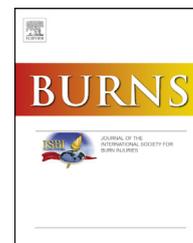


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# Rethinking burns for low & middle-income countries: Differing patterns of burn epidemiology, care seeking behavior, and outcomes across four countries



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## ABSTRACT

**Purpose:** Low-and middle-income (LMIC) countries account for 90% of all reported burns, nevertheless there is a paucity of providers to treat burns. Current studies on burns in LMICs have not evaluated the gap between care seeking and receiving. This study explores this gap across socioeconomically similar populations in a multi-country population based assessment to inform burn care strategies.

**Methods:** The Surgeons OverSeas Assessment of Surgical Need (SOSAS) instrument is a cross sectional national, cluster random sampling survey administered in Nepal, Rwanda, Sierra Leone, and Uganda from 2011 to 2014. The survey identifies burn etiology, demographics, timing, disability, and barriers to receiving care.

**Results:** Among 13,763 individuals surveyed, 896 burns were identified. Rwanda had the highest proportion of individuals seeking and receiving care (91.6% vs 88.5%) while Sierra Leone reported the fewest (79.3% vs 70.3%). Rwanda reported the largest disability while Nepal reported the highest proportion with no disability (47.5% vs 76.2%). Lack of money, healthcare providers, and rural living reduce the odds of receiving care by 68% and 85% respectively.

**Conclusions:** Despite similar country socioeconomic characteristics there was significant variability in burn demographics, timing, and disability. Nevertheless, being geographically and economically disadvantaged predict lack of access to burn care.

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## 1. Introduction

Globally, burns are responsible for an estimated 11 million injuries each year and rank fourth in injury-related health burden behind road traffic accidents, falls, and violence [1]. The incidence of significant burn injury in low- and middle-income countries (LMICs) is nearly ten-times greater than that in high-income countries (HICs) (1.3 per 100,000 people compared to 0.14 per 100,000 people); further, LMICs harbor 90% of all burns globally [1,2]. Despite this large burden of disease, health systems in LMICs are not well equipped to prevent, treat or rehabilitate burn injuries [3].

Several hospital and population-based studies in LMICs have attempted to describe the burden of burn injury and risk factors potentially amenable to burn prevention [1–5]. However, multi-country population-based assessments of burn injury demographics, patterns of burn-related disability, and care seeking behavior are lacking from LMICs [6–8]. Such comparative studies are needed in order to identify the differences between countries and the unifying drivers of inadequate burn care, which could, in turn, inform both national and broader burn prevention and capacity improvement strategies. To address this gap, we analyzed burn data from the Surgeons OverSeas Assessment of Surgical Need (SOSAS), a cross-sectional survey of surgical need, barriers to surgical care, and disability across Rwanda, Sierra Leone, Nepal, and Uganda.

## 2. Methods

### 2.1. Settings

The four chosen countries were chosen due to long standing local partnerships and the survey's sponsoring organization—Surgeons OverSeas. Brief descriptions of each country are provided to give context to the data presented.

Nepal is a land-locked low-income country in South Asia. The population mainly lives in rural areas (81.8%), many of which are located at high-altitude and rely on combustible fuels for heat [9]. Approximately 11.2% of government expenditure is on healthcare [10]. Burn injury incurs an estimated 216 disability-adjusted life-years (DALYs) per 100,000 people annually [11].

Rwanda is an east sub-Saharan African country. Approximately 72% of the population lives in rural areas [9]. The government spends 9.9% of its budget on healthcare [10]. Burn injury incurs an estimated 195 DALYs per 100,000 people annually [11].

Sierra Leone is a coastal west sub-Saharan African country. Approximately 60% of the population lives in rural areas [9]. Only 10.8% of government expenditure is used for healthcare [12]. Burns incur an estimated 195 DALYs per 100,000 people annually [11].

Uganda is also an east sub-Saharan African country. Nearly 84% of the population live in rural areas [9]. Government expenditure on healthcare is 11.0% [12]. Burns incur an estimated 257 DALYs per 100,000 people annually [11].

A summary of demographic, economic, and health statistics is provided in Table 1 [9,10,12–18].

### 2.2. Study design and population

SOSAS is a cross-sectional, population-based survey which was performed countrywide in Rwanda, Sierra Leone, Nepal, and Uganda [7,8,19–21] in 2011, 2012, and 2014, respectively.

Detailed descriptions of the study populations, sample size estimates, and sampling methods have previously been described [7,8,19,21–24]. Briefly, the study used a cluster randomized sampling strategy. The country sample size was estimated to be 3745 from the formula,  $n = Z^2 p(1-p)/L^2$ , where  $L$  is the accepted range around the estimated prevalence of the disorder (1%),  $Z$  is the confidence interval factor of 1.96,  $p$  is (estimated) prevalence of the condition (7.3%). Estimated prevalence is derived from a pilot study in Sierra Leone [25]. The sample size was multiplied by “small design-factor” of 1.3, to account for the assumption that surgical conditions are not typically clustered [25]. Administrative areas proportional to the population of each country were selected at random for participation in the study. Within each administrative area, 30 households were randomly selected using random walk methodology [21–25]. Within each household, the head of household provided demographic information about the household and its inhabitants. Subsequently, two members of each household were selected at random for a full interview. A household member was defined as a person who ate from the same pot and slept in the same structure the night before [7,8,19–21].

**Table 1 – Demographic, economic, and health statics of the four countries from the World Health Organization, Institute of Health Metrics, and World Bank in 2014.**

Country	Nepal	Rwanda	Sierra Leone	Uganda
Population	28.17 million	11.34 million	6.315 million	37.78 million
% Rural population	81.8%	72.2%	60.4%	84.2%
GDP per capita (USD)	694.1	638.7	679.0	572.0
% Access to electricity	76.3%	18%	14.2%	18.2
% Access to non-solid fuel	20.5%	2%	2%	2.6%
Government expenditure on health	11.2%	9.9%	10.8%	11.0%
Doctors per 1000 people	.04	.6	.02	.08
Nurses & midwives per 1000 people	.3	.67	.18	.72
Disability adjusted life years of burns per 100,000 people	216.16	194.72	194.86	256.77

### 2.3. Data collection

The SOSAS tool was administered in two parts. The first half of the survey solicits household demographics, access to health-care, and recent deaths within the household. The second half of the survey assess the two previously randomly selected individuals using a verbal head to toe physical examination specific for past or current surgical conditions [21]. A total of six anatomical regions are evaluated in the survey, including (1) face, head and neck, (2) chest and breast, (3) abdomen, (4) groin and genitalia, (5) back, and (6) extremities. The survey seeks to identify any surgical condition including wounds, masses, burns, and deformities and the cause/mechanism [21]. Finally, care seeking behavior and care received were queried in a yes/no fashion [21].

### 2.4. Variable definitions

Collected demographic data (e.g. age) are representative of the time at interview, not necessarily the time of injury. Age groups are based on WHO criteria for child, adolescent, adult, and elder [26]. The barriers variable ranges from 1 to 6: (1) “No Money for Healthcare”; (2) “No Money for Transportation”; (3) “No Time”; (4) “No Trust in Health Facility”; (5) “No Skilled Physicians/Nurses Available”, (6) “No Need” [7]. The care seeking variable represents those who sought out a nurse, doctor, or health care facility. The care met variable represents those who had an active medical problem and received appropriate care. A no result for the care met variable therefore indicates that either care was not sought or care was sought but not provided. Disability was assessed based on a validated scale from 1 to 5: (1) The condition is not disabling; (2) I feel ashamed; (3) I’m not able to work like I used to; (4) I need help with transportation; or (5) I need help with daily living [7].

### 2.5. Data analysis

Sociodemographic information, burn prevalence, care seeking behavior, and burn-related outcomes were described and compared across the four countries using  $X^2$  for non-parametric data and ANOVA for parametric data. Logistic regression was used to evaluate individual predictors variables for the care met variable with the reference condition set as “yes” or having care met. The barriers variable has a base case of “no money for healthcare” and the highest value as “No Need”. Thus, an odds ratio of  $<1$  in this case represents an increase chance for responding that care was not met. Finally, a multi-variate model was created to calculate adjusted odds-

ratios with statistical significance set at 95%,  $P < .05$ . Data were analyzed in STATA v14 [27].

### 2.6. Ethics statement

Appropriate institutional review board (IRB), government, and community authority approvals were granted prior to study in all countries (Appendix A). Informed consent was obtained from all respondents prior to the survey and parental consent was obtained for individuals younger than 18 years of age. Individuals who were deemed to be cognitively impaired by their household members were excluded from the study [7,8,19,20,25].

## 3. Results

Overall, 7134 households were sampled, which included 13,763 individuals (97.6% average response rate across the countries). A total of 13,806 injuries were recorded, of which 896 (6.5%) were burns. Of those, 595 (66.4%) were the result of a flame and 301 (33.6%) were scald injury (Table 2). Individuals with scalds were more likely to report their care met than those with flame burns (OR 2.1,  $P < .001$ ), however this finding was not statistically significant in the multi-variate model (OR<sup>a</sup> .47,  $P = .54$ ).

The average age at the time of interview was 29.5 years (SD  $\pm 21$  years), 54.0% were female, and 82.0% lived in rural areas (Table 3). Overall 47% of burn injured reported the ability to read and 49.6% were employed outside the home (Table 3).

Table 3 provides demographic information of burn injuries across the four countries. Only in Nepal were males (57.0%) more affected than females ( $p = .008$ ). When comparing burn victims between countries by age at time of interview, Uganda had the largest proportion within the newborn-5 years old category (21.5%,  $p < .001$ ). Similarly, when examining the 65 or older category, Rwanda had the greatest proportion of respondents within this category between the countries (11.1%,  $p < .001$ ).

Literacy rates amongst burn victims were highest in Sierra Leone (60%,  $p < .001$ ). Employment outside the home was highest in Rwanda (57.2%,  $p < .001$ ). When comparing burn victims between countries by percent rural to urban living, Rwanda had the largest proportion of rural burn victims (94.9%,  $p < .001$ ). Sierra Leone reported the largest proportion of urban respondents reporting a burn injury (45.5%,  $p < .001$ ). Respondents who were urban living were more likely to have

**Table 2 – Burn type and percent of all injuries across the four surveyed countries.**

Burns type	Nepal	Rwanda	Sierra Leone	Uganda	P value	OR	95% CI	P value	OR <sup>a</sup>	95% CI	P value
Flame	141 (81.9%)	422 (82.1%)	16 (11.0%)	16 (24.6%)							
Scald	31 (18.1%)	92 (17.9%)	129 (89%)	49 (75.4%)	$<.001$	2.1	1.5-3.1	$<.001$	.47	.04-5.2	.54
Total burns of all injuries	172 (6.4%)	514 (16.2%)	145 (3.9%)	65 (.02%)							

<sup>a</sup> Adjusted odds-ratio evaluated burn type, age, age categories, sex, literacy, occupation, rural living, timing of injury, current injury, reason for not pursuing care, disability, care seeking, and study country.

**Table 3 – Demographic characteristics of burn victims within surveyed households across the four countries.**

Burns	Nepal (171)	Rwanda (514)	Sierra Leone (145)	Uganda (65)	Average	P value	OR	95% CI	P value	OR <sup>a</sup>	95% CI	P value
Age (mean)	30.5	32.1	22.8	21.2	29.5	<.001	.99	.99-1	.415	1.05	.96-1.15	.317
Age groups												
Newborn-5	5 (2.9%)	38 (7.4%)	28 (19.3%)	14 (21.5%)	21.5 (12.8%)							
6-14	36 (20.9%)	99 (19.3%)	32 (22.0%)	15 (23.1%)	45.5 (21.3%)							
15-64	117 (68.1%)	320 (62.2%)	81 (55.9%)	34 (52.3%)	138 (59.6%)							
65 or older	14 (8.1%)	57 (11.1%)	4 (2.8%)	2 (3.1%)	19.3 (6.3%)	<.001	.93	.81-1.1	.34	.24	.034-1.7	.15
Female	74 (43%)	287 (55.8%)	87 (60%)	38 (58.5%)	486 (54%)							
Male	98 (57%)	227 (44.2%)	58 (40%)	27 (41.5%)	410 (46%)	.008	1.15	.8-1.6	.44	1.4	.34-5.6	.66
Literacy	49 (28.5%)	254 (49.4%)	87 (60%)	30 (49.2%)	420 (47%)							
Illiterate	123 (71.5%)	259 (50.4%)	58 (40%)	31 (49.8%)	471 (53%)	<.001	1.2	.85-1.7	.30	1.42	.33-6.1	.64
None/student/home-maker	103 (59.9%)	220 (42.8%)	83 (57.2%)	41 (63.1%)	447 (50.4%)							
Employed outside home	68 (40.1%)	292 (57.2%)	61 (42.8%)	20 (36.9%)	441 (49.6%)	<.001	.72	.5-1.02	.07	3.0	.46-19	.26
Rural	110 (64%)	488 (94.9%)	79 (54.5%)	55 (84.6%)	732 (82%)							
Urban	62 (36%)	26 (5.1%)	66 (45.5%)	10 (15.4%)	164 (18%)	<.001	1.05	.66-1.6	.83	.15	.03-.79	.026

The bolded values are simply statistically significant P-values.

<sup>a</sup> Adjusted odds-ratio evaluated burn type, age, age categories, sex, literacy, occupation, rural living, timing of injury, current injury, reason for not pursuing care, disability, care seeking, and study country.

their care met (OR<sup>a</sup> .15, P<.05). The remaining demographic data were not statistically significant.

When reviewing the timing of burns the majority occurred more than 12 months prior to the interview (Table 4). Sierra Leone reported the highest percentage of burns occurring within the last month from the interview (22.7%, p<.001). Nepal reported the largest proportion of burns occurring greater than 12 months before the interview (82.0%, p<.001). The majority of respondents reported their burn to no longer be a current condition, however nearly half (49.7%, p<.001) of the patients in Sierra Leone reported a current burn. Timing of injury was not found to be a statistically significant predictor of not having a respondent’s care met (OR<sup>a</sup> .72, P=.43).

Reasons for not receiving care are reported in Table 5. Uganda reported the greater proportion of burns victims indicating “no money for healthcare” as their primary reason for not receiving care (42.11%). Rwanda reported the largest percentage stating “no skilled physicians/nurses available” as their reason for not receiving care (65.6%, p<.001). Reasons

other than “no need” were less likely to have their care met (OR<sup>a</sup> .32, P<.01).

Disability resulting from burn injury is reported in Table 6. The greatest proportion of burn victims reporting the highest form of disability (“need help with daily life”) was observed in Uganda at 11.1% (p<.001). The majority of respondents reported, “no disability” across the four countries; however, 37.4% of burn injured reported, “not able to work” in Rwanda (p<.001). Disability was not found to be significantly associated with not having care needs met (OR<sup>a</sup> 1.12, P=.69).

Data comparing care seeking and receiving across the four study countries are reported in Table 7. The largest proportion of individuals seeking burn care was in Rwanda (91.6%, <.001). Similarly, the largest proportion of individuals reporting receiving care was in Rwanda (88.5%, p<.001). The largest unmet need for burn care was reported in Uganda at 11.8% (Fig. 1). There was no association found when evaluating study country as a predictor for care unmet in the multi-variate analysis (OR<sup>a</sup> .97, P=.96).

**Table 4 – Report of burn timing relative to the date of interview and indication of current condition across the four countries.**

Burns	Nepal (172)	Rwanda (514)	Sierra Leone (145)	Uganda (65)	P value	OR	95% CI	P value	OR <sup>b</sup>	95% CI	P value
Timing											
Last month	14 (8.14%)	51 (10)	33 (22.7)	8 (12.31)							
Within past 12 months	17 (9.88%)	75 (14.65%)	49 (33.8%)	17 (26.15%)							
More than 12 months ago	141 (81.98%)	387 (75.35%)	63 (43.5%)	40 (61.54%)	<.001	.27	.21-.34	<.001	.72	.32-1.61	.43
Current condition											
No	125 (72.7%)	449 (87.35%)	73 (50.34%)	36 (55.38%)							
Yes	47 (27.3%)	65 (12.65%)	72 (49.66%)	29 (44.62%)	<.001	<sup>a</sup>					

The bolded values are simply statistically significant P-values.

<sup>a</sup> Unable to calculate due missing data.

<sup>b</sup> Adjusted odds-ratio evaluated burn type, age, age categories, sex, literacy, occupation, rural living, timing of injury, current injury, reason for not pursuing care, disability, care seeking, and study country.

**Table 5 – Description of reasons for why care was not sought by burn victims across the four surveyed countries.**

Burns	Nepal (77)	Rwanda (468)	Sierra Leone (106)	Uganda (19)	P value	OR	95% CI	P value	OR <sup>a</sup>	95% CI	P value
“No Money for Healthcare”	4 (5.19%)	76 (16.24%)	35 (33.02%)	8 (42.11%)							
“No Money for Transportation”	0 (0%)	2 (.43%)	1 (.94%)	0 (0%)							
“No Time ”	1 (1.3%)	7 (1.5%)	2 (1.89%)	1 (5.26%)							
“No Trust in Health Facility ”	5 (6.49%)	53 (11.32%)	2 (1.89%)	1 (5.26%)							
“No Skilled Physicians/Nurses Available”	22 (28.57%)	307 (65.6%)	3 (2.83%)	4 (21.05%)							
“No Need”	45 (58.44%)	23 (4.91%)	63 (59.43%)	7 (11.1%)	<b>&lt;.001</b>	.86	.78-.95	<b>.004</b>	.32	.15-.70	<b>&lt;.01</b>

The bolded values are simply statistically significant P-values.

<sup>a</sup> Adjusted odds-ratio evaluated burn type, age, age categories, sex, literacy, occupation, rural living, timing of injury, current injury, reason for not pursuing care, disability, care seeking, and study country.

**Table 6 – Responses for SOSAS disability scale from burn victims across the four surveyed countries.**

Disability scale	Nepal (172)	Rwanda (514)	Sierra Leone (145)	Uganda (65)	P value	OR	95% CI	P value	OR <sup>a</sup>	95% CI	P value
“No Disability”	131 (76.2%)	270 (52.5%)	88 (60.7%)	43 (68%)							
“Feel Ashamed”	6 (3.5%)	12 (2.33%)	31 (21.4%)	7 (11.1%)							
“Not Able to Work”	29 (16.9%)	193 (37.4%)	21 (14.5%)	5 (7.9%)							
“Need help with transportation”	3 (1.7%)	16 (3.1%)	0 (0%)	1 (1.6%)							
“Need help with daily life”	3 (1.7%)	21 (4.1%)	4 (2.8%)	7 (11.1%)	<b>&lt;.001</b>	1.3	1.15-1.53	<b>&lt;.001</b>	1.13	.64-2.0	<b>.68</b>

The bolded values are simply statistically significant P-values.

<sup>a</sup> Adjusted odds-ratio evaluated burn type, age, age categories, sex, literacy, occupation, rural living, timing of injury, current injury, reason for not pursuing care, disability, care seeking, and study country.

**Table 7 – Response of seeking care and having care met from burn victims across the four surveyed countries.**

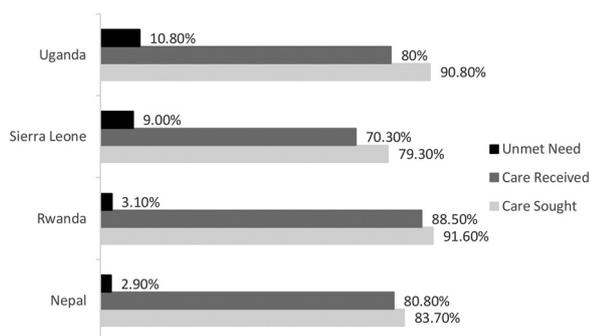
Burns	Nepal (172)	Rwanda (514)	Sierra Leone (145)	Uganda (65)	P value	OR	95% CI	P value	OR <sup>c</sup>	95% CI	P value
Seek care											
Yes	144 (83.7%)	471 (91.6%)	115 (79.3%)	59 (90.8%)							
No	28 (16.3%)	43 (8.4%)	30 (20.7%)	6 (9.2%)	<b>&lt;.001</b>	<sup>a</sup>					
Care met											
Yes	139 (80.8%)	455 (88.5%)	103 (70.3%)	52 (80%)							
No	33 (19.2%)	59 (11.5%)	43 (29.7%)	13 (20%)	<b>&lt;.001</b>	1.3	1.02-1.6	<b>&lt;.05</b>	.97	.28-3.6	<b>.96</b>

The bolded values are simply statistically significant P-values.

<sup>a</sup> Unable to analyze due to missing values.

<sup>b</sup> Study country as a predictor of having care met.

<sup>c</sup> Adjusted odds-ratio evaluated burn type, age, age categories, sex, literacy, occupation, rural living, timing of injury, current injury, reason for not pursuing care, disability, care seeking, and study country.



**Fig. 1 – Percentage of respondents reporting seeking care, receiving care, and the difference between as the unmet need.**

#### 4. Discussion

This study is the first of its kind to describe differences of burn demographics, timing of injury, and disability across four low-income countries. These differences demonstrate the need for a more thorough understanding of local contexts, barriers, and health systems responsible for burn prevention and treatment. Despite these differences our multi-variate model demonstrates that rural living, lack of money for transportation, and lack of access to specialized burn care were significant barriers to burn care across the four countries.

While the demographic patterns of burns have varied in the literature some similarities and differences can be noted. In this study, the majority of burns were due to flames. In a review of hospital-based studies across LMICs the majority of burn

mechanism was due to flame [2,28]. In contrast, a single Ethiopian community survey reported scalds as the primary mechanism; however, the majority of victims were children under 5 [29]. Much of the literature reports children as the primary victims of burns in LMICs [1,2,28]. In contrast, in this study, the average age of respondents was 29.5 years, however the majority reported the initial injury occurring greater than a year prior to the interview and thus the exact age of injury is difficult to ascertain. We did find that burn survivors were often unemployed-illiterate females from rural areas in each of the studied countries. When solely analyzing adult data, a similar pattern was noted among adults in Ethiopia [29]. Given the reported variation in burn demographics across LMICs, prevention strategies will need a more nuanced examination of the demographic and socioeconomic risk factors driving burn injuries.

In the SOSAS surveys, 24%–50% of respondents reported some form of disability, ranging from “feeling ashamed” to “needing help with daily life.” While assessments of disability are reported within the literature, the majority are from hospital-based studies and thus do not provide a broad view of burn morbidity at the population level [1,30]. In the current study disability was not stratified by age and 2%–11% of individuals reported needing ‘help with daily life’. Of the available cross sectional surveys, the largest to date reported that 2% of children in Bangladesh had permanent disability from burns [5]. Another cross sectional survey from Ethiopia reported 9.4% of surveyed patients developed “significant sequelae” [29]. Similarly, a Ghanaian survey reported 11%–32% of respondents having some degree of “physical impairments” [30]. Despite similar government expenditures on health, access to electricity, and physician to population ratios, there is significant variability in reported disability from burns across the surveyed countries. These findings call into question whether indicators of development have utility in predicting burden burn disability and suggest that more attention must be dedicated to burn care capacity building.

Few studies have evaluated care seeking behaviors and barriers to care at the population level in LMICs. Across the four countries, approximately 80% reported seeking care for their burn, however some 20–30% reported not having their burn care needs met. Similarly, studies from Nigeria, Ethiopia, Malawi and Ghana suggest that few patients were able to access burn care in a timely fashion, or knew the potential risks of delaying burn care [29–31]. Despite different patterns of burn demographics, timing, and disability, we uncovered significant predictors of unmet burn care that do apply across the across the studied four countries. Our multi-variate model demonstrated a 68%–85% reduction in the likelihood of receiving burn care for those respondents who were had lack of money for transportation, limited supply of healthcare providers, and were rural living, respectively. While these factors have long been identified as barriers to healthcare in general these findings provide targetable predictors for LMICs. For example, Rwanda reported the highest proportion of burns seeking and receiving care. Of the LMICs in this study, Rwanda is the only country to report universal health coverage [32]. Finally, respondents in Nepal reported the greatest proportion of “no disability” among burn victims. Nepal has the highest

expenditure on health as well as highest health development index between the countries surveyed and thus possibly offers the most definitive burn care available such as skin grafting [10,12]. Understanding these and other barriers to care (e.g., structural, sociocultural, financial barriers) and how they differ within and between LMICs is an essential step to addressing the gaps to burn care globally.

As a multi-country cross sectional survey of burns, this studies’ strengths come from its community level approach, its evaluation of burn morbidity, and its assessment of unmet need, which offers a deeper view of barriers to burn care than previous studies in LMICs. Furthermore, no study to date has captured burn data across four LMICs using a standardized approach. While, several hospital-based studies comment on populations with poor access to care, no study to date attempts to quantify predictors of this unmet need [3].

Nonetheless, this study has several limitations. With the exception of Nepal, self-reported data was not corroborated by physical exam or hospital records. This limitation to community-based cross sectional studies has been noted in similar studies [5]. However, SOSAS has since been validated and proves to be a strong proxy for head to toe physical examinations [7]. The SOSAS survey does not assess for other type of burns (e.g. chemical, electrical), which may significantly add to the burden of burn injuries reported [33]. In addition, the study was unable to assess the timing of care seeking compared to burn injury, and what type of care was received. Potentially, much of the care received was untimely or inappropriate, which would continue to strengthen the cause for improving burn prevention and care capacity initiatives in LMICs. Finally, while our study attempted to assess mortality from burn injuries, incomplete data gathering of this variable limited intra-country comparison and was thus excluded.

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## 5. Conclusion

While this study provides insight into the differences of demographics, timing, and morbidity associated with burn injuries across four LMICs, it most substantially quantifies the likelihood of not receiving burn care. A substantial number of respondents indicated their condition was current, their care had not been met, and their injuries were disabling. Furthermore, individuals who were rural living, economically disadvantaged, and lived in area with no access to burn specialization are at increased risk of not having the burn care needs met. Across LMICs this pattern is likely to exist and identifying it will be an essential first step to providing care. Access to healthcare and cost of healthcare were central barriers to care in this study and will certainly need to be addressed in any LMIC wishing to improve its burn outcomes. Given the differences between countries, burn prevention strategies and care capacity will need to be tailored to the local socio-economic and geographic barriers to achieve timely care. Furthermore, it is essential to assess the reasons behind unmet need for burn care nationally, or even at a more granular level (e.g., region or community). Initiatives to strengthen burn prevention and capacity can no longer safely assume that one strategy fits all in LMICs.

## Author contributions

The study was designed by the SOSAS4 Research Group and Adam L. Kushner. Data collection, or supervision thereof, was done by SOSAS4 Research Group and Adam L. Kushner. The data were analyzed and interpreted by Dattesh R. Dave, Neeraja Nagarjan, Joseph K. Canner, Adam L. Kushner, and Barclay T. Stewart. Manuscript preparation was done by Dattesh R. Dave, Neeraja Nagarjan, Joseph K. Canner, Adam L. Kushner, Barclay T. Stewart. All authors contributed critically and significantly to drafting a final manuscript. All authors approved the final version.

## Conflicts of interest

None.

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