was determined by the formula;

$$n_i = \frac{N_i \sigma_i}{N_1 \sigma_1 + N_2 \sigma_2 + \dots + N_k \sigma_k} \text{ and results are shown in the Table 1.}$$

**Table 1. Number of schools sampled per province**

Province name	No. of private schools	No. of public schools	Sample size $n_k$ of private schools	Sample size $n_k$ of public schools	Total
Coast	135	145	3	6	9
Central	367	695	11	15	26
Eastern	571	707	27	33	60
Nairobi	290	48	16	11	27
Rift valley	746	806	23	55	78
Western	261	429	9	19	28
Nyanza	485	746	11	36	47
North Eastern	21	36	3	9	12
<b>Total</b>	<b>2876</b>	<b>3612</b>	<b>103</b>	<b>184</b>	<b>287</b>

The schools were randomly selected using computer generated random numbers with each province acting as a sampling frame.

The researchers were assisted by six trained education officers where they used questionnaires comprising a series of structured questions and open narrative sections. The questionnaire's validity was ascertained through a pilot study by the four researchers. Details

on the causes and circumstances surrounding falls were obtained with physical inspection of the school facility using observational guidelines. Two independent trained education officers reviewed each questionnaire to confirm authenticity of the entered data. The data collection process took 1 year (January – December 2010). The screening questions was “During the past 12 months, how many fall related injuries were reported to you by students which may have required your attention either to provide medical attention or have student stay out of school for at least 1 day”.

The data analyses were conducted using SPSS version 16 where Chi square test, was used to assess relationship that existed among schools of various categories and some given variables, Fishers exact test was used where at least 80% of the cells did not meet the recommended expected frequency of 5 or greater. Cramer’s V was used to measure the strength of association or dependency between two nominal variables and some given variables in the contingency tables. Logistic regression model was used to estimate p values, the probability that a particular outcome would occur.

### 3. RESULTS

#### 3.1 Demographic Characteristic

During the one year period that data were collected, 6287 injuries were recorded from the schools with 31% of them (n=1,950) being falls related. On average, the injury rate was 4.5 per 100 students per year with about 1.41 injuries per 100 students per year being fall related.

The injury rate was highest among boys than among girls (4.67 and 2.93) injuries per 100 students per year respectively with significant statistical difference between the means (t=4.34, df=3; p<0.05).

Boys from District schools had the highest fall related injuries (18 per 1000 per year) with girls from National schools having the lowest rate (5.2 per 1,000 per year) as shown in Table 2. However, there was no significant statistical difference between the category of the school and gender of the student in injury occurrence through a fall ( $\chi^2=5.54$ , df=3, p>0.05).

**Table 2. Rates of fall related injury occurrence by gender**

School category	Gender		
	Number of injury cases per 1000 student		
	Boys	Girls	Mean
District	18	12.1	15.3
Provincial	13.4	9.1	11.4
National	9.5	5.2	8.4
Private	16	9.2	12.4
Mean	14.8	9.64	12.3

#### 3.2 Construction of Schools Physical Structures

Whereas all National schools showed they did submit construction plans to local government for perusal before setting up physical structures, 65% of District schools didn’t submit and most did not have them. There was significant statistical difference between the category of

the school and the submission of schools construction plans to local government ( $r^2=0.4058$ ,  $df=1$ ,  $p=0.0014$ ).

Slightly more than half of all the sampled schools (55%,  $n=159$ ) had septic channels for drainage of liquids and sewerage.

Toilet and bathroom facilities in a school are important areas where conflict among students may arise when they are subjected to competition for them. Such conflicts may manifest as scampering for space, interpersonal feuds and acting in hurried manner to avoid getting late for programmed school activities which eventually may result to injuries. The optimum toilet facility in a school is defined as one door for every 25 girls and 1 door and a urinal for every 30 boys. About 40% ( $n=113$ ) of schools had congestion in toilets use with more than half of private schools ( $n=53$ ) having below optimum toilet facilities. There was significant difference between category of the school and toilet congestion ( $r^2=0.964$ ,  $df=1$ ,  $p<0.0001$ ). The study showed that the leading causes of falls were slippery paths (38%,  $n=741$ ) with other causes being rough ground (18%,  $n=351$ ) and slippery floors (13%,  $n=253$ ). Other causes of injury related falls were falls as one runs to class and fall from staircases each contributing to 10%,  $n=195$ . There was no significant difference between the category of school and cause of fall ( $\chi^2=24.3$ ,  $p>0.05$ ,  $df=15$ ;  $v=0.3226$ ).

The floor of the bathrooms should be impervious to moisture and finished with a smooth and readily cleansed hard wearing surface [14]. The textures of the bathroom floors in the schools with boarding facilities were examined and results analyzed. About (52%,  $n=106$ ) of schools had not met the building codes standards with significant difference in the category of schools and the texture of the floor of bathrooms ( $r^2=0.776$ ,  $df=1$ ;  $p=0.0019$ ).

Thirty eight percent of falls among students were attributed to slippery paths. Three main forms of paths laying materials in schools were identified and results shown in the Table 3.

**Table 3. Type of construction materials and respective percentage (in %) of used in construction of walkways**

School category	Construction materials of walkways (%)			
	Earth	Concrete	Bitumen	total
National	43	43	14	100
Provincial	51	46	3	100
District	81	19	-	100
Private	61	36	3	100
<b>Total</b>	<b>63</b>	<b>34</b>	<b>3</b>	<b>100</b>

About two thirds ( $n=182$ ) of the schools had paths that were laid with earth and more than 80% ( $n=69$ ) of District schools being similarly laid. There was significant relationship between the category of school and the laying of paths in the schools ( $\chi^2=19.9$ ,  $p<0.05$ ,  $df=6$ ).

To prevent students from straying into grass or flowers gardens, the respondents reported three main materials they had used to hedge their pathways and the results were shown in Table 4.

The material used in hedging a walkway is a crucial aspect in injury occurrence as its texture may affect the severity of injury inflicted to a student upon accidental contact. For every five

provincial schools, two had walkways hedged with barbed wires. There was a significant relationship between the category of the school and the type of the hedges for its walkways.

$$(\chi^2=26.1, p<0.05, df=9).$$

**Table 4. Types of materials and respective percentage (%) used in the construction of the hedges along walkways**

Category	Barbed wire	Stones	Timber	None	Total
National	57	29	14	0	100
Provincial	41	4	5	49	100
District	15	9	2	73	100
Private	23	13	8	56	100
<b>Total</b>	<b>28</b>	<b>9</b>	<b>6</b>	<b>57</b>	<b>100</b>

#### 4. DISCUSSION

Falls are significant causes of injuries among students. A study in Jiangxi Province China [15] showed a pyramid for falls among children 0-17 years of age. For every 690 falls related injuries, 24 led to hospitalization (1–9 days), 13 being hospitalized for 10 or more days, 4 getting permanent disability and 1 death. If the same pyramid would apply in this study, the observed injuries would be three times in each category.

Falls are also cited as the leading cause of injury among 13 – 15 years old in the Global school Health survey covering 26 countries [16]. UNICEF – TASC Surveys have found that falls to be a leading cause of morbidity and disability in children resulting in high social and economic costs [17]. This study did not quantify the cost of injury among students but a study conducted in 1995 in Canada showed annual injuries from childhood falls were estimated to cost 630 million Canadian dollars [18].

The current study showed that injury rates were higher among boys than girls. These results agree with WHO Global Burden of Diseases [19] of 2008, which showed that males outnumbered females for fall-related injury and indeed most types of injury among children and young people. This is the case in most countries and applies to both fatal and non-fatal falls [20]. Males often strive to perform more challenging and daring acts – the risk taking behavior.

The study showed that 86% of National schools had optimum or above optimum toilet facility as compared to only 58% of District schools. That 81% of District schools compared with 43% of National schools had paths that were earth-laid is an indication that more National schools had better infrastructures than District schools. Schools with fewer students' toilet facilities would have students competing for such facilities. The competition may lead to students running to seize the earliest chances to use the facilities, especially between lessons. Injury occurrence rate would be increased by when the paths are slippery or unduly rough or dark. For such reasons the rates of injuries were higher among the District schools which are taken to be "poorer" in facilities as compared to higher cost National schools. Baslet [21], in a systematic review of risk factors for fall related injuries among children found a strong relationship between social class and incidence of falls. He showed complex association between social deprivation and increased risks having several underlying factors including over-crowded environments, hazardous environment, and lack of access to healthcare among others.

The “build environment” is a vital determinant of fall related injuries. This study showed that most of injury related falls occurred in slippery paths. About two thirds of the schools had earth laid paths which turn slippery especially after rains. About 28% of foot paths were hedged with barbed wire while other materials for hedging were either timber or stones. Lord et al. [22] stated that environment hazard such as poor lighting, slippery and uneven surfaces together with foot ware and clothing have negative impacts on the consequences of falls.

The researchers suggest that multi-factorial interventions including assessment of implementation of Safety Standards Manual for Schools in Kenya and Schools health policy must be carried out in high schools in order to mitigate fall related injuries. Improved collection and storage of injury related data and improvement on school's health records data-management is suggested as a requirement. A database from schools health information would help in policing, evaluation and feedback. Engineers, architects, builders and masons must be sensitized for safer designs of stairs, paths, grab bars, railings and playgrounds.

## 5. CONCLUSION

The study showed that the injury rate was 4.5 per 100 students per year with about 31% of them being fall related. The rate was significantly higher among the boys than the girls. There was a marked variation in the build environment in schools of various categories and this may be the main reason why rates of injuries varied among school categories. The National schools with safer physical environment had lower injury rate than the District schools. Observance and implementation of building regulations need to be enforced particularly by government in order to reduce not only the negligence related injuries but also to prevent litigations that may arise as schools breaching tort laws.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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