Burns Open 3 (2019) 75–82

Contents lists available at ScienceDirect

Burns Open

journal homepage: www.burnsopen.com

Review of the epidemiology of burn injuries in Ethiopia; implications for study design and prevention

Edna Adhiambo Ogada [a,1,*], Abiye Hailu Gebreab [b], Thomas Stephen Potokar [c,2]

[a] Centre for Global Burn Injury Policy and Research, College of Human and Health Sciences, Swansea University, Singleton Park, 25 Haldane Building, Swansea SA2 8PP, United Kingdom
[b] Burn Unit, Yekatit-12 Hospital, Federal Government of Ethiopia, Ministry of Health, Addis Ababa, Ethiopia
[c] Centre for Global Burn Injury Policy and Research, College of Human and Health Sciences, Swansea University, Singleton Park, Swansea, United Kingdom

ARTICLE INFO

Article history:
Received 25 April 2019
Received in revised form 14 May 2019
Accepted 18 May 2019
Available online 18 May 2019

Keywords:
Injury
Ethiopia
Epidemiology
Prevention
Burns

ABSTRACT

Background: 90% of burn deaths occur in lower resource settings, where prevention programs are uncommon. Efficient planning and resource allocation for prevention requires consistent and reliable data. Published research on burn epidemiology from these settings is limited in scope and rigor and often not replicable.
Objective: The objective of the review was; to examine the literature to determine what information exists on the epidemiology of burn injuries in Ethiopia; to assess its utility and suitability for planning interventions for burn prevention.
Methods: Taking a public health approach in which burn injuries fall within the broader field of injury, a broad key term search was performed in Safety Lit and MEDLINE. We reviewed the literature on burn epidemiology in Ethiopia, to assess its utility and suitability for planning interventions for burn prevention.
Results: Our search strategy yielded more information than burn specific search strategies. We identified 23 studies drawn from observational and primarily hospital-based, cross sectional studies. They offer a preliminary evidence base that can be used to make recommendations for future surveillance, risk factor exploration and prevention initiatives.
Conclusion: We conclude that the low rate of burn cases identified from observational studies; the challenge of defining and coding injury in the field; recall bias; mean case series data from tertiary units are more efficient and sustainable for monitoring burn epidemiology in Ethiopia. We recommend the establishment of a national trauma registry or WHO's Global Burn Registry (GBR) to gather data in Ethiopia and countries in comparable settings. Community studies, provide the best avenue to gauge knowledge, attitudes and practices relevant to injury prevention, first aid and health seeking behaviour. This critical preliminary synthesis on burn epidemiology frames future national research and policy on burn surveillance and prevention.

1. Introduction

90% of burn deaths occur in LMIC, where prevention programs are uncommon and the quality of acute care is inconsistent [1]. Potokar, Chamania, Prowse and Whitaker [2], highlighted the discrepancy in the amount of burns research being published that originates from low and middle income countries (LMICs) compared to high income countries (HIC). Of over 1000 original articles reviewed in the "Burns" journal between 1996 and 2006, one-quarter originated from LMICs and three quarters from HICs. Smolle et al. [3], applied a search strategy using the combination of the key words: "thermal"; "injury"; "trends"; "epidemiology"; "tbsa"; "size"; "depth"; and "mortality", found no studies from low and middle income countries. Efficient resource allocation, distribution, and planning for burn prevention and service provision requires consistent and reliable data. The objective of the review was; to examine the literature to determine what information exists on the epidemiology of burn injuries in Ethiopia; to assess its utility and suitability for planning interventions for burn prevention.

2. Method

A country specific search strategy taking a public health perspective where burn injuries are housed within the field of injury,

* Corresponding author.
E-mail addresses: e.a.ogada@swansea.ac.uk (E.A. Ogada), abiyeh@gmail.com (A.H. Gebreab), t.s.potokar@swansea.ac.uk (T.S. Potokar).
[1] http://orcid.org/0000-0003-0181-2505.
[2] http://orcid.org/0000-0001-9282-8128.

https://doi.org/10.1016/j.burnso.2019.05.002
2468-9122/

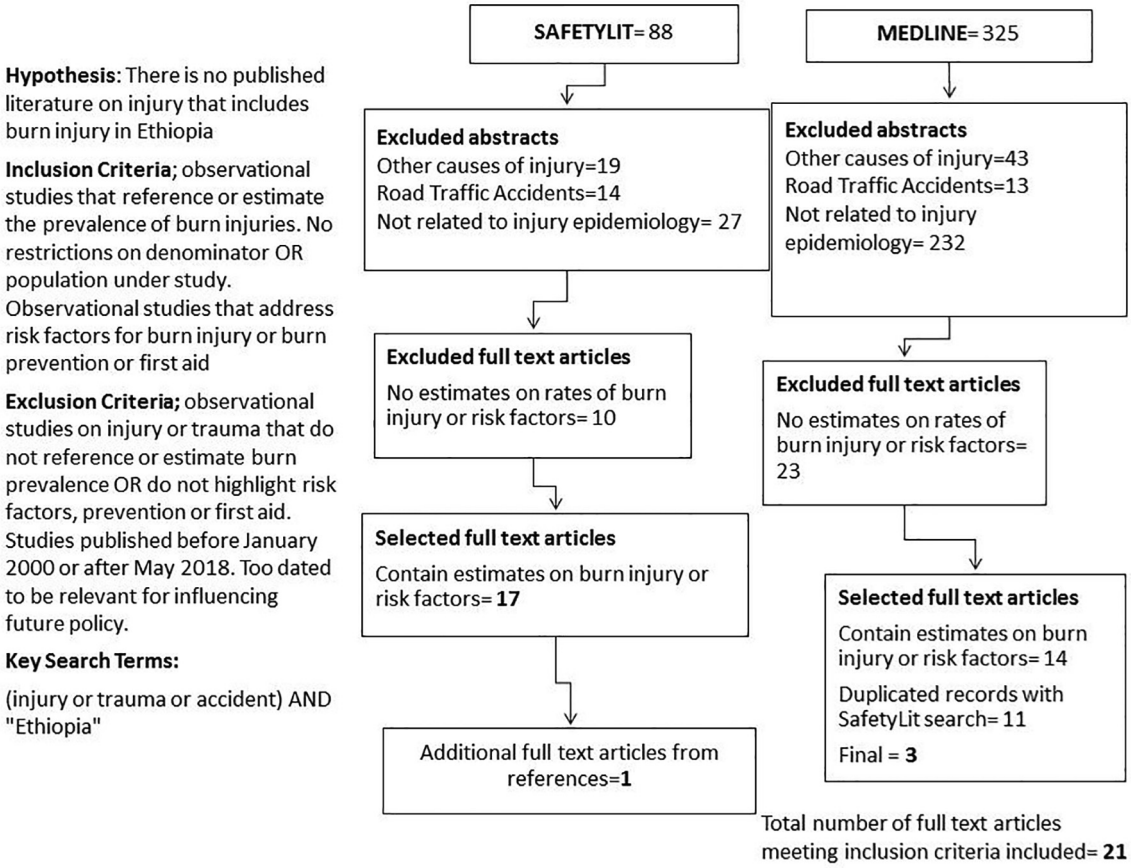

Fig. 1. Article review and exclusion process.

a literature search was performed in SafetyLit [4] and MEDLINE. Two recent published and relevant national reports with estimates on burn injury prevalence were also reviewed. Fig. 1 illustrates the search hypothesis, inclusion and exclusion criteria, key terms and selection process. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were used to report on the cross sectional studies that were identified following this review of published literature on injury in Ethiopia.

3. Results

3.1. Overview of studies on injury in Ethiopia

Twenty three studies that met the inclusion criteria were selected for the review. Fig. 2 is a map of Ethiopia's that plots studies that have been published on injuries in Ethiopia in the last two decades. There remains a lack of information on injury and burn injuries from most areas in the country. Geographic coverage is limited to large referral hospitals in 4 out of 11 regions in the country, with half of the studies taking place in Addis Ababa. The other half were undertaken in larger regional towns namely, Jimma, Mekelle and selected towns in the Amhara region none of which currently have burn units.

Tables 1 and 2 [5–27], estimate that burns account for about 1.5% to 9% of injuries in the all age groups and between 4% and 15% of injuries in the paediatric population. The prevalence of burn injury in the population under study was very low and estimated in a range of between 0.1 and 1.2% for all studies reviewed. Of the 23 studies reviewed only 9 reported the use of statistical tests of association to examine the relationship between injury and risks or social and demographic factors.

3.2. Hospital based studies for tracking trends in prevalence

Of ten observational cross sectional studies in the overall population, half were prospective, and half were retrospective. Only two studies collected data over a period longer than one year, with shortest study period being two months. Eight conducted a full census of available records during the study period, while two sampled from the available data. Wolde, Abdella and Ahmed [13], was the only study that referenced the quality of data, affirming the often cited inferior quality of data from Health Management Information Systems in government facilities in low resource settings. Of 40,000 injury records reviewed in the Addis Ababa Health bureau, a high rate of misclassification was evident. Forty-four percent of all unintentional injuries were categorized under "other accidental causes" and had to be excluded from the analysis putting in doubt both the numerator and denominator used to calculate burn prevalence.

3.3. Community based studies for measuring the prevalence and/or relative burden of burns injuries

Fig. 3 illustrates the findings from two studies carried out in conjunction with the Federal Government of Ethiopia. The discrepancy between the findings from the injury modules on the relative burden of burn injuries from [6,8] conducted six months apart points to the following challenges; i) lack of a concise and standard field definition of what constitutes a burn injury; ii) lack of standard coding of causes of injury and mechanisms; iii) lack of a standard approach to reporting on the burden of injury; iv) lack of a standard approach to sampling, e.g. the World Health

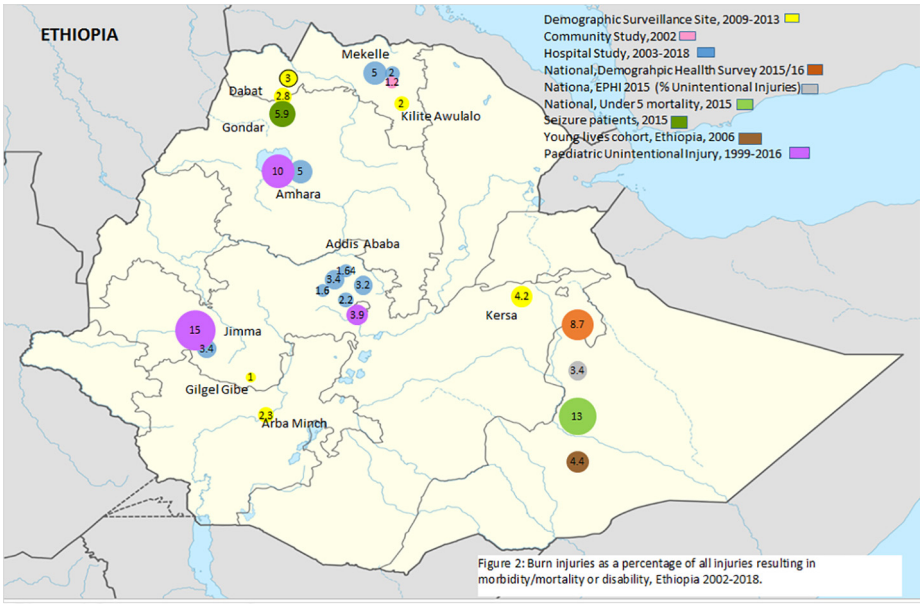

Fig. 2. Burn injuries as a percentage of all injuries resulting in morbidity/mortality or disability, Ethiopia 2002–2018.

Table 1
Summary description of studies reporting on burn injury in Ethiopia, 2000–2018.

Author	% of injuries	% in pop	Study location, design, data source, period, size, population and case definition	Strengths (S), limitations (L) and biases (B)
Gelaye, 2019 [5]	4.5%	0.3%	**Five Health Demographic Surveillance Sites (HDSS)** Verbal Autopsy data on all deaths between 2009 and 2013 28 deaths due to accidental exposure to fire, smoke, 623 deaths by external causes and 9719 deaths in total Cause of death ascertained by interview with next of kin and VA forms reviewed independently by 2 blinded physicians and settled by a 3rd physician for any disagreements	Cross sectional data drawn from an open dynamic cohort **(S)** Non-representative small sample **(L)** Recall bias **(B)**
CSA, 2016 [6]	8.7%	0.2%	**National Sample** • Population based demographic health cross sectional survey conducted every 5 years since 2000 with an injury module included in 2016 • 12 month period prior to data collection in early to mid- 2016 • 48 burn injuries, 548 injuries, 16,650 households; 28,371 men and women aged 15–59 years • Any household members who were involved in any accident with injuries severe enough that they could not carry out their normal activities for $\geq$ 1 day or resulted in their death	• Large representative national sample- PPS method **(S)** • Recall bias **(B)** • Weighted percentages to ensure national representation **(S)**
Amdeslasie, 2016 [7]	2.0%	–	**Mekelle, Tigray** • Retrospective sampled based cross sectional review of hospital records from January to December 2013 • 625 injuries from >10,000 OPD visits using semi-structured data collection form using ICD10 to classify causes of trauma	• Not clear if sample was representative of injury patients in OPDs **(L)** • Use of ICD codes **(S)** • Chi square test for associations between categorical variables **(S)**
EPHI, 2016 [8]	3.4%	0.1%	**National Sample** • Population based survey on Non Communicable Diseases (NCDs) with a module on injury12 month period prior to data collection in mid-2015 • 9 burn injuries, 253 injured in non-road traffic accidents, 9800 respondents – 15–69 years • Accidental injuries other than road traffic crashes with required medical attention	• Large representative national sample- PPS method **(S)** • Recall bias**(B)** • Prevalence and mean variance with 95% confidence interval (CI) **(S)**
Bashah, 2015 [9]	5.0%	–	**Amhara** • Prospective cross-sectional study in 3/5 regional referral hospitals selected by lottery method. Participants included proportionally considering daily patient flow after sample size calculated using a single population proportion formula • Data collection from March to April 2014 • 414 participants from undefined population making OPD visits during study period • Semi-structured data collection form adapted from WHO injury surveillance guidelines	• Sample size calculation not replicable given the information provided **(L)** • Outlier findings -Injuries were 50% of OPD visits **(L)** • Bivariate and multivariable logistic regression with odds ratio OR and CIs for associations between injury and dependent factors **(S)**

(*continued on next page*)

Table 1 (*continued*)

Author	% of injuries	% in pop	Study location, design, data source, period, size, population and case definition	Strengths (S), limitations (L) and biases (B)
Meskere, 2015 [10]	–	–	**Addis Ababa** • Prospective Cross sectional study design based in Tikur Anbesssa Specialized hospital • Focus on pre hospital care for trauma patients treated at the facility during study period of February to March 2013 • Structured questionnaire	• Full census of patients admitted to the emergency department **(S)** • Limited to patients who arrive alive to a single facility **(L)** • Short study period **(L)** • Calculated ORs looking at pre-hospital care and SES indicators **(S)**
Woldemichael, 2011 [11]	3.4%	0.3%	**Jimma, Oromia** • Retrospective cross sectional review of records of injured patients at surgical out-patient department from April 2010 to January 2011 • 1102 injury records from a total of 13,500 OPD visits • Semi-structured data collection form adapted from WHO injury surveillance guidelines • Case defined as an injury presented by one person for the first time irrespective of whether that person had one or multiple injuries	• Full census of records during study period **(S)** • Limited to one tertiary level facility **(L)** • Binary logistic regression to calculate adjusted ORs and CIs **(S)**
Gemechu, 2009 [12]	2.2%		**Addis Ababa** • Retrospective review of autopsy records- consecutive 2 month period excluding children during a 2 month period • 98 natural cause deaths, 90 injury deaths and a total of 188 autopsies • Causes of death defined from accompanying police report or clinical information or both including histopathological analyses using tissue blocks obtained from the subjects	• Full census of records during study period **(S)** • Small sample and short study period **(L)**
Wolde, 2008 [13]	3.2%	0.1%	**Addis Ababa** • Retrospective review of data from the District Health Information System (DHIS) from the health bureau of Addis Ababa city administration from July 2005 to June 2006 • 40,752/ 1,044,025 – (3.9%) OPD visits were for injuries at OPD departments, 44% of unintentional injuries classified as "other accidental causes" with no clear indication of what these were • Semi-structured data collection form using ICD10 to classify causes of trauma, only first visit for an injury included in the study	• Full census of records during study period with indication of data quality **(S)** • Largest health bureau in Ethiopia providing preventive and curative services via five hospitals and 24 health centres **(S)**
Alemu, 2008 [14]	5.0%	–	**Mekelle, Tigray** • Retrospective audit of all victims brought dead to Mekelle hospital due to trauma from September 2004 to June 2006–6 electrical fatalities of 120 fatalities • Police reports and medical records, not quantified but authors reported poor quality and lacking information lead to exclusion of fatalities	• Full census of records during a long study period **(S)** • Limited to one tertiary level facility **(L)**
Kebede, 2008 [15]	1.6%	–	**Addis Ababa** • Prospective cross-sectional study. Six major government referral hospitals from February 2003 to August 2003 in the Addis Ababa Health Bureau • 148 burn related injuries of 9000 injured patients • Semi-structured data collection form using ICD10 to classify causes of trauma	Full census of cases presenting **(S)**Not inclusive of private facilities **(L)**
Osman, 2003 [16]	5.0%	0.3%	**Gondar, Amhara** • Prospective cross-sectional study- North Gondar administrative zone in two hospitals and 12 functional health centres, 72 health stations and 30 health posts from April- July 2000 • 95 burn patients of 1982 injury patients/ 37,026 patients who visited facilities	• Full census of cases presenting **(S)** • Only accessible health centres includes in the study **(L)** • Short study period **(L)** • Indicated use of Statistical Package but reported no tests or results **(L)**
Taye, 2003 [17]	3.9%	–	**Addis Ababa** • Prospective cross-sectional study- Tikur Anbessa Hospital from January to June 1999 • 3822 injured patients presenting to emergency rooms of the surgical and paediatric department • Simplified hospital trauma registry developed in Uganda based on WHO minimum data set and adopted and refined by Injury Prevention Initiative for Africa	• Full census of cases presenting **(S)** • Short study period in a single tertiary facility in a single department **(L)**
Nega, 2002 [18]	–	1.2%	**Mekelle, Tigray**Population based cross sectional study of 7309 respondents in Mekelle townBurn injuries larger than 2 cm by 2 cm or lesions that formed blisters	• Annual incidence of burn injury **(S)** • Representative Community based sample **(S)** • Recall bias **(B)** • Limited to burn injury **(L)** • Did a chi square analysis with CIs and calculated ORs for burn injury considering SES factors and means of cooking **(S)** • Collected information on KAP and first aid practices **(S)**

Organisations' [28] guide for community based surveys on injury; and iv) a need to account for more than just fire-related injuries as in the DHS, given e.g. Ready et al. [19] observed an increase in electrical burns in their study.

3.4. Causes and risk factors of burn injuries

Table 3 synthesizes findings on the causes and risk factors for burn injuries where this information was presented in the papers

Table 2
Summary description of studies reporting on burn injury in sub- populations in Ethiopia, 2000–2018.

Author	% of injuries	Study location, design, data source, period, size, population and case definition	Strengths (S), limitations (L) and biases (B)
Ready, 2018 [19]	–	**Addis Ababa** Yekatit 12 Hospital burn unit, Two study populations drawn from burn patients admitted to the unit between July 2001 to September 2002 (121 patients) and January to December 2016 (176 subjects)	Case series design limited to burn patients **(L)** Identified key risk factors for burn injury and a significant increase in electric burns presenting to the unit in the two study times, however specific statistical test performed was not referenced **(L)** Limited or no access to archive data as Yekatit 12 only maintains physical charts for 10 years- reliant on a Mulat, 2006 study for previous population data **(L)**
Li, 2018 [20]	13%	**National** • Data sources were the Central Statistics Agency (CSA) of Ethiopia and the World Bank as well as model based estimates from WH) and the Global Burden of Disease (GBD) 2016 project • Sub population of children aged 0–14 years of age	• Systematic review of data and studies with multiple stakeholders and sectors within and external to Ethiopia **(S)** • Despite triangulation of various data sources and extensive literature review, there as a lack of quality data on the causes of injury on which estimates were based **(L)**
Chala, 2017 [21]	3%*	**HDSS site in Dabat**Prospective cross sectional study in a population of 67,395 living in 16, 039 households of which 1228 people were found with disabilities using a structured and pre-tested questionnaire administered in all households using a filtering tool for inclusion	• Cross sectional data drawn from an open dynamic cohort (census every 7 years, quarterly update visits in between) **(S)** • Limited to only one HDSS site so not representative of national population **(L)** • No statistical analysis related to injury and disability but binary logistic regression was fitted to elicit socio economic factors associated with disability **(S)**
Bifftu, 2017 [22]	5.9%	**Gondar, Amhara** • Retrospective cross sectional study looking at seizure related injuries among selected patients with epilepsy at the University of Gondar Hospital • Data collected in November- December 2015 • Single proportion formula used to calculate sample size for systematic random selection of participants • Semi- structured tool administered to 409 participants recruited from an expected sample size of 422	• Limited to population with epilepsy **(L)** • No previously established prevalence rate indicated in sample size calculation and no reference for sampling approach **(L)** • Recall bias **(B)** • Bivariate and multivariable logistic regression with odds ratio and confidence intervals assessed to investigate the relationship between seizure related physical injuries and independent variables **(S)**
Tiruneh, 2017 [23]	10%	**Amhara** • Prospective cross sectional study on childhood unintentional injuries conducted in April 2016 among a sample of injured children less than 18 years of age attending emergency centres for Amhara National Regional State Hospitals • Single proportion formula used to calculate sample size for systematic random selection of participants using a pre-tested interview tool administered to 893 participants recruited from an expected sample size of 963	• Limited to children reporting with unintentional injuries **(L)** • No reference for sampling approach **(L)** • Recall bias and short study period **(B, L)** • Investigated risk factors for injury and conducted simple and multiple logistic regression analysis **(S)**
Mariam, 2006 [24]	15%	Jimma, Oromia • Prospective cross sectional study on paediatric accidents from July 2003 to June 2004 at Jimma University hospital among children under 15 involved in accidents and examined in out or inpatient departments of surgery and paediatrics • Pre-tested structured questionnaire administered to 452 cases meeting inclusion criteria	• Full census of paediatric patients under 15 involved in accidents during study period **(S)** • Identified risk factors and performed statistical analysis but did not indicate which tests **(L)**
Derbew, 2006 [25]	3.8%	**Addis Ababa** • Retrospective study between 1999 and 2004 at Tikur Anbessa University Hospital of all paediatric patients (aged 12 years or under) who had operations or procedures under general anaesthesia in the major operation theatre • Data sources for extracted indicators included the operation registry book and patient charts • Study identified a total of 6070 operations or procedures that met study inclusion criteria of which 228 were related to burn injury or burn contracture	• Full census and long study period **(S)** • Limited to surgical patients undergoing anaesthesia **(L)** • No indication of data quality **(L)**
Howe, 2006 [26]	4.4%	**National** • Cross sectional study carried in sentinel sites within four countries; Ethiopia, India, Peru and Vietnam investigating risk factors for injuries- Young Lives Study (YLS) • Cluster sampling strategy with semi-purposive sampling within each country selected by local experts to represent a range of regions or policy contexts and living conditions with oversampling of sites covering poor areas • 2000 children recruited aged 6–17 months in each country- 1999 in Ethiopia of which 242 suffered any injury	• Non representative sample **(L)** • Sampling approach not clearly defined or referenced **(L)** • Calculated odds ratios looking at child injury and socio economic variables **(S)**
Mulat, 2006 [27]	–	**Addis Ababa** • Prospective cross-sectional study- Yekatit 12 Hospital from July 2001 to September 2002 • 121 burn unit patients/ 7589 **or 1.6%** of admission patients in the study periodSemi-structured data collection tool used to gather data from patients arriving within 72 h of burn injury from all over the country with burns $\geq$ 15% TBSA for adults and $\geq$10% TBSA in children or had burns involving special areas or caused by electricity	• Case series design limited to burn patients **(L)** • Identified key risk factors and causes for burn injury **(S)** • Reported use of chi square, *t*-test and odds ratios to compare dependent and independent factors **(S)** • Tables only presented absolute counts **(L)**

* of disabilities caused by injury.

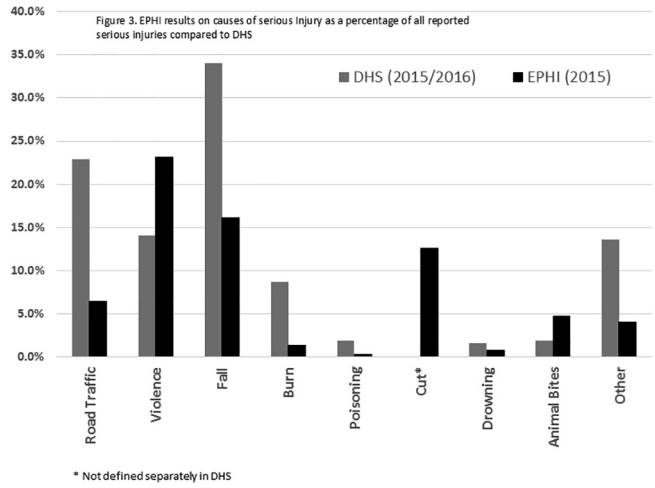

Fig. 3. EPHI results on causes of serious Injury as a percentage of all reported serious injuries compared to DHS.

Table 3
Risk Factors and Causes of Burn Injuries and deaths, Ethiopia 2000–2018.

Study	Ranked Cause of Burn	Risk Factors
Ready, 2018 [19]	Flame Electrical	Cooking Outdoor high voltage electrocution esp. among men in 2001 vs. 2016 cohort
Tiruneh, 2017 [23]	Scalds Flame	Adult presence
CSA, 2016 [6]	*Not reported*	Women Rural residence Lower Income
EPHI, 2016 [8]	*Not reported*	Women Urban residence
Woldemichael, 2011	*Not reported*	Under 5 s Women
Kebede, 2008	*Not reported*	Household Children under 5 yrs. Risk of industrial burns > men
Gemechu, 2009 [12]	Electrical shock	*Not reported*
Alemu, 2008 [14]	Electrical shock	*Not reported*
Mulat, 2006 [28]	Flame Scald Electrical Chemical Other	Exploding kerosene stoves- adults Open Fires- Women Scalds- Children Chemical/Electrical Burns- Industry Workers
Mariam, 2006 [24]	Scalds Flames	Children less than 10 yrs. Rural Residence
Osman, 2003 [14]	Flame Scald Electrical Chemical	Children Men > Electric and Chemical Burns
Nega, 2002 [18]	Scald Flame Contact Electrical	Children Domestic burn injuries- Women Employed head of households HH size ≥ 4Middle and High Income HH • Level of education

and reports reviewed from Tables 1 and 2. Table 3 highlights that flame burns rank first as a mechanism of burn injury in the all ages, while scalds are the leading cause of burns in children. Electrical burns are on the increase and children, women and those residing in rural areas experience a greater frequency of burn injuries occurring mainly at home.

4. Discussion

Krug [29] states that the lack of data on the size of the injury problem and on prevention has contributed to the traditional view of injuries as "accidents", suggesting that they are random unavoidable events and has resulted in their historical neglect, both as a subject of research and as a preventable outcome". He further states that "Expenditure on injury-related research lags behind other health outcomes when considering global research expenditure per disability-adjusted life-year".

The most rigorous and broad scoped approach to calculating the incidence and risk factors for burn injury, would be to establish a community cohort [30]. This is not feasible or efficient given limited resources and competing public health needs in Ethiopia even within field of injury itself.

The low rate of burn cases identified from population-based cross sectional studies, the challenges with defining and coding injury in the field, and recall bias inherent in the survey design make the collection of case series data from tertiary units and emergency departments, the more efficient and sustainable approach to monitoring burn epidemiology in Ethiopia. Declining injury rates, presumably resulting from prevention efforts or improvements in social and economic conditions, would mean it would become increasingly difficult to detect burn injury incidence using community based research designs. The utility of community based surveys to monitor burn prevalence arose during a workshop of injury prevention professionals working in low resource settings at the Centre for Global Burn Injury Policy and Research [31]. The consensus was that community based research were more useful for establishing risks, knowledge, attitudes and practices with regard to prevention and first aid of burns as well as treatment seeking behaviour. Noting its limitation in representing burn injuries in the wider community, collecting case series data is in sync with the expected output of WHO's Global Burn Registry (GBR) which was designed to collect data on risk factors and causes of burn injury with a focus on generating data for burn prevention interventions. Furthermore it dispenses with the challenge of defining a denominator for burn prevalence, focusing instead on actionable risk factors for burn injuries serious enough to require medical treatment that can be monitored and tracked over time.

With a population of over 100 million spread across 1 million square kilometres, Yekatit 12 and Addis Ababa Burn Emergency and Trauma (AaBET) hospitals are the only dedicated burn units in Ethiopia currently. As the only official referral units for burn injuries, these two hospitals admit the most serious burn cases presenting for treatment country wide. Collecting, collating and presenting data on patient outcomes and risk factors from these hospitals and other regional hospitals admitting burn patients should be prioritised, so as to generate evidence to support prevention interventions in Ethiopia.

There are however challenges to reviewing retrospective data from tertiary level hospitals. Though the data from the burn units is used to submit reports to the FMOH, the current health records management systems in both Yekatit 12 and AaBet and indeed emergency departments in regional tertiary hospitals are paper-based and not currently entered into a central database that can be queried.

4.1. Implications for prevention and pre-hospital care

Only two studies in Table 1 looked at injury prevention and/or first aid. Nega and Lindtjørn [18] found that the most common first aid measures for burns represented harmful practices. Meskere, Dinberu and Azazh [10], examined patterns and determinants of pre-hospital care among trauma patients in Tikur Anbessa

specialized hospital. They found that only 16% of 437 cases of injury received any type of pre-hospital care. Key barriers to timely and adequate pre-hospital care were: lack of appropriate transportation (poorly furnished ambulances), distance to hospital, and cost of transportation from patient's perspective and lack of knowledge of confidence to perform first aid by those with the patient at the time of the injury.

4.2. Recommendations for policy and practice

Drawing on the findings of this review which found that women and children in the domestic setting experience greater frequency of flame and scald injuries, future interventions may include; participatory design of cook stoves; alternative energy for cooking, lighting and heating; regulation on kerosene and gas stoves; and behavioural changes in child supervision and /or cooking and heating practices in the home. Ideally, interventions should be centred on the population at risk, for example children in the household setting at risk for burns are also at risk for falls, poisoning and in some cases drowning. A number of studies [32–36], have demonstrated the feasibility of this integrated approach. The increase in electrical burns among men indicates a need for regulation for electrical safety. Further research on electrical burns will highlight what the key risk factors are and inform policy in this area. Above all, all future interventions need to be developed and lead by with communities and local and national governance to ensure sustainability and ownership, even if external actors provide support in the process.

This review has also demonstrated that data collected routinely as part of patient management, can provide a solid basis from which more rigorous surveillance with broader scope in time and place can be undertaken, to inform planning and policy for burn prevention and management in Ethiopia. Nonetheless, it needs to be collected in a more systematic and consistent manner, over longer period of times and stored in databases that can be queried. We propose that tertiary level departments where serious burn injuries present, should register to participate in the GBR which if sustained would generate case series data over several years. Though we note that the GBR may present a parallel system to existing Health Management Information Systems (HMIS) in typically understaffed, underfunded and overstretched health systems. Peck et al. [37], in describing the pilot of the GBR tool in concluded that the main results "suggested few significant potential obstacles to establishing a GBR with standardised collection of data", but did not qualitatively explore the reasons for the wide variation in the reported time required to complete or upload the form nor report on challenges to registering to participate. As global registries are introduced, clearly designed implementation strategies need to be tested to ensure uptake and sustainability. An abbreviated version of the GBR, drawing on retrospective data from admission records and patient charts, can provide much needed data to review burn epidemiology to date. Clinical and public health planning and policy professionals are the key stakeholders who can drive the development of a national network for burn injury surveillance using data that we have demonstrated, already exists even if it is sometimes of poor quality.

Acknowledgements

N/A.

Author contribution

All authors made substantial contributions to the conception, review and interpretation of data. EAO conducted the literature review and wrote the initial draft of the manuscript. AHG and TSP revised the manuscript critically for important intellectual content. All authors have given final approval of the version to be submitted.

Ethics Committee Approval.

N/A.

Funding

This study was funded by the National Institute for Health Research [Global Health Research Group on Burn Trauma, Swansea University (16/137/110)]), Global Health Research]. The views expressed are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care, United Kingdom.

Declaration of Competing Interest

The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Paper Context

Published research on burn epidemiology in lower resource settings is limited. A country specific search strategy placing burns in the broader field of injury yielded more results than a burn limited search. We found that estimated rates from population studies in Ethiopia was very low. Future epidemiological data and surveillance should be drawn from rigorously collected data in secondary and tertiary hospitals. Population studies should focus on community knowledge, attitudes and practices around burn prevention, first aid and health seeking behaviour.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.burnso.2019.05.002.

References

[1] Peck MD. Epidemiology of burns throughout the world. Part I: distribution and risk factors. Burns 2011;37(7):1087–100.
[2] Potokar TS, Ali S, Chamania S, Prowse S, Whitaker IS. A global overview of burns research highlights the need for forming networks with the developing world. Burns 2008;34(1):3–5.
[3] Smolle C, Cambiaso-Daniel J, Forbes AA, Wurzer P, Hundeshagen G, Branski LK, et al. Recent trends in burn epidemiology worldwide: a systematic review. Burns 2017;43(2):249–57.
[4] Safety Lit, https://www.safetylit.org/ [Accessed 26 March 2018].
[5] Gelaye KA, Tessema F, Tariku B, Abera SF, Gebru AA, Assefa N, Zelalem D, Dedefo M, Kondal M, Kote M. Injury-related gaining momentum as external causes of deaths in Ethiopian health and demographic surveillance sites: evidence from verbal autopsy study. Glob Health Action 2018;11(1). https://doi.org/10.1080/16549716.2018.1430669.
[6] Ethiopia and USA. Central Statistical Agency (CSA) [Ethiopia] and ICF Macro. Ethiopia Demographic and Health Survey, Table 2.7.1, p.31. https://dhsprogram.com/publications/publication-FR328-DHS-Final-Reports.cfm; 2016 [Accessed 1 August 2018].
[7] Amdeslasie F, Kidanu M, Lerebo W, Ali D. Patterns of Trauma in patients seen at the Emergency Clinics of Public Hospitals in Mekelle, Northern Ethiopia. Ethiop Med J 2016;54(2):63–8.

[8] Ethiopia. Ethiopian Public Health Institute (2016). Ethiopia, NCD STEPS. Ethiopia STEPS Report on Risk Factors for Non Communicable Disease and Prevalence of Selected NCDs, Page 88, Figure 9.1; Proportion of causes of non-road traffic incidents by sex and place of residence. https://www.who.int/ncds/surveillance/steps/Ethiopia_2015_STEPS_Report.pdf; 2015 [Accessed 1 August 2008].
[9] Bashah DT, Dachew BA, Tiruneh BT. Prevalence of injury and associated factors among patients visiting the Emergency Departments of Amhara Regional State Referral Hospitals, Ethiopia: a cross-sectional study. BMC Emerg Med 2015;15(1):20. https://doi.org/10.1186/s12873-015-0044-3.
[10] Meskere Y, Dinberu M, Azazh A. Patterns and determinants of pre-hospital care among trauma patients treated in Tikur Anbessa Specialized Hospital, Emergency Department. Ethiop Med J 2015;53(3):141–9.
[11] Woldemichael K, Berhanu N. Magnitude and pattern of injury in Jimma University Specialized Hospital, South West Ethiopia. Ethiop J Health Sci 2011;21(3):155–65.
[12] Gemechu T, Tinsae M, Ashenafi S, Rodriguez VM, Lori A, Collins M, et al. Most common causes of natural and injury-related deaths in Addis Ababa, Ethiopia. Pathol - Res Pract 2009;205(9):608–14. https://doi.org/10.1016/j.prp.2009.02.007.
[13] Wolde A, Abdella K, Ahmed E, Tsegaye F, Babaniyi OA, Kobusingye O, Bartolomeos K. Pattern of injuries in Addis Ababa, Ethiopia: a one-year descriptive study. East Cent. Afr.J Surg 2008;13(2):14–22.
[14] Alemu MH. Pattern of pre hospital fatal injuries in Mekelle, Ethiopia. Ethiop Med J 2008;46(2):179–83.
[15] Kebede T, Mekonene T, Bartolemes K, Taye M, Munie T, Meleses M. Injury surveillance in six hospitals of Addis Ababa, Ethiopia. Ethiop Med J 2008;46(4):383–90.
[16] Osman M, Kebede Y, Anberbir S. Magnitude and pattern of injuries in North Gondar administrative zone. Northwest Ethiop Ethiop Med J 2003;41(3):213–20.
[17] Taye M, Munie. Trauma registry in Tikur Anbessa Hospital, Addis Ababa, Ethiopia. Ethiop Med J 2003;41(3):221–6.
[18] Nega KE, Lindtjørn B. Epidemiology of burn injuries in Mekele Town, Northern Ethiopia: a community based study. Ethiop J Health Dev 2002;16(1):1–7.
[19] Ready FL, Gebremedhem YD, Worku M, Mehta K, Eshte M, GoldenMerry YL, et al. Epidemiologic shifts for burn injury in Ethiopia from 2001 to 2016: implications for public health measures. Burns 2018;44(7):1839–43. https://doi.org/10.1016/J.BURNS.2018.04.005.
[20] Li Q, Alonge O, Lawhorn C, Ambaw Y, Kumar S, Jacobs T, et al. Child injuries in Ethiopia: a review of the current situation with projections. PLoS ONE 2018;13(3):. https://doi.org/10.1371/journal.pone.0194692e0194692.
[21] Chala MB, Mekonnen S, Andargie G, Kebede Y, Yitayal M, Alemu K, et al. Prevalence of disability and associated factors in Dabat Health and Demographic Surveillance System site, northwest Ethiopia. BMC Public Health 2017;17(1):e762.
[22] Bifftu BB, Tadesse Tiruneh B, Mekonnen Kelkay M, et al. Seizure-related injuries among People with epilepsy at the outpatient department of the university of Gondar Hospital, Northwest Ethiopia: cross-sectional institutional-based study. Neurol Res Int 2017:1–5. https://doi.org/10.1155/2017/4970691.
[23] Tiruneh BT, Bifftu BB, Anlay DZ, Bayu NH, Tewolde AW, Takele WW, et al. Factors associated with unintentional injury among the paediatric age population in the hospitals of Amhara National Regional State, Ethiopia. Afr J Emerg Med 2017;7:S55–9. https://doi.org/10.1016/J.AFJEM.2017.08.008.
[24] Mariam AM, Sadik MW, Minas GJ. Patterns of accidents among children visiting Jimma University Hospital, South West of Ethiopia. Ethiop Med J 2006;44(4):339–45.
[25] Derbrew M, Ahmed E. The Pattern of paediatric surgical conditions in Tikur Anbessa University Hospital, Addis Ababa Ethiopia. Ethiop Med J 2006;44(4):331–7.
[26] Howe LD, Huttly SRA, Abramsky T. Risk factors for injuries in young children in four developing countries: the Young Lives Study. Trop Med Int Heal 2006;11(10):1557–66. https://doi.org/10.1111/j.1365-3156.2006.01708.x.
[27] Mulat T, Lars OS. Description of patients admitted to a burn unit of Yekatit 12 hospital, Addis Ababa, Ethiopia. Ethiop Med J 2006;44(4):369–75.
[28] Switzerland. World Health Organisation, Department of Injuries and Violence Prevention. http://www.who.int/violence_injury_prevention/publications/surveillance/06_09_2004/en/; 2004 [Accessed on 1 August 2018].
[29] Krug E. Injury surveillance is key to preventing injuries. Lancet 2004;364(9445):1563–6.
[30] Mann CJ. Observational research methods. Research design II: cohort, cross sectional, and case-control studies. Emerg Med J. 2003;20:54.
[31] Global Burns. http://globalburns.org/news-and-events/week-of-workshops/ [Accessed on 1 August 2018].
[32] Odendaal W, van Niekerk A, Jordaan E, Seedat M. The impact of a home visitation programme on household hazards associated with unintentional childhood injuries: a randomised controlled trial. Accid Anal Prev 2009;41(1):183–90. https://doi.org/10.1016/j.aap.2008.10.009.
[33] Swart L, van Niekerk A, Seedat M, Jordaan E. Paraprofessional home visitation program to prevent childhood unintentional injuries in low-income communities: a cluster randomized controlled trial. Inj Prev 2008;14(3):164–9. https://doi.org/10.1136/ip.2007.016832.
[34] Schwebel DC, Swart D, Simpson J, Hui SA, Hobe P. An intervention to reduce kerosene-related burns and poisonings in low-income South African communities. Heal Psychol 2009;28(4):493–500. https://doi.org/10.1037/a0014531.
[35] Schwebel DC, Swart D, Hui SA, Simpson J, Hobeb P. Paraffin-related injury in low-income South African communities: knowledge, practice and perceived risk. Bull World Health Organ 2009;87(9):700–6. https://doi.org/10.2471/BLT.08.057505.
[36] Van Niekerk A, Menckel E, Laflamme L. Barriers and enablers to the use of measures to prevent paediatric scalding in Cape Town, South Africa. Public Health Nurse 2010;27(3):203–20. https://doi.org/10.1111/j.1525-1446.2010.00846.x.
[37] Peck M, Falk H, Meddings D, Sugerman D, Mehta S, Sage M. The design and evaluation of a system for improved surveillance and prevention programmes in resource-limited settings using a hospital-based burn injury questionnaire. Inj Prev 2016;22:i56–62. https://doi.org/10.1136/injuryprev-2015-041815.