Injury Surveillance in a Rural Sub-Saharan Setting: Results from a Pilot Surveillance Initiative in Nzega District, Tanzania

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ABSTRACT

Introduction: Ninety percent of all injuries occur in low- and middle-income countries and most of these injuries are largely preventable. Most injury surveillance systems are focused in large urban settings, which largely ignore injury mechanisms in rural contexts which are critical settings for planning future prevention efforts.

Methods: Injury event information was collected from July 1 to July 31, 2013 at Nzega District Hospital (NDH) in central Tanzania using an injury questionnaire derived from World Health Organization injury surveillance guidelines. One hundred injured patients were enrolled and surveyed about the location of their injury, cause and other contextual and demographic factors.

Results: Seventy-nine percent of participants were males and the most prevalent injury cause for all participants was road traffic collisions, making up 31% of the injuries. Violence was the second most prevalent cause, accounting for 28% of the injuries, and the number one cause of injuries for women. Twenty-three percent (n=7) of patients suffering from injuries due to road traffic collisions were given a prognosis of long-term disability of six months or more.

Conclusion: Nzega District experienced a large number of injuries in a one-month period, consistent with other studies conducted in low- and middle-income country settings and is higher than several infectious diseases already considered pressing public health problems. More comprehensive data collection is required in order to fully understand the extent of this public health problem.

INTRODUCTION

Injuries, both intentional and unintentional, are of public health importance worldwide. This is especially felt in the low- and middle-income countries (LMICs) which are the setting for 90% of all injuries occurring worldwide. It is estimated that road traffic injuries (RTI) alone account for 1.2 million deaths each year Borowy (2013). This figure is in the same league as tuberculosis, which accounted for 1.3 million deaths globally in 2012 as reported by the World Health Organization (WHO) WHO (2013). Moreover, in LMICs, deaths from RTIs are on the rise, especially among pedestrians and motorcyclists. This has been estimated to be due to increased motorization, combined with poorly organized traffic environments, and weakly enforced traffic legislation Bachani et al. (2012); Mohan (2002); Zimmerman et al. (2012); Odero (2010).

Unfortunately, in many African contexts, data on injury events and their contributing risk factors is either rare, not routinely collected, or of poor quality. One reason for this is that fewer resources for data collection are made available for injury control relative to other health concerns Mukhopadhyay et al. (2009). In Tanzania, several studies have described injuries in urban centers such as Dar es Salaam

and Mwanza Moshiro et al. (2005); Kamala et al. (2011); Chalya et al. (2012). While informative, these studies routinely point to the considerable paucity of data characterizing rural regions of the country. The lack of both community and clinically-based studies hamper efforts to design interventions which take into consideration the unique features of rural settings. Thus the present study seeks to augment the present state of understanding, by focusing data collection efforts in a rural resource-limited setting in Tanzania's interior.

The present investigation was conducted with two aims. The first aim was to examine the efficacy of an injury surveillance tool for routine collection of data on hospital treated injuries in a rural setting. The second aim was to examine the incidence and patterns of injury over a one-month period in a rural district hospital.

METHODS

Setting

Nzega District is located on the central plateau of Tanzania, with a population of approximately 500,000. It is bordered by Igunga District in the East, Uyui in the south, Kahama District in the West and Shinyanga rural District in the North. Nzega District is organized into 37 Wards and 167 Villages with 1001 sub villages. As is the case in many other regions of Tanzania, it faces a severe shortage of qualified healthcare personnel. The problem has increased in recent years with the implementation of the Primary health Services Development Program which has resulted in an increased number of health facilities Council (2012).

Study design

The Nzega Injury Surveillance Project (NISP) was a descriptive cross-sectional survey carried out between July 1 and July 31, 2013. We surveyed patients admitted to the Nzega District Hospital (NDH) emergency department for any injury. Nzega District Hospital is a government run hospital in central Tanzania, which serves an estimated population of 33,127 Council (2012).

Study population

Participants included all individuals who arrived at the NDH for treatment of an injury during a one-month enrollment period between July 1 and July 31, 2013. The study included all adult patients $\geq$18 years of age who consented to be included in the study. Patients who did not consent or who were deceased before they arrived at the hospital were excluded from the study. Recruitment of patients to participate in the study was performed in the surgery ward of the hospital, which acted as the treatment center for all injuries, regardless of severity.

Survey instrument

After asking for participants' consent, individuals were surveyed using the "Nzega Trauma Survey" (Appendix). The survey focused on extracting both closed and open-ended answers based on the injury event, the environment, victim information, the activity the patient was performing during the injury, contributing factors and the injured area of the body. Additional questions focused on physician prognosis and follow-up treatment.

Data collection

Data on both intentional and unintentional injuries were collected using a pre-tested, coded questionnaire. The pre-testing consisted of collection of injury cases for a 24-hour period prior to July 1. All data collected here was excluded from the larger survey. Members of the hospital staff acted as third party translators and we consulted with a team of physicians and nurses before agreeing upon accurate Swahili translations for our survey questions. Information on this questionnaire included demographic information (age, sex, education), information on how patients arrived at the hospital (how long did it take to get to the hospital, who accompanied the injured patient, by what means did they arrive) circumstances of the injury (time of injury, location of the injury, people present when the injury was sustained, influence of alcohol), outcomes of the injury (likelihood that the injury would result in long term disability) and characteristics of the injury (mechanism of the injury, body region affected, type of injury). Information collected and presented only included individuals who arrived at the NDH for treatment.

Data analysis

Descriptive analyses were performed using the R Statistical Environment (11). Cross-tabulations were carried out with respect to demographic variables and responses pertaining to the injury event.

Ethical considerations

Informed verbal consent was provided by each of the study participants prior to inclusion. Participation in the study was not a precondition for treatment and all participants were free to withdraw their answers at any time. The study protocol and data collection received approval from the regional and local offices of the Nzega District Council Health Services Board and the District Medical Officer.

RESULTS

Instrument efficacy

The survey was effective in capturing common injury mechanisms, such as: RTIs, interpersonal violence, falls, and animal bites, but was less effective in capturing more unusual mechanisms. Fifteen percent of patients in the study sustained injuries from unusual injury mechanisms, for example, one patient sustained an injury of a foreign body in a patient's nasal cavity. As these injuries were unique in nature and were not likely to be a recurring injury among the general population, we recorded them as "other." The "other" category also included several cases of injuries due to aggressive farm animals. The trauma survey was also unable to objectively determine whether an injury resulted in a long-term disability. We could only rely on a "prognosis," since we were unable to provide follow-up to patients suffering from more severe injuries.

Demographic data

A total of 100 injured patients were treated at NDH during the study period. One individual was excluded because they died prior to arrival. This figure, which considered on a population basis, translates into a one month incidence of 346 per 10,000 persons. The figure was calculated using the population of the catchment area of NDH Council (2012). Of the 100 patients treated 79% (n=79) were male. The ages of patients ranged from 4 to 80 years of age, with a mean age of 27 years (see Table 1 for the average age for each injury mechanism). The average age for males and females were 27 and 24 years respectively. The majority of all reporting individuals were between the ages of 20 and 35 (n=42). Forty-three percent (n=18) of the patients in this age range were injured through acts of violence (Table 1).

Table 1. Demographics of sample by injury type (n, %)(column percents)

Variable	Road traffic collision (n=31)	Act of Violence (n=28)	Fall (n=23)	Animal Bite (n=3)	Other (n=15)	Total (n=100)
Age	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
<11)	1 (3)	0 (0)	11 (48)	2 (67)	3(20)	17 (17)
12-19	7 (23)	3 (11)	5 (22)	1 (33)	4 (27)	20 (20)
20-35	14 (45)	18 (64)	6 (26)	0 (0)	4 (27)	42 (42)
36-55	6 (19)	3 (11)	0 (0)	0 (0)	4 (27)	13 (13)
>55	3 (10)	4 (14)	1 (4)	0 (0)	0 (0)	8 (8)
Mean age	32	34	16	6	24	27
Sex						
Male	25(81)	21 (75)	17 (74)	2(67)	14 (93)	79 (79)
Female	6(19)	7(25)	6(26)	1(33)	1(7)	21()0.21)

Mechanism of injury

We describe injuries by mechanism in Table 2. Road traffic collisions were the most frequent cause of all injuries, accounting for 31% of all reported injuries, followed by acts of violence (28%) and falls (23%).

127 Injuries were more serious with mechanisms due to road traffic collisions and acts of violence with 7 and
128 4 patients respectively expected to experience long term disability according to the treating physician.
129 Individuals with these types of injury mechanisms were also more likely to stay hospital for a longer
130 duration and experience multiple injuries.

Table 2. Demographics of sample by injury mechanism (n, %)(column percents)

Variable	Road traffic collision (n=31)	Act of Violence (n=28)	Fall (n=23)	Animal Bite (n=3)	Other (n=15)
Expected long term disability					
Yes	7 (23)	4 (14)	0	0	0
No	22 (74)	24 (86)	23 (100)	3 (100)	15 (100)
Type of Injury	1 (3)	0	0	0	3 (20)
Lodged foreign body	6 (19)	3 (11)	0 (0)	0 (0)	4 (27)
Sprain / laceration	11 (36)	20 (71)	4 (17)	2 (67)	9 (60)
Fracture	5 (16)	0	10 (43)	0	0
Soft tissue damage	2 (6)	1 (4)	1 (4)	0	0
Mulitple Injuries	7 (23)	7 (25)	1 (4)	0	0
Other	0	0	0	1 (33)	1 (7)
Location of Injury					
Face	2 (6)	3 (11)	1 (4)	0	2 (13)
Head/Neck	6 (19)	12 (43)	3 (13)	0	1 (7)
Chest/Adbomen	0	1 (4)	0	0	1 (7)
Extremities	19 (61)	10 (36)	18 (78)	2 (67)	11 (73)
Back	0	0	0	1 (33)	0
Other	2 (6)	0	1 (4)	0	0
Mulitple	2 (6)	2 (7)	0	0	0
Length of hospital stay					
<24 hours	20 (67)	18 (64)	19 (86)	3 (100)	14 (93)
25-48 hours	5 (16)	2 (7)	1 (5)	0	1 (7)
49-72 hours	2 (7)	1 (4)	0	0	0
>72 hours	3 (10)	7 (25)	2 (9)	0	0
Time of injury occurrence					
06:01-12:00	9 (29)	6 (21)	6 (26)	2 (67)	4 (27)
12:01-18:00	9 (29)	5 (18)	7 (30)	1 (33)	5 (33)
18:01-24:00	10 (32)	5 (18)	10 (44)	0	4 (27)
00:01-06:00	3 (10)	12 (43)	0	0	2 (13)

DISCUSSION

133 The first aim of the present study was to examine the efficacy of a surveillance instrument for the
134 routine injury data collection in a rural hospital. Although our instrument was adequately able to collect
135 circumstantial information surrounding the injuries that were presented at NDH, the acquisition of data
136 related to long-term disabilities is only possible with a longer data collection period. Since in this pilot

study, the intention was only to collect data during a one month period, we posed a question to the attending physician to provide a reasonable clinical opinion as to the likelihood of a disability resulting from the injury. In certain instances the physician was unsure if a disability would develop or not. In these circumstances, the physician had to rely on their estimates. Also, similar to Mutto et al. we faced challenges capturing the occurrence of poisonings and drownings within the injury surveillance period Mutto et al. (2011). Mutto et al. also cited a triage issue for why poisonings are under-reported. Poisonings were likely to go directly to a medical department, and not a surgical ward where the injury surveillance was occurring Mutto et al. (2011). We faced a similar challenge, and therefore would frequent other wards on a daily basis to see if an injured case was reported elsewhere. Furthermore, the Nzega region is very dry with no significant rains for nine months of the year. All of the data collection in this study was carried out during the dry season which may explain the lack of water related events.

The second aim of this study was to gather information on the incidence and patterns of injuries in the rural region of Nzega, Tanzania in order to help create injury prevention programs. We found that 100 patients sustained injuries during a one month period. This roughly translates to an incidence rate of 346 per 10 000 per year. This figure is consistent with similar studies done in Pakistan (413 per 10 000 per year) and other regions of Tanzania (327 per 10 000 per year) Moshiro et al. (2005); Ghaffar et al. (2004).

The current study revealed that the major mechanisms for injuries included RTIs, acts of violence, and falls. This result is consistent with other studies Moshiro et al. (2005); Ghaffar et al. (2004). Road traffic injuries were also found to be the most likely injury mechanism to result in long term disability. Many motorcyclists and bicyclists do not wear helmets and drive recklessly. Passengers who do not wear helmets run the risk of sustaining head or neck injuries. It is also common in many settings in Africa and other low and middle income countries for cars, bicycles, livestock, and pedestrians to share the same traffic space on narrow poorly maintained roads Borowy (2013). This exponentially increases the likelihood of involvement in road collisions. Successful implementation of a prevention program for injuries lies in using evidence-based practices. Data should guide the direction of the prevention program to ensure that the program reaches those most affected. A literature review by Liu et al. collected information on the use of helmets by motorcycle riders. They found that the use of helmets reduce head injuries by 69% and reduced death by 42% Liu et al. (2008). The authors believe that the data from this research can be used to create a programming aimed at preventing injuries in the region.

There is an obvious requirement for more detailed research on injuries in the Nzega District, with a specific focus on road traffic incidents and violence. We are lacking in large scale, population-based studies which might offer insight into injuries which do not get reported to hospital settings. This study presents an opportunity to expand on the surveillance on injuries in Tanzania. With more research into injuries in the Nzega District and elsewhere in Tanzania, it may be possible to create prevention strategies in order to prevent injuries based on examining and targeting their risk factors. This in turn will reduce costs to individuals, hospitals and society and will contribute to breaking the poverty cycle.

Limitations

This study has several limitations. First, language difficulties, such as translating the survey in a culturally appropriate manner may have limited the interpretability of the survey for participants. In order to minimize language barriers we trained bilingual hospital staff to translate the survey into Swahili for patients. Second, this study only looked at one hospital that covered a small area in the Tabora Region. This, along with the short one-month data collection period resulted in a small sample size that limits generalizability. Third, we were unable to capture injuries outside of the Nzega District Hospital, for those individuals who died as a result of their injuries or for patients who attended a different ward from the surgery ward. Future research should capture injury demographics over a 12-month period. Seasonal variations between the dry and wet seasons could have an impact on the results. Finally, our study period overlapped with Ramadan. Nzega has a sizable Muslim population (30%) Council (2012). Research has suggested that fasting during Ramadan may increase the risk of injuries due to hypohydration, increased perception of fatigue, glycogen depletion, altered carbohydrate intake, and sleep phase shift Güvenç (2011). However, the present study did not record information on which individuals were fasting during the study period. Taken together the present study highlights the need for longer term surveillance within a larger population.

CONCLUSIONS

This study describes the incidence and patterns of injuries in Nzega, including their demographic factors. We found that there was a high incidence of injuries in Nzega with the major mechanisms being road traffic incidents and acts of violence. The information revealed in this study is important for contributing to future injury prevention programs in the region. However, a more complete surveillance effort is called for in order to create successful prevention programs.

ACKNOWLEDGMENTS

Author contributions

LD and AB participated equally in the study design, data collection, analysis and interpretation of the data. LD drafted the first manuscript. LL and MK participated in the study design, data collection, carried out analysis and interpretation of the data and participated in the drafting of the manuscript in consultation with the co-authors. HK and MLW participated in the study design, implementation of the study protocol and interpretation of the analyses. All authors have given their approval of the manuscript.

REFERENCES

Bachani, A. M., Koradia, P., Herbert, H. K., Mogere, S., Akungah, D., Nyamari, J., Osoro, E., Maina, W., and Stevens, K. A. (2012). Road Traffic Injuries in Kenya: The Health Burden and Risk Factors in Two Districts. *Traffic Injury Prevention*.

Borowy, I. (2013). Road Traffic Injuries: Social Change and Development. *Medical History*, 57(1):108–138.

Chalya, P. L., Mabula, J. B., Dass, R. M., Mbelenge, N., Ngayomela, I. H., Chandika, A. B., and Gilyoma, J. M. (2012). Injury characteristics and outcome of road traffic crash victims at Bugando Medical Centre in Northwestern Tanzania. *Journal of Trauma Management & Outcomes*, 6:1.

Council, N. D. (2012). Comprehensive council health plan for the period of july 2011 - june 2012. *Nzega, Tanzania: Regional Administration and Local Government*.

Ghaffar, A., Hyder, A. A., and Masud, T. I. (2004). The burden of road traffic injuries in developing countries: the 1st national injury survey of Pakistan. *Public Health*, 118(3):211–217.

Güvenç, A. (2011). Effects of Ramadan Fasting on Body Composition, Aerobic Performance and Lactate, Heart Rate and Perceptual Responses in Young Soccer Players. *Journal of Human Kinetics*, 29:79–91.

Kamala, B., Wilson, M. L., and Hasselberg, M. (2011). Pattern of childhood falls in a low-income setting: a cross-sectional study in Dar es Salaam. *International Journal of Injury Control and Safety Promotion*, 18(4):305–311.

Liu, B. C., Ivers, R., Norton, R., Boufous, S., Blows, S., and Lo, S. K. (2008). Helmets for preventing injury in motorcycle riders. *Cochrane Database of Systematic Reviews*, 1.

Mohan, D. (2002). Road safety in less-motorized environments: future concerns. *International Journal of Epidemiology*, 31(3):527–532.

Moshiro, C., Heuch, I., Astrøm, A. N., Setel, P., Hemed, Y., and Kvåle, G. (2005). Injury morbidity in an urban and a rural area in Tanzania: an epidemiological survey. *BMC Public Health*, 5:11.

Mukhopadhyay, B., Boniface, R., and Razek, T. (2009). TRAUMA IN TANZANIA: Researching Injury in a low-Resource Setting. *McGill Journal of Medicine : MJM*, 12(2).

Mutto, M., Lawoko, S., Nansamba, C., Ovuga, E., and Svanstrom, L. (2011). Unintentional childhood injury patterns, odds, and outcomes in Kampala City: an analysis of surveillance data from the National Pediatric Emergency Unit. *Journal of Injury and Violence Research*, 3(1):13–18.

Odero, W. (2010). Road traffic injuries: are we winning the war in Kenya? *East African Medical Journal*, 87(11):433–435.

WHO (2013). *Global tuberculosis report 2013*. World Health Organization.

238   Zimmerman, K., Mzige, A. A., Kibatala, P. L., Museru, L. M., and Guerrero, A. (2012). Road traffic injury
239   incidence and crash characteristics in Dar es Salaam: a population based study. *Accident; Analysis and*
240   *Prevention*, 45:204–210.

PeerCorps-CIPCS Nzega Trauma Survey (document intended for double-sided printing)

INSTRUCTIONS.[241]**Authorized personnel are asked to complete this questionnaire when confronted with a reportable injury.**

A. Event information

Date of incident:

_____/____/_____
DD/MM/YYYY

Date reported:

_____/____/_____
DD/MM/YYYY

Q1) Time of event:

☐ 1. Morning (6:01-12:00)
☐ 2. Afternoon: (12:01-18:00)
☐ 3. Evening: (18:01-24:00)
☐ 4. Night: (00:01-06:00)
☐ 88. Did not know / remember

Q2) Who brought you to the hospital?

☐ 1. Self
☐ 2. Mother
☐ 3. Father
☐ 4. Both parents
☐ 5. Other family member
☐ 6. Friend
☐ 7. Other
☐ 88. Did not know / remember

Q3) How did you arrive at the hospital?

☐ 1. Taxi
☐ 2. Walked
☐ 3. Bicycle
☐ 4. Private vehicle
☐ 5. Motorbike
☐ 6. Other form of transport
☐ 88. Did not know / remember

Q4) How long did it take you to get to the hospital?

☐ 1. 0-30 minutes
☐ 2. 31-60 minutes
☐ 3. 1-2 hours
☐ 4. 2 hours or more
☐ 88. Did not know / remember

B. Environment

Q5) Where did the incident take place?

☐ 1. At home   2. ☐ In school   3. ☐ At workplace   4. ☐ Highway / street   ☐ 5. Other place

☐ 88. Did not know / remember

C. Respondent information

Q6) Were there multiple persons injured in the incident? 1. ☐ Y   2. ☐ N   88. ☐ Did not know / remember

Q7) Sex of the injured person?

☐ 1. Male
☐ 2. Female

Q8) Age_____

(Check ☐ if <1 year)
☐ 88. Did not know / remember

Q9) Did you have any <u>vision</u>, <u>hearing</u> or <u>mobility</u> impairment prior to the event?
1. ☐ Y 2. ☐ N

Q9a) Have you consumed any alcohol within the past 6 hours?
1. ☐ Y   2. ☐ N

Q10) Have you reported to a hospital with an unrelated injury during the past 12-months?

1. ☐ Y 2. ☐ N

3. ☐ Did not know

Q11) Years of formal schooling completed _____.

D. Activity

Q12) What were you doing when you were injured?

☐ 1. Working   ☐ 2. Education   ☐ 3. Sport   ☐ 4. Traveling   ☐ 5. Doing nothing   ☐ 6. Other   ☐ 88. Did not know / remember

E. Injury Information

Q13) [Ask attending physician] What type of injury does the patient have?

☐ 1. Fractures (all types)

☐ 2. Sprain / dislocation

☐ 3. Lacerations (open wounds)

☐ 4. Burn / scalds (all degrees)

☐ 5. Concussion

☐ 6. Lodged foreign body

☐ 7. Abrasions, bruises, soft tissue damage

☐ 8. Multiple injuries

☐ 9. Other, visceral internal injuries

F. Anatomical site of injury

Q14) Where is the physical location of the initial injury?

☐ 1. Face

☐ 2. Head/neck

☐ 3. Chest / abdomen

☐ 4. Extremities

☐ 5. Back

☐ 6. Other

☐ 7. Multiple

G. External cause of injury

Q15) Injury mechanism (what directly contributed to the injury)?

☐ 1. Road traffic collision

☐ 2. Poison

☐ 3. Fall

☐ 4. Drowning / near drowning

☐ 5. Act of violence (including self-inflicted injuries)

☐ 6. Fire

☐ 7. Animal bite

☐ 8. Other

H. Supervision and witnesses

Q16) Who was with you at the time of the incident?

☐ 1. Alone

☐ 2. Friend

☐ 3. Parent / guardian

☐ 4. Other

☐ 88. Did not know/remember

Narrative (Use this section to clarify any of the above, make notations or to identify a death):

Q17) [Ask attending physician]: How long will patient remain in hospital under care / supervision? 1. ☐ <24 hours; 2. ☐ 24-48 hours; 3. ☐ 49-72 hours; 4. ☐ >72 hours

Q18) [Ask attending physician]: Will the injury likely result in any long-term disability (6 months or more)? 1. ☐ Y 2. ☐ N 3. ☐ Did not know

Information received by: _____   **Reported by:** _____