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Traumatic amputations in a Ghanaian tertiary hospital over a 6-year period: A retrospective study

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Abstract

Background: Traumatic amputation refers to an injury to a limb that results in its immediate separation from the body or may ultimately lead to loss of the limb. The most common causes include falls, road traffic accidents, explosions, and armed conflicts. These could result in complications such as haemorrhage, infection, shock, and psychological trauma. Out of 160 traumatic amputations over a 6-year period, traumatic amputations were found to be more common in the groups of people aged 20 years or less (43.1%), self-employed groups or artisans (50.9%), groups with some level of education (59.7%), and with a male preponderance (85%). Road traffic accidents were associated with the female group (54.2%) and the unemployed (53.4%). The use of prosthetics among amputees is not a common practice, though they are the common remedy for traumatic injuries (45.6%). Upper limbs (54.4%) were the most common site of traumatic amputations, with 62.1% below the elbow. There was a significant relationship between the mechanism and the site of injury. While primary trauma (59.4%) was the immediate cause of traumatic amputation, it is essential to educate the public about the dangers associated with injury management by bonesetters, as well as to promote road safety education to reduce the incidence of traumatic amputations.

Keywords: Traumatic, amputations, Ghana

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INTRODUCTION

Traumatic amputation refers to an injury to a limb that results in the instant separation of that limb from the rest of the body, or one that will eventually lead to the loss of the limb [1]. These incidents are often preceded by explosions, particularly in countries where armed conflict is prevalent [2]. For this reason, some studies commonly refer to this condition as the "signature wound of Iraq," occurring mainly at the transtibial or transfemoral level among soldiers in Iraq and Afghanistan [3]. As of 2017, approximately 57.7 million people globally had limb amputations secondary to trauma. The most common causes of traumatic limb amputations include falls and injuries resulting from road traffic accidents (RTAs), as reported in the Global Burden of Disease 2017 study [4]. A study conducted in India, which focused on the correlation between anxiety, depression, and living with amputation, indicated that lower limb amputations were significantly associated with anxiety and depression linked to pain perception. The disability-adjusted life years (DALYs) from lower limb amputations were 8000 for both male and female diabetic participants, according to a study conducted in Brazil [5]. Aside from the physical limitations of amputation, there are also psychosocial consequences that affect an individual's quality of life, which need to be addressed holistically [6].

Complications of traumatic amputations include haemorrhage, infection, shock, and psychological trauma. Management of traumatic amputations should therefore involve supportive care, psychological care, and education on the use of prosthetics [7]. However, in orthopaedic practice, the use of prosthetic devices following amputation remains uncommon despite the clear need. For example, Collin et al. reported that although 85% of amputees had tried prostheses, only 5% used them for ambulation for more than half of the day [8]. Our literature search did not

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reveal any similar study done in Ghana or in Africa, which highlights traumatic amputation in adults in the country. This study, therefore, sought to provide evidence of prevalence, patterns, and mechanisms of traumatic amputations in a tertiary hospital in northern Ghana, along with their causes and associated sociodemographic characteristics.

MATERIALS AND METHODS

This was a retrospective study on traumatic amputations observed in the trauma orthopaedic unit of Tamale Teaching Hospital over the period 2017 - 2022. Ethical clearance (CHRPE/AP/656/24) was sought to access patients' electronic health records from the health information management system of the Tamale Teaching Hospital. Data from all patients admitted to the trauma/orthopaedic ward during the study period were retrieved, and the study variables were collected from the patients' folders and entered into an Excel spreadsheet, which was later exported to IBM SPSS Statistics version 24. The variables collected included age, sex, level of education, and cause of trauma. Also recorded were mechanism (vehicular types), level of amputation, patient prosthetic use, outcomes (infection, reoperation, uneventful), and length of hospital stay. Using retrospective data, analyses were conducted with IBM SPSS version 24.0, and descriptive statistics were employed to determine means and frequencies. Associations between variables were assessed using Chi-Square analysis, ANOVA, and Student's t-test where applicable. The significance level was set at a p-value of 0.05. This is a retrospective study of electronic medical records. The KNUST Ethics Committee waived the requirement for informed consent for the publication of patient records, including those of minors, given the study's retrospective nature. For surgical procedures, all patients provided written informed consent prior to their operations. Data were collected electronically from the Tamale Teaching Hospital's Health Information Management System. Patient records were fully anonymised prior to data analysis to ensure confidentiality.

RESULTS

There were 160 traumatic amputations over the study period (2017 - 2022), with an increase in traumatic amputation from 2017 to 2021 (10.6% to 20.6%). However, there was a decline in 2022 (20.6% to 16.9%) (Figure 1). The median age of the studied cases was 25.0 years. The minimum age recorded was 15 days (this was a neonate and an outlier), while the maximum was 63 years. The majority of cases occurred among individuals aged 20 years and below. A majority (85.0%) of these cases were male. Approximately half (50.9%) of these individuals were self-employed or worked as artisans. Most (59.7%) had attained some level of education up to secondary school or less (Table 1). Overall, 54.4% of traumatic amputations involved the upper limb. Of these, 62.1% were below the elbow. Among lower limb amputations, approximately half (50.7%) were below the knee. Lower limb traumatic amputations predominated (54.8%) among individuals aged 41 years and above, whereas upper limb amputations were more common among those aged 20 years or younger, although this association was not statistically significant ($p > 0.05$). Males accounted for 55.9% of upper limb amputations, while the majority of females (54.2%) sustained lower limb amputations; however, this gender difference was also not statistically significant ($p > 0.05$) (Table 2).

The chi-square analysis revealed a statistical association between the mechanism of injury and the site of traumatic amputation ($p < 0.001$). With the exception of RTA injuries, a higher proportion of upper limb amputations was associated with the mechanisms of assault (87.1%), entrapment in industrial machinery (84.6%), falls from height (81.8%), and others (66.7%). In contrast, RTA injuries predominantly resulted in lower limb amputations (77.8%) (Figure 2). RTA were the predominant mechanism of injury, accounting for 45.6% of cases that resulted in traumatic amputation. The other significant mechanisms of injury related to traumatic amputations in this study were falls from height (20.9%) and assaults (19.6%).

Additionally, the most common indicator for amputation (59.4%) was primary trauma. Meanwhile, the significance of the remaining cases of amputation stemmed from complications arising from traditional bone setters (Table 3). A greater proportion (52.2%) of those aged 20 or younger experienced amputations due to complications from traditional bone setters, compared to individuals aged 21 and above, who had more amputations resulting from primary trauma ($p < 0.05$). Among males, the majority (61.8%) underwent amputations due to primary trauma, whereas for females, 54.2% of the amputations were attributed to complications from traditional bone setters ($p > 0.05$). Regarding education, 70.7% of individuals without formal education experienced amputations resulting from primary trauma, compared to 52.5% of those with some level of education, a difference that was statistically significant ($p < 0.05$). Regarding employment status, most (69.8%) of those employed had their amputations stemming from primary trauma. Conversely, the majority (53.4%) of those without any form of employment had their amputations due to complications from traditional bone setters ($p < 0.05$) (Table 4). The difference between age groups and the mechanism of injury was not statistically significant ($p = 0.251$) (Table 5).

The prevalence of prosthesis use for the two-year (2021 to 2022) period was 8.9% (3.5% - 18.5%). The prevalence of prosthesis use was 10.3% (3.0% - 25.1%) for patients amputated in 2021, compared to 8.0% for those amputated in 2022. In terms of sex distribution, prosthesis use was higher among females at 18.2% (4.0% – 46.7%) compared to 7.0% for males. The use of prostheses was proportionally higher among those aged 20 years or less, at 13.0% (3.8% -

Table 1. Sociodemographic characteristics of traumatic amputations over the study period

		Frequency	Percent
Age group	20 years or less	69	43.1
	21 -40 years	60	37.5
	41 -60 years	25	15.6
	61 years or more	6	3.8
	Total	160	100.0
Sex	Male	136	85.0
	Female	24	15.0
	Total	160	100.0
Occupation	Self-employed or Artisan	81	50.9
	Employed	5	3.1
	Student / Child	69	43.4
	Unemployed	4	2.5
	Total	159	100.0
Educational Level	No Education	58	36.5
	Secondary or less	95	59.7
	Tertiary	6	3.8
	Total	159	100.0

Table 2. Sociodemographic factors associated with the site of amputation

		Site of Amputation				Test statistics
		Lower limb		Upper limb		
Age group	20 years or less	25	36.2%	44	63.8%	X^2= 4.398 p > 0.05
	21 -40 years	31	51.7%	29	48.3%	
	41 years and above	17	54.8%	14	45.2%	
Sex	Male	60	44.1%	76	55.9%	X^2= 0.830 p > 0.05
	Female	13	54.2%	11	45.8%	
Ever educated	No	28	48.3%	30	51.7%	X^2= 0.330 p > 0.05
	Yes	44	43.6%	57	56.4%	
Employment status	Employed/self-employed	43	50.0%	43	50.0%	X^2= 1.682 p > 0.05
	Unemployed/student/ child	29	39.7%	44	60.3%	

Table 3. Mechanisms of injury and causes of traumatic amputations

		Frequency	Percent
Mechanism of Injury	Assault	31	19.6
	RTA	72	45.6
	Fall from height	33	20.9
	Stuck in a Machine	13	8.2
	Others	9	5.7
	Total	158	100.0
Indication for amputation	Primary Trauma	95	59.4
	complication from traditional bone setters	65	40.6
	Total	160	100.0

Table 4. Sociodemographic factors associated with the cause of traumatic amputation

	If trauma, cause				
	Primary Trauma		complication from traditional bone setters		
Age group					
20 years or less	33	47.8%	36	52.2%	X^2= 7.621 p < 0.05
21 -40 years	43	71.7%	17	28.3%	
41 years and above	19	61.3%	12	38.7%	
Sex					
Male	84	61.8%	52	38.2%	X^2= 2.147 p > 0.05
Female	11	45.8%	13	54.2%	
Educated					
No	41	70.7%	17	29.3%	X^2= 5.057 p < 0.05
Yes	53	52.5%	48	47.5%	
Employment status					
Employed/self-employed	60	69.8%	26	30.2%	X^2= 8.787 p < 0.05
Unemployed/student/child	34	46.6%	39	53.4%	

Table 5. The association between age and mechanism of injury

	Mechanism of Injury					Total	Test statistics
	Assault	RTA	Fall from height	Stuck in a Machine	Others		
Age group							
Below 40 years	28	52	28	10	6	124	X^2=5.799 p=.215
	22.6%	41.9%	22.6%	8.1%	4.8%	100.0%	
40 years and above	3	20	5	3	3	34	
	8.8%	58.8%	14.7%	8.8%	8.8%	100.0%	
Total	31	72	33	13	9	158	
	19.6%	45.6%	20.9%	8.2%	5.7%	100.0%	

Table 6. Analysis of prosthesis use across participant characteristics

	Prosthesis/No Prosthesis							
	No				Yes			
	Frequency	Percent	95.0% Lower CL	95.0% Upper CL	Frequency	Percent	95.0% Lower CL	95.0% Upper CL
Admission Year								
2021	26	89.7%	74.9%	97.0%	3	10.3%	3.0%	25.1%
2022	23	92.0%	76.7%	98.3%	2	8.0%	1.7%	23.3%
Sex								
Male	40	93.0%	82.5%	98.0%	3	7.0%	2.0%	17.5%
Female	9	81.8%	53.3%	96.0%	2	18.2%	4.0%	46.7%
Age group								
20 years or less	20	87.0%	69.1%	96.2%	3	13.0%	3.8%	30.9%
21 -40 years	18	90.0%	71.6%	97.9%	2	10.0%	2.1%	28.4%
41 years and above	11	100.0%	.	.	0	0.0%	.	.
Educational Level								
No Education	19	100.0%	.	.	0	0.0%	.	.
Secondary or less	29	85.3%	70.7%	94.2%	5	14.7%	5.8%	29.3%
Tertiary	1	100.0%	.	.	0	0.0%	.	.
Occupation								
Self-employed or Artisan	26	96.3%	84.0%	99.6%	1	3.7%	0.4%	16.0%
Employed	1	100.0%	.	.	0	0.0%	.	.
Student / Child	22	84.6%	67.5%	94.6%	4	15.4%	5.4%	32.5%
Lower limb Site								
Below knee	11	84.6%	59.1%	96.7%	2	15.4%	3.3%	40.9%
Above Knee	13	81.3%	57.9%	94.4%	3	18.8%	5.6%	42.1%

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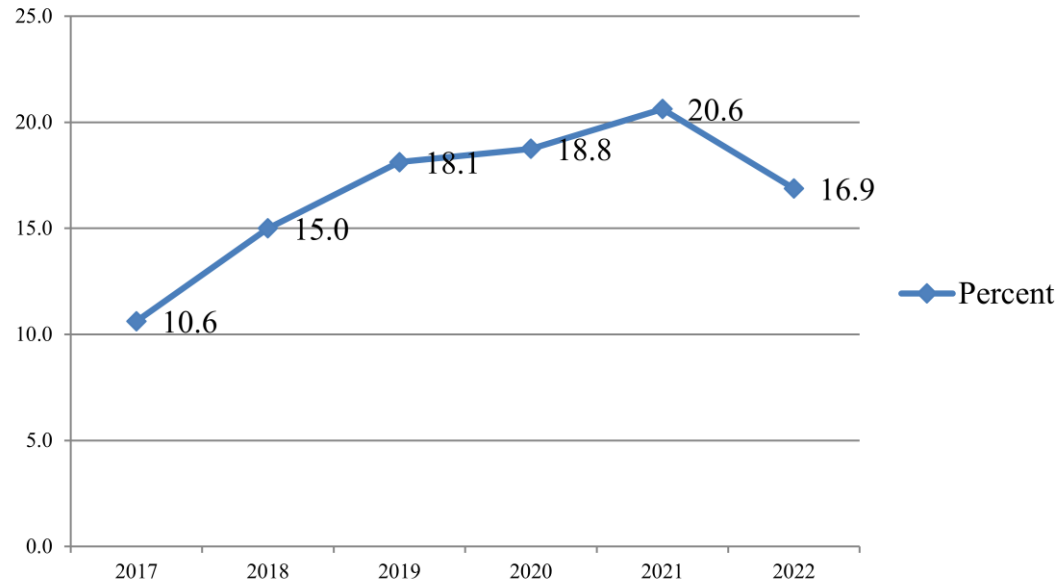

Figure 1. Trend of traumatic amputation over the study years

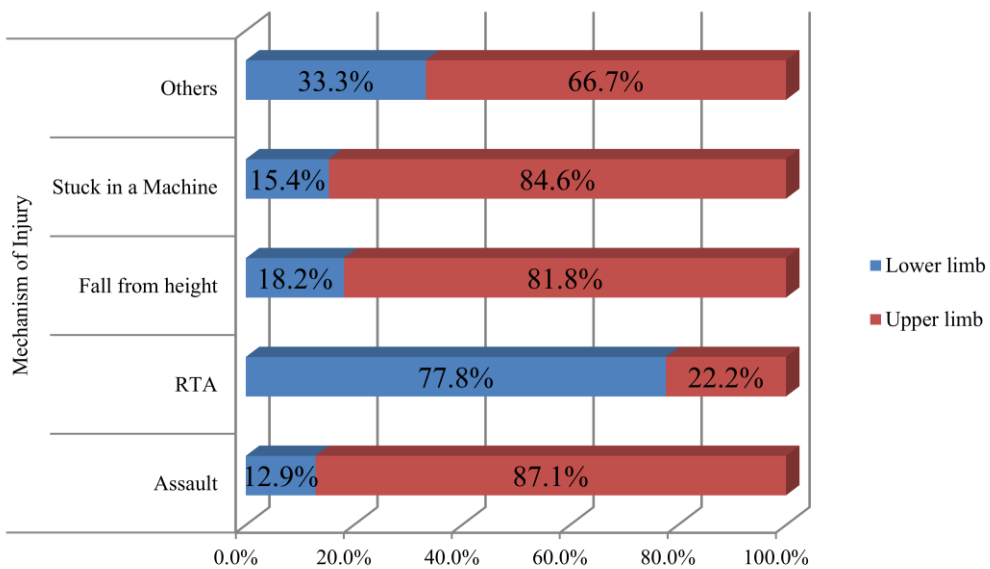

Figure 2. Association between the mechanism of injury and site of traumatic amputation (X^2= 58.865, p < 0.001)

30.9%), compared to 10.0% (2.1% - 30.9%) for those aged 21 – 40 years, and 0.0% for those over 40 years. The use of prostheses was recorded only among individuals with educational attainment up to secondary level, at 14.7% (5.8% - 29.3%). The prevalence of prostheses was particularly high among students at 15.4% (5.4% - 32.5%), compared to 3.7% (0.4% - 16.0%) among those who were self-employed or artisans, and 0.0% among those in employment. In this study, the use of prostheses was used only among individuals with lower limb amputations, with the highest prevalence at 18.8% (5.6% - 42.1%) among those with above-knee amputations, compared to 15.4% (5.4% - 32.5%) among those with below-knee amputations (Table 6).

DISCUSSION

An overview of the literature indicates that most traumatic amputations occur in males between the ages of 1 and 5 years and 13 and 17 years. In the same study, amputations of the digits were most common in the younger group, primarily due to accidental injuries involving sharp objects. In contrast, the more severe amputation injuries that occurred in the older age group were usually due to lawnmowers and motor accidents [9]. Other studies have also classified traumatic amputations by age group and the types of accidents typical in each [12]. In this study, the majority of participants were aged 20 years or younger (43.1%), with a median age at the time of amputation of 25 years. This age group aligns with the findings of the study by Mencio [9]. The age group in our study showed a significant association with the mechanism of injury. Although a chi-square analysis in this study showed no significant differences between age groups and mechanisms of injury, the younger age group of 20 and below (52.2%) experienced complications due to traditional bone setters. In this study, the median age of participants (26.3 years) was lower than what was reported in other studies [11]. The discrepancy arises because this study focused only on traumatic amputations. In contrast, the 2021 study by Yempabe et al. at Tamale Teaching Hospital included an older age group (mean age 43.6 years) and an outlier, a 2-year-old [11]. This highlights differences in sociodemographic characteristics of traumatic amputations across geographical locations. Many young people with traumatic amputations in society also increases the likelihood of disability among the majority of the population, and necessitates the need for accessible disability-friendly infrastructure nationwide.

With regard to sex, the findings in this study reveal that traumatic amputations were more prevalent among males. A more recent study conducted at Tamale Teaching Hospital involving 112 patients who underwent surgical amputation also found the majority to be male [11]. Males predominantly suffered upper limb amputations (55.9%) in this study, aligning with findings from similar studies in Ghana and other countries, with only a few studies not involving amputations in the upper limbs [10,12,13,19]. Males have been reported to be more involved in high-risk activities that predispose them to road traffic accidents and occupational falls and incidents [17], which makes them more likely to have traumatic amputations.

Road traffic accidents were identified as the most common mechanism of injury. This study found that road traffic accidents (45.6%) and assaults (19.6%) were the most common mechanisms. Assault is a common causative factor in most of the traumatic amputations in the Tamale Teaching Hospital, most likely due to weapon accessibility and tribal clashes within that area, as previously reported in the Northern Region [16]. Falls from a height accounted for 20.9%. In adults, the most common causes, in descending order, were motor vehicle accidents, industrial incidents, and motorbike accidents [12]. In the paediatric population, the most common causes included caught-in-between mechanisms, doors, machinery, motor vehicle accidents, firearms, and off-road vehicle–related injuries [12]. In contrast with this study being caught in a machine was the second least common mechanism of injury (8.2%), despite being more prevalent in the study by Ramirez [12]. Blast injuries were not a major mechanism of injury in this study, mainly because Ghana is not currently in a state of war, and the participants were not employed in roles that required handling explosives.

This study revealed that upper limb amputations were more prevalent (54.4%) than lower limb amputations (45.6%), possibly because the majority of participants were under 20 years old. Upper limb amputations appear to be more common among the younger age group [9]. Additionally, in this study, upper limb amputations accounted for the most common site at 54.4%, with below-elbow amputations being the most prevalent among these at 62.1%. Among lower limb amputations, 50.7% occurred below the knee. Compared to this study, a previous investigation carried out at Cape Coast Teaching Hospital revealed the mean age of amputations to be 60.92 years, with a higher female-to-male ratio and lower limb amputations constituting 90.48%, primarily resulting from diabetic foot gangrene [10]. In contrast, 54.2% of amputations among females in this study were due to complications from traditional bone setters, with the same proportion resulting in lower limb amputations. Furthermore, the disparity between this study and the other conducted in Cape Coast is most likely due to the exclusion of non-trauma cases, with diabetes mellitus playing a major role in that of the Cape Coast study.

Some of the factors affecting patronage of traditional bone setters include cost, accessibility, and prompt service, as well as societal and cultural ideologies [19]. In this study, more than half of the traumatic amputation injuries were due to primary trauma (59.4%), as opposed to complications from traditional bone setters. The amputations caused by complications from traditional bone setters were 2.9 times higher (40.6%) than those in a 2016 Nigerian study (14.9%) [18]. A study on factors influencing patronage of services by traditional bonesetters in Northern

Ghana found that individuals aged 19-39 were most likely to consult a traditional bonesetter [19]. In this study, 54.2% of females suffered amputations due to complications from bonesetters. It is unclear why most female participants resort to bone setters; however, low cost, societal, and cultural influences may play a major role. Also in this same study, 70.7% of participants with no formal education reported that trauma was the primary mechanism of injury. The majority of those who sought the services of bonesetters (53.4%) were unemployed. It is essential to educate people about the dangers of seeking services from traditional bonesetters.

In December 2021, 157 traditional bone setters underwent a 9-month training programme in Ghana focused on the basic principles of fracture management. This training led to improved documentation, enhanced management of uncomplicated fractures, and a higher rate of referrals (37 cases) to hospitals for fractures that could have resulted in further complications [21]. However, there is a need for more education in the community about the dangers of resorting to bone setters for fracture management instead of visiting a hospital for specialist care. In communities where traditional bone setters are prevalent, bone setters can be trained to treat wounds aseptically and to identify traumatic injuries and fractures that may require referral for specialist care. Occupation is known to contribute significantly to traumatic amputations, with most occurring among those in the paper and wood manufacturing industry, particularly carpenters and loggers [12]. In this study, 50.9% of participants identified themselves as self-employed or artisans. Among employed participants, 69.8% experienced amputations due to primary trauma. This highlights the need for policies that ensure a safe workplace with adequate compensation to protect artisans and others at risk of traumatic amputations.

Globally, approximately 35 – 40 million people require prostheses [14]. About 57.7 million people are living with disabilities due to limb amputations secondary to traumatic injuries [4]. In the African context, a study by Mduzana et al. [20] found an annual increase in prosthetic use, with most users being male and under 40 years old. In the present study, males constituted 7.0% of prosthesis users. Most participants who used prostheses were in the 20-year-old or younger age bracket (13.0%), and only those who had completed up to secondary level education (14.7%) reported using a prosthesis. In a Rwandan study, 19.5% of prosthesis users had attained primary level education [15]. Prosthesis use was most prevalent among students (15.4%) in this study. In contrast, in the Rwandan study, it was highest among the self-employed and unemployed [15]. In this study, above-knee amputations accounted for 18.8% of prosthesis users, while in the Rwandan study, the below-knee group was the majority at 22.0% [15]. The level of education influences prosthesis use, highlighting the importance of education in improving amputees' quality of life.

Traumatic amputations have physical as well as psychosocial implications. Some of these effects include post-amputation pain, psychological stress, and mental illness (for example, phantom limb), decreased mobility with cardiovascular implications, and permanent disability [19]. Prevention of traumatic amputations involves educating the public about risk factors, avoiding high-risk situations such as road traffic accidents (adhering to speed limits, road signs, and road safety practices), and engaging in activities. Additionally, wearing personal protective equipment at work helps prevent occupational hazards. Since most traumatic amputations lead to permanent disabilities, there is a need to educate amputees on prostheses and provide psychological assistance for any mental health challenges that patients may encounter in the future.

Limitations

This study did not assess comorbidities, mental health status before and after amputation, disability, or post-amputation adjustability. The specific laterality of the affected limb was also not captured. These remain important areas that future researchers could explore.

Conclusion

Traumatic amputations are more prevalent among younger individuals aged 20 or younger, self-employed groups or artisans, and those with some level of education, with a predominance among males. Road traffic accidents are the most common cause of these injuries. The upper limbs are the most frequent site of traumatic amputations, particularly below the elbow. There is a significant relationship between the mechanism and site of injury. The prevalence of prosthesis use remains low, with only individuals with lower limb amputations employing them. Complications arising from bonesetters were particularly associated with females and the unemployed. While primary trauma is the main immediate cause of traumatic amputation, there is an urgent need to educate the public on the dangers associated with injury management by bonesetters, as well as on road safety, to reduce the incidence of traumatic amputations.

DECLARATIONS

Ethical consideration

Permission was granted by the Tamale Teaching Hospital for the data to be collected, and ethical approval and clearance were granted by the Kwame Nkrumah University of Science and Technology (KNUST) Committee on Human Research, Publication, and Ethics on 22nd July 2024.

Consent to publish

All authors agreed on the content of the final paper.

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None

Competing Interest

The authors declare no conflict of interest

Author contribution

ADBIB and NAABD contributed to conceptualisation and participated in manuscript review and editing. NAABD drafted the initial version. ARA performed data analysis. All authors read and approved the final manuscript.

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Availability of data

Data is available upon request to the corresponding author

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