Epidemiology of Traumatic Injuries in the Northeast Region of Haiti: A Cross-sectional Study

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Keywords: emergency care; Haiti; injury; road traffic accidents; trauma

Abbreviations:
KTS: Kampla Trauma Score
LMIC: low- and middle-income countries
MSPP: Ministère de la Santé Publique et de la Population (Ministry of Public Health and Population)
RTA: road traffic accident
RTS: Revised Trauma Score
WHO: World Health Organization

Abstract

Introduction: More than 90% of traumatic morbidity and mortality occurs in low- and middle-income countries (LMIC). Haiti is the poorest country in the Western Hemisphere and lacks contemporary statistics on the epidemiology of traumatic injuries. This study aimed to characterize the burden of traumatic injuries among emergency department patients in the Northeast region of Haiti.

Methods: Data were collected from the emergency departments of all public hospitals in the Northeast region of Haiti, which included the Fort Liberté, Ouanaminthe, and Trou du Nord sites. All patients presenting for emergent care of traumatic injuries were included. Data were obtained via review of emergency department registries and patient records from October 1, 2013 through November 30, 2013. Data on demographics, mechanisms of trauma, and anatomical regions of injury were gathered using a standardized tool and analyzed using descriptive statistics. Temporal analysis of injury frequency was explored using regression modeling.

Results: Data from 383 patient encounters were accrued. Ouanaminthe Hospital treated the majority of emergent injuries (59.3%), followed by Fort Liberté (30.3%) and Trou du Nord (10.4%). The median age in years was 23 with 23.1% of patients being less than 15 years of age. Road traffic accidents (RTAs) and interpersonal violence accounted for 65.8% and 30.1% of all traumatic mechanisms, respectively. Extremity trauma was the most frequently observed anatomical region of injury (38.9%), followed by head and neck (30.3%) and facial (19.1%) injuries. Trauma due to RTA resulted in a single injury (83.8%) to either an extremity or the head and neck regions most frequently. A minority of patients had medical record documentation (37.9%). Blood pressure, respiratory rate, and mental status were documented in 19.3%, 4.1%, and 0.0% of records, respectively. There were 6.3 injuries/day during the data collection period with no correlation between the frequency of emergent trauma cases and day of the week ($R^{\wedge 2} = 0.01$).

Conclusions: Traumatic injuries are a common emergent presentation in the Northeast region of Haiti with characteristics similar to other LMIC. Documentation and associated data to adequately characterize the burden of disease in this region are lacking. Road traffic accidents are the predominate mechanism of injury, suggesting that interventions addressing prevention and treatment of this common occurrence may provide public health benefits in this setting.

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Introduction

Traumatic injuries are a substantial global health problem accounting for over five million deaths annually.[1] Among these, more than one million fatalities are attributable to road traffic accidents (RTAs).[2] At approximately 90%, a disproportionate burden of injury-related deaths occur in low- and middle-income countries (LMIC).[1,3,4] It is estimated that one-third of injury-related deaths could be prevented with improved trauma systems in LMIC.[5] In high-income settings, the development of injury surveillance and subsequent

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improved understanding of the epidemiology and treatment of traumatic illness has significantly reduced morbidity and mortality.[6,7] Paradoxically, while the majority of the disease burden exists in LMIC, there is a paucity of available information to define and address this public health problem.[8] In response, international bodies have identified traumatic injuries as a focus point for global health initiatives with development of injury surveillance, trauma response systems, and enhanced injury research as crucial aspects.[9,10]

Haiti is one of the poorest countries in the Western Hemisphere and has the highest rates of infant, child, and maternal mortality among western nations.[11-14] Contemporary data on mortality due to trauma in Haiti are scarce. In 2014, the Pan American Health Organization (PAHO; Washington, DC USA) was unable to report injury mortality estimates due to a lack of available data.[13] Estimates from 2012 and 2013 by the World Health Organization (WHO; Geneva, Switzerland) placed interpersonal violence as the seventh leading cause of death among adults and injuries as the sixth leading cause for children less than 15 years of age in Haiti.[15] As in most resource-limited settings, the poorest of the Haitian population bear the disproportionate majority of health burdens. The Northeast Department, with a population of approximately 350,000 people, is one of the most economically disadvantaged regions of Haiti with approximately 80% of inhabitants living on less than one US dollar per day.[16]

The Northeast region is served by three public hospitals: Fort Liberté, Ouanaminthe, and Trou du Nord, which are part of Ministère de la Santé Publique et de la Population (MSPP), Haiti's Ministry of Health. These health facilities each have 24-hour acute care emergency departments with personnel available to provide trauma care. Currently, no formalized trauma surveillance is undertaken at any of the MSPP facilities in the Northeast Department of Haiti.

Although no organized injury surveillance exists in Haiti, there is a small literature base in relation to trauma. A survey study published in 2014 found that four of six hospitals in the central region of Haiti reported treating >250 trauma patients per month.[17]Additionally, a cross-sectional study from Fort Liberté Hospital in the Northeast region found that approximately 25% of all acute care and emergency patients presented for evaluation and treatment of traumatic injuries.[18] Although these studies provide some information on the burden of trauma in Haiti, the data are not sufficient to define the epidemiology of traumatic injuries.

Given the importance of the development of trauma care and research in LMIC,[10] and the dearth of available information from Haiti, it follows that geographically-focused data are needed to guide public health policies and interventions. This cross-sectional study aimed to assess the epidemiology of traumatic injuries in the Northeast Department of Haiti with a goal of informing and enhancing public health practices.

Methods

Ethics Statement

The study was approved by the Institutional Review Board of the State University of New York Downstate Medical Center (Study number: 729977-1; Brooklyn, New York USA) and the MSPP from the Northeast Department, Haiti.

Study Design, Participants, and Setting

This hospital-based, cross-sectional, retrospective observational study was undertaken in the Northeast Department of Haiti. Data were collected on patients presenting at all public hospital emergency departments in the region from October 1, 2013 through November 30, 2013. Sites included were Fort Liberté, Ouanaminthe, and Trou du Nord hospitals. All patients presenting for evaluation and treatment of emergent traumatic injuries were eligible for inclusion. Traumatic injuries were identified by study personnel and defined as an injury or wound caused by the application of external force or violence.[19] These personnel were emergency medicine physicians trained and practicing clinically in the United States. Patients with non-traumatic causes for presentation were excluded.

The emergency departments of the included hospital sites represent the only 24-hour publicly accessible health care access points in the region. Each department is staffed at all times by at least one nurse and physician. Each of three departments has regular access to basic supplies for care of traumatic injuries, inclusive of gauze, tourniquets, scalpels, sutures, and splints, but none has access to Computed Tomography, blood products, spinal immobilization devices, or mechanical ventilators. Emergent surgical services consistently are available at the Fort Liberté and Trou du Nord hospitals and intermittently available at the Ouanaminthe hospital.[20]

Procedures and Data Collection

Personnel trained in study protocols gathered data using a standardized collection instrument. The collection tool was designed to assess factors pertinent to the epidemiology of traumatic injuries in the Northeast region of Haiti. The tool was derived from previous work exploring prehospital care capabilities in the same setting,[17] and it also utilized components of previously validated evaluation tools to characterize injury burdens and prognostic outcomes for patients with traumatic injuries.[8] Specifically, variables from the Revised Trauma Score (RTS) and the Kampala Trauma Score (KTS) were incorporated.[21-23] The anatomical regions of injuries were characterized based on classifications used to calculate standard injury severity scores.[24,25]

As has been employed previously in formative trauma research in low-income settings, a hospital-based surveillance protocol was used.[26-28] Data were obtained through review of emergency department registry logs and hospital records. Ministère de la Santé Publique et de la Population protocols require that all patients presenting for care at emergency departments are recorded in the departments' registry logs, in addition to having medical documentation in the patient's own hospital record. Emergency department registry logs contain basic information including: date of presentation, age, gender, and reason for evaluation. Medical records are maintained in each hospital's records department and are filed by name and unique medical records numbers. All patients presenting for emergency care are intended to have written documentation of evaluation and treatment for each emergency health interaction. To enhance data acquisition, a redundant sampling strategy was employed in which trained study personnel extracted data from the medical records and department registry logs in parallel for all emergency patients presenting during the study period. Duplicate records were triangulated using patient name, date of birth, and date of care with duplicate results removed. Department registries and medical records were accessed with the aid of on-site records staff at each MSPP hospital site. Study personnel responsible for record review and data extraction were fluent in Haitian Creole and French, the languages used for documentation.

All patients presenting for emergent care of traumatic injuries at the hospital sites during the study period were included.

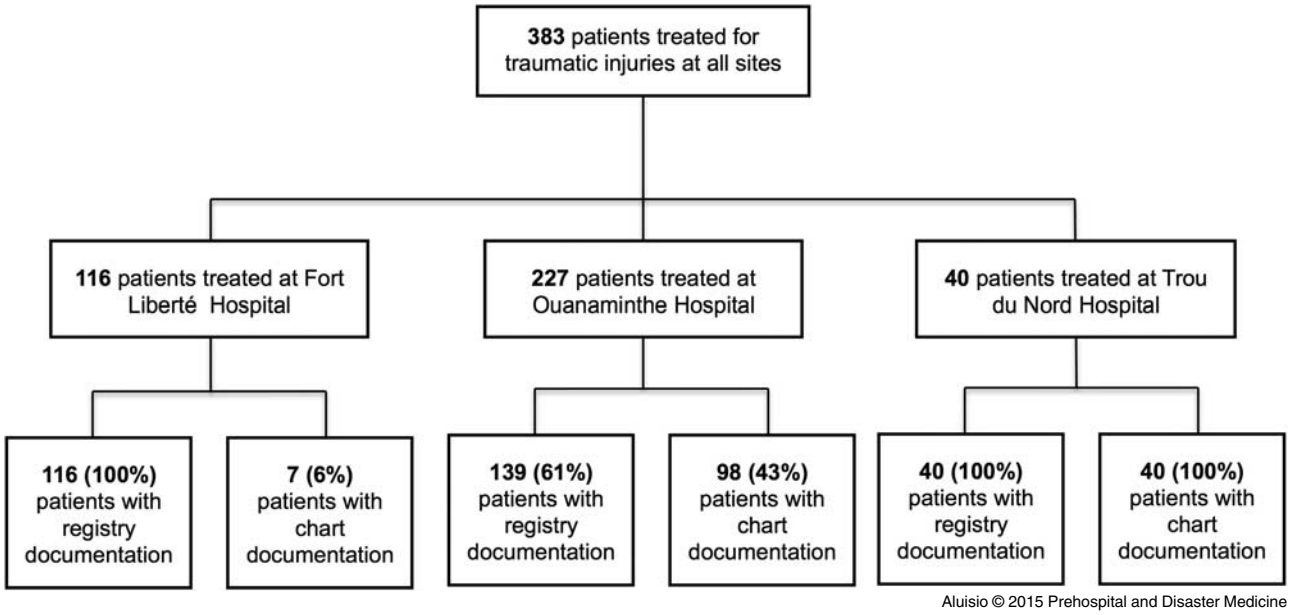

Figure 1. Study Population.

Data used to define mechanisms and anatomical regions of injuries primarily were extracted from medical records and then from department registries if not available in the medical records. If neither source provided sufficient information to characterize the traumatic mechanism, it was deemed not specified. Data on physiologic factors pertaining to components of the RTS, KTS, and number of injuries sustained in relation to the index trauma visit were derived solely from medical records.[21-23] If more than one anatomical region was indicated as injured, each region of injury was recorded.

Statistical Methods

Data analysis was performed using STATA version 11.0 (StataCorp; College Station, USA). Descriptive analyses were undertaken for the overall study population. Characteristics of chart documentation pertaining to the index traumatic event were evaluated. To assess patients suffering trauma via RTA, an a priori subgroup analysis was performed where RTA patients were stratified by hospital site and evaluated. Categorical variables were explored using frequencies with percentages, and continuous variables were analyzed using means with corresponding standard deviations or medians with corresponding interquartile ranges. For categorical variables, statistical differences were assessed using Fisher's exact tests. Given known population density variations which occur in the Northeast region due to day-specific weekly commerce gatherings and prior research which has demonstrated temporal variations in injury patterns, the frequency of traumatic injuries based on day of the week were explored.[17] The frequency of injuries was plotted by day of the week and examined graphically for the overall cohort and stratified by hospital site. The plotted relationships did not approximate any polynomial functions and were fit with linear regression modeling to yield an $R^{\wedge 2}$ statistic for goodness-of-fit.[29]

Results

A total of 383 patient encounters for traumatic injuries were recorded during the data collection period. The majority of patients were evaluated and treated at the Ouanaminthe (59.3%) and Fort Liberté (30.3%) hospitals. Forty patients (10.4%) with injuries were evaluated and treated at the Trou du Nord hospital. In comparison to emergency department registry logs, there was variability in data capture by medical records with ascertainment of 6.0%, 43.0%, and 100.0% of patients at the Fort Liberté, Ouanaminthe, and Trou du Nord hospitals, respectively (Figure 1).

The median age in the overall population was 23 years. Children less than 15 years of age accounted for 23.1% of the population across all hospital sites. The majority of patients overall with traumatic injuries were male (62.7%) and less than 44 years of age (88.5%). A mechanism of injury was documented in 193 patient encounters (50.5%; Table 1). Among these patients, RTA was the most frequently reported mechanism of trauma (65.8%), followed by assaults (30.1%) and accidental injuries (4.1%). Anatomical regions of injuries were documented via emergency department registries or hospital charts in 172 patient encounters (44.9%). Extremity trauma was the most frequently injured anatomical region (38.9%), followed by head and neck injuries (30.3%) and facial trauma (19.1%; Table 1). No significant differences existed for mechanism of injury based on hospital site ($P = .41$).

There was medical record documentation for 145 (37.9%) trauma evaluations during the study period. Documentation in medical records for traumatic injuries was significantly different based on hospital site ($P < .001$) with documentation occurring in all cases at the Trou du Nord hospital, as compared to less than one-half of cases at the Ouanaminthe hospital and only six percent of cases at the Fort Liberté hospital. Patients' mental statuses were not recorded for any patient in any medical record. Vital signs for systolic blood pressure and respiratory rate were documented in 19.3% and 4.1% medical records, respectively. Among traumatic evaluations with medical record documentation, a single injury was most frequently documented with only 16.2% having greater than one injury noted. No mortalities were documented during treatment of injured patients in the medical record documentation (Table 2).

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	n (%)/Median (IQR)
Age in Years	23.0 (15.0-32.0)
Age Ranges	
0-14	84 (23.1%)
15-44	238 (65.4%)
45-64	33 (9.1%)
≥65	9 (2.5%)
Gender	
Male	239 (62.7%)
Female	142 (37.3%)
Mechanism of Injury	
RTA	127 (33.2%)
Assault	58 (15.2%)
Accidental Injury	8 (2.1%)
Mechanism Not Specified	190 (49.5%)
Anatomic Region of Injury	
Head and Neck	52 (30.3%)
Face	33 (19.1%)
Chest	6 (3.5%)
Abdomen	6 (3.5%)
Extremities	67 (38.9%)
Other	8 (4.7%)

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Table 1. Cohort Characteristics
Abbreviation: RTA, road traffic accident.

	n (%)
Documentation at Hospital Sites[a]	
Fort Liberté	7 (6.0%)
Ouanaminthe	98 (43.2%)
Trou du Nord	40 (100.0%)
RTS Documentation	
Glasgow Coma Scale	0 (0.0%)
Systolic Blood Pressure	28 (19.3%)
Respiratory Rate	6 (4.1%)
Documentation of Neurological Status[b]	0 (0.0%)
Number of Injuries Documented	
1	114 (83.8%)
2	20 (14.7%)
3	2 (1.5%)
Hospital Mortalities	0 (0.0%)

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Table 2. Characteristics of Medical Record Documentation
Abbreviation: RTS, Revised Trauma Score.
[a] Numbers reported for medical record documentation represent medical records per hospital site with denominator values drawn from the number traumatic evaluations occurring at the site.
[b] Neurological status assessed for documentation of patient characteristics to determine AVPU (alert, responds to verbal stimuli, responds to painful stimuli, unresponsive) as has been used previously in the Kampla Trauma Score.

Road traffic accidents accounted for 33.2% of evaluations for traumatic injuries. There were two injuries due to RTA recorded at the Trou du Nord Hospital site during the study period. The majority of patients were male across all sites. Among 37 patients with documented anatomical regions of injuries due to RTA, head and neck injuries were most frequently documented at the Fort Liberté and Trou du Nord hospitals, while extremity injuries were the most common at the Ouanaminthe hospital. For the majority of patients with injuries due to RTA, a single injury was documented at all hospital sites (Table 3).

There was an average of 6.3 injuries per day across all sites during data collection. Figure 2 illustrates visits by day of the week over the study period. There was no correlation between the frequency of emergent trauma cases and day of the week ($R^{\wedge 2} = 0.01$). The lack of correlation was maintained when the analysis was stratified by hospital site (data not shown).

Discussion

This study provides the first available data on patients with traumatic injuries presenting for emergent care in the Northeast Department of Haiti. The results demonstrate that trauma is a common reason for presentation to the public hospital system in the region and that patients were predominantly male, in their third decade of life, and injured via RTA. Documentation practices were immensely deficient at the hospital sites studied. This highlights the need for improved prospective trauma surveillance in the region to more comprehensively define burdens of disease and inform interventional public health programming.

Given the projected global increase in the burden of traumatic injuries with a disproportionate burden occurring in low-income countries, understanding the epidemiology of injuries in resource-constrained settings, such as the one studied, is crucial.[30-32] Similar to global trends and findings from other LMIC settings, the present study found that males less than 45 years of age were the predominant population presenting for care of traumatic injuries.[33-35] Additionally, this finding reproduces data from a prior study from the same region in Haiti, suggesting validity in the results.[17]

Counter to previous reports from low-income areas, the most frequent anatomical location of trauma in this setting was extremity injuries.[36,37] This may stem from sampling bias. The hospital-based data collection methodology was not able to sample patients with injuries who failed to present for treatment. Subsequently, this may have skewed the distribution of observed injuries, as severely injured patients who expired in the prehospital

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	Hospital Site		
	Fort Liberté (n = 49)	Ouanaminthe (n = 76)	Trou du Nord (n = 2)
Age in Years[a]	26 (21-46)	23 (16-30)	35 (24-46)
Gender			
Male	30 (61.2%)	50 (65.8%)	2 (100.0%)
Female	19 (38.8%)	26 (34.2%)	0 (0.0%)
Anatomic Region of Injury			
Head and Neck	5 (83.2%)	7 (23.3%)	1 (100.0%)
Face	1 (16.7%)	4 (13.3%)	0 (0.0%)
Chest	0 (0.0%)	1 (3.3%)	0 (0.0%)
Abdomen	0 (0.0%)	1 (3.3%)	0 (0.0%)
Extremities	0 (0.0%)	14 (46.7%)	0 (0.0%)
Other	0 (0.0%)	3 (10.0%)	0 (0.0%)
Number of Injuries Documented			
1	5 (100.0%)	35 (77.8%)	2 (100.0%)
2	0 (0.0%)	9 (20.0%)	0 (0.0%)
3	0 (0.0%)	1 (2.2%)	0 (0.0%)

Table 3. Characteristics of RTA Patients by Hospital Site
Abbreviation: RTA, road traffic accident.
[a] Reported estimates represent median with corresponding interquartile range.

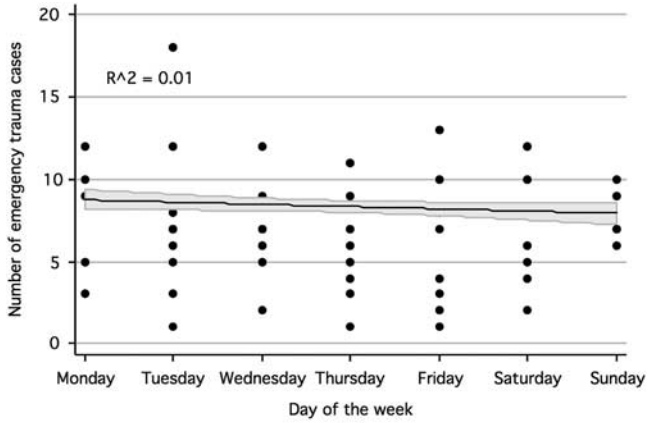

Figure 2. Frequency of Traumatic Injuries by Day of the Week.[a]
[a] Regression line with 95% confidence interval shown.

setting may not have been captured. Similarly, as out-of-hospital mortality due to trauma in low-income settings is known to be high, the sampling frame may also contribute to the lack of observed deaths in the data.[38-40]

Among patients with a documented mechanism of injury, RTAs were the predominant etiology in the population studied. This result agrees with prior reports from other LMIC. A retrospective study from Tanzania reported similar trends in mechanisms of injuries, with RTA and interpersonal violence observed as the most frequent mechanisms in that cohort.[33] Further, a multinational surveillance study carried out in five countries in sub-Saharan Africa demonstrated a similar proportion of injuries due to RTA as in the current study.[41] As RTAs are the global epidemiologic driver for the increase in deaths due to trauma, their predominance as a mechanism in the present study highlights their importance in the Haitian setting.[2] Although these data are limited, the findings suggest that interventions aimed at prevention and treatment of RTA may be an efficacious public health endeavor in the Northeast region. However, further prospective work evaluating programming designed around mitigating injuries associated with RTA is needed to assess this hypothesis.

Multiple deficiencies in documentation of traumatic injuries were found in this study. Overall medical records were maintained for less than one-half of injured patients, although there was variation by hospital site. There was a lack of sufficient data across all sites to accrue information for calculation of trauma prognostication or injury severity scores.[21-25] Although these findings limit the data reported, they demonstrate the need for investment in improved trauma surveillance systems and training of health care practitioners to better define the burden of disease and inform regional interventions. In El Salvador and Nicaragua, development of trauma registries has been associated with improved injury prevention and treatment initiatives.[42] A systematic review on the topic of trauma surveillance in LMIC concluded that although

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trauma registries are not common, implementation is both feasible and needed.[8] Taken in concert, the findings of the present study and of prior reports support statements by the WHO which recommend development of injury surveillance, trauma response systems, and enhanced injury research in resource-constrained settings.[9,10] Investment in surveillance in the Northeast Department of Haiti would likely serve to better define the epidemiology of traumatic disease in the region and to inform the development of setting-appropriate interventions. To enhance the understanding of disease burden and sustainably facilitate development of prospective surveillance, advocacy and supportive policies from the Haitian MSPP, in conjunction with education of local stakeholders, will be needed.[43]

Limitations

This study must be interpreted in the context of its limitations. Given the retrospective design, the results are subject to selection and misclassification biases. As previously discussed, the hospital-based data collection likely suffered from selection bias as only patients presenting for care were eligible for inclusion. Further, if failure of documentation of the visit occurred, this subset of patients would not have been assessed. As the methodologies employed redundant sampling of both patient departmental registries and full medical records, this should have been minimized; however, such bias is likely present in the results. Additionally, if patients presented for reasons both medical and traumatic in nature, they could have been misclassified in the documentation process and not captured in the cohort. These limitations are substantial; however, in settings without formal trauma surveillance systems, institution-based data collection is utilized to provide an initiation point for defining burdens of disease and associated health needs.[41,44] The current work aimed to serve as sentinel surveillance for traumatic injuries in the Northeast region with the goal of informing the public health knowledge base. As injuries have known epidemiologic variability over time,[45] temporal trends in the data were analyzed. However, the cross-sectional design does not provide information on the incidence of injuries that would likely be important in development of trauma care systems. A prospective trauma surveillance study would address this limitation and provide longitudinal data on injury patterns in this setting.

Conclusions

This work provides baseline epidemiological data on traumatic injuries in the Northeast Department of Haiti. The results demonstrate that injuries are a common emergent presentation in this area of Haiti and the characteristics observed were similar to data from other LMIC. Road traffic accidents were the predominant mechanism of injury, suggesting that interventions aimed at prevention and treatment of RTA may be efficacious in this setting. Documentation of traumatic injuries was deficient in the population and limits the results of this study; however, it highlights the need for improved surveillance to better define the burden of disease and to inform interventions in the region.

Author Contributions Statement

ARA, ADW, AL, and CB conceived and designed the study. ADW and AL supervised data collection and study activities. ARA, ADW, AL, and CB were responsible for statistical analysis and data reporting. ARA, ADW, AL, and CB drafted the manuscript and contributed to revisions and final presentation. All authors read and approved the final manuscript.

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