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## Prevalence of preventable household risk factors for childhood burn injury in semi-urban Ghana: A population-based survey

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### ABSTRACT

**Objective:** Childhood burns are a leading cause of injury in low- and middle-income countries; most of which are preventable. We aimed to describe the prevalence of household risk factors for childhood burn injury (CBI) in semi-urban Ghana to inform prevention strategies for this growing population.

**Methods:** We conducted a population-based survey of 200 households in a semi-urban community in Ghana. Households were randomly selected from a list of 6520 households with children aged <18 years. Caregivers were interviewed about CBI within the past 6 months and potentially modifiable household risk factors.

**Results:** Of 6520 households, 3856 used charcoal for cooking (59%) and 3267 cooked indoors (50%). In 4544 households (70%), the stove/cooking surface was within reach of children under-five (i.e., <1 m). Higher household wealth quintiles (OR 0.95; 95%CI 0.61–1.49) and increasing age (OR 0.82; 95%CI 0.68–0.99) were associated with lower odds of CBI. Living in uncompleted accommodation (OR 11.29; 95%CI 1.48–86.18 vs rented room) and cooking outside the house (OR 1.13; 95%CI 0.60–2.14 vs cooking indoors) were also predictive of CBI.

**Conclusions:** This study identified a high prevalence of CBI risk factors in semi-urban households that may benefit from targeted community-based prevention initiatives.

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## 1. Introduction

Burns are the fourth most common cause of injury death and disability worldwide, incurring more than 20 million disability-adjusted life years annually [1,2]. Nearly 95% of burn injuries occur in low- and middle-income countries (LMICs), most of which are preventable [3,4]. Children under five years of age are the most vulnerable group [4].

Poverty, illiteracy, difficulty in providing adequate supervision, and household conditions in urban slums have been cited as reasons for the high rate of burn injury in many LMICs [5]. Additionally, studies have reported that the majority of childhood burns occurs in the home, and may be preventable with better understanding of local risk factors, which can serve as targets for intervention [4,6–8].

While household risk factors for childhood burn injury in urban and rural communities have been well described, household characteristics that pose a risk for childhood burn injuries in rapidly growing semi-urban communities in LMICs are poorly understood [9]. To address this gap, we studied potentially modifiable household risk factors for childhood burn injury in a semi-urban community in Ghana. By doing so, the findings might inform targeted community-based prevention initiatives.

## 2. Methods

### 2.1. Study population

The study was conducted in the Asawase sub-metropolis of Kumasi, Ghana. Asawase is a semi-urban community characterized by inadequate social amenities (e.g., playgrounds, baby-sitting facilities), and poor housing standards. The community is occupied predominantly by households of lower socio-economic status.

In Asawase, most households live in compound homes, which are large buildings with rooms or flats that are rented out to different families. All of the families usually share the same basic utilities. Most of these households are single rooms or flats (i.e. a living room and a bedroom). These accommodation types typically do not have a separate kitchen within the home; thus, cooking is done on the porch, outside, or in an enclosed structure nearby. More than one family often uses enclosed structures designated for cooking.

Other households live in uncompleted structures while saving money to complete them. This accommodation type may have a designated area indoors used for cooking; however, the kitchen might not be completed. Thus, households may also cook on the porch, outside, or in an enclosed structure nearby. Further, uncompleted accommodation may have fewer safety features (e.g. guard rails or bannisters, socket covers, cabinetry for stoves). Thus, results from the parent study documented that children who lived in uncompleted accommodation had more than 3.5 times the odds of any injury compared to those who lived in rented rooms or flats [10].

### 2.2. Sample strategy

The study was nested in the Family Health and Wealth Study (FHWS), which was a community-based survey that examined how family size affected health and wealth [11]. A comprehensive description of the study area and population has been published [12].

Briefly, every household with at least one child aged <18 years in each of the four Asawase study community clusters was enumerated ( $N = 6250$ ). The FHWS randomly sampled 200 households from each of the four community clusters. For the present study, 50 households were randomly selected from the 200 sampled households in each of these four clusters. From each household, one eligible caregiver was randomly selected for interview.

### 2.3. Survey

Caregivers were interviewed with a structured questionnaire regarding household characteristics and potentially modifiable risk factors for childhood burn injuries. Risk factors were generated from the 2008 Ghana Demographic and Health Survey [13]. A household burn was defined as an injury that:

1. Was caused by flame or hot objects or substances;
2. Occurred within 200 m of the house;
3. Prevented the child from going to school or work, or for which treatment was sought; and
4. Occurred within the previous six months.

We considered 200 m as the furthest distance that most children under five years would get away from the house. Recall periods of 1–3 months and 1-year have been proposed for surveys of less severe and more severe/fatal injuries in developing countries, respectively [14]. We used a recall period of six months to capture injuries of all levels of severity.

### 2.4. Data analysis

Analyses were conducted with STATA v11 (StataCorp, College Station, TX). All analyses included sampling weights, and accounted for clustering at community and household levels [12].

The associations between household risk factors and occurrence of burn injury in a child aged less than 18 years were evaluated with bivariate logistic regression. Multivariable regression was not presented given too few burn injuries in each of the potential sub-groups generated by the model.

### 2.5. Ethics

The study was approved by the Kwame Nkrumah University of Science and Technology Committee on Human Research and Publication Ethics, and the University of Washington Institutional Review Board. Informed consent was obtained from each respondent prior to the survey. No identifying information was collected.

### 3. Results

#### 3.1. Household characteristics

Two hundred households with at least one child aged less than 18 years of age were sampled, which represented 6520 households in Asawase. Most households lived in rented single rooms (4619 households; 71%); 3856 households used charcoal for cooking (59%) (Table 1).

One out of every two households cooked indoors (50%), but half of these did not have a separate kitchen (51%) (Table 1). Among households that rented single rooms, 60% cooked outdoors. In most homes, the height of the stove or cooking surface was within reach of a child under-five years (i.e. within 1 m from the floor; 70%).

#### 3.2. Caregiver characteristics

The median caregiver age was 34 years (interquartile range 29–38 years) (Table 2). Most caregivers had only basic elementary school education (66% of caregivers), and 68% engaged in hourly work. Although most caregivers took care of only one child under-five years of age (63%), 37% of caregivers took care of two or three children under-five years. Similarly, most caregivers had at least one older child

(i.e. 5–18 years) living in the home (78%), who may be responsible for supervising.

#### 3.3. Children and childhood burn injuries

There were 637 children aged less than 18 years in the study sample, representing 20,575 children living in Asawase. Three hundred and twenty-one children sustained at least one burn injury in the six months prior to survey, giving a 3.2% annual incidence of burn injury (31 burn injuries per 1000 children per year). The incidence was only marginally higher among males (3.6%) compared to females (2.6%;  $p = 0.64$ ). Most (77%) burn injuries were of moderate severity (i.e. the child missed school/work but did not seek medical care, or sought medical care but was not hospitalized).

Risk factors for electrical burn injuries were not examined specifically; however 101 children sustained an electricity-related injury six months prior to survey (9.8 electricity-related injuries per 1000 children per year).

#### 3.4. Risk factors for childhood burn injury

Bivariate analysis revealed that the odds of childhood burn injury reduced by 18% for every year increase in age of the child (OR 0.82; 95%CI 0.68–0.99) (Table 3). Additionally, households that lived in uncompleted accommodation (OR

**Table 1 – Characteristics of households in Asawase sub-metropolis of Kumasi, Ghana (N = 6520).**

	n	(%)	95%CI
House structure and ownership			
Rented room	4619	71	(64.2–76.7)
Rented flat	1425	22	(16.6–28.2)
Uncompleted accommodation	476	7	(4.5–11.8)
Wealth index (quintiles)			
Lowest 1	1381	21	(15.4–27.6)
2	1380	21	(15.5–27.5)
3	1386	21	(15.5–27.6)
4	1070	16	(11.4–22.0)
Highest 5	1204	19	(13.2–24.3)
Main type of fuel used			
Charcoal	3856	59	(52.0–66.3)
Kerosene	18	0.3	(0.0–0.8)
Natural gas	2646	41	(33.4–47.8)
Cooking arrangement			
Open fire	127	2.0	(0–4.0)
Coal pot	3957	61	(53.5–67.9)
Open stove	2082	32	(25.2–38.7)
Closed stove	353	5.4	(3.2–7.6)
Cooking place			
Inside the home	3267	50	(44.5–55.7)
Separate structure	1030	16	(11.2–21.8)
Outdoors	2223	34	(28.3–40.4)
Height of stove or cooking surface			
Not within reach of child under 5 years*	1975	30	(24.8–36.3)
Within reach of child under 5 years	4544	70	(63.7–75.1)

\* Within 1 m of the floor.

**Table 2 – Characteristics of caregivers in Asawase sub-metropolis of Kumasi, Ghana (N = 6520).**

	n	(%)	95% CI
Median caregiver age; years (IQR)	34	(29–38)	
Relationship to child			
Mother	5554	85	(80.3–90.1)
Father	763	12	(7.5–15.9)
Other	202	3.1	(0.5–5.7)
Education			
None	1038	16	(10.8–21.0)
Primary	4333	66	(59.4–73.5)
Secondary	1040	16	(10.4–21.5)
Tertiary	109	1.7	(–0.2 to 3.6)
Employment			
Unemployed	1294	20	(14.2–25.5)
Hourly worker	4457	68	(61.7–75.1)
Salaried worker	769	12	(7.1–16.5)
Number of children <5 years under caregiver's supervision			
1	4105	63	(55.9–70.1)
2–3	2414	37	(29.9–44.1)
Number of children 5–18 years under caregiver's care			
None	1422	22	(15.6–28.0)
1–2	3156	48	(41.0–55.8)
≥3	1942	30	(23.2–36.4)

11.29 95%CI 1.48–86.18) and households that lived in rented flats (OR 5.16 95%CI 1.23–21.62) had greater odds of burn injury than those that lived in completed rented rooms. Households with a higher wealth quintile had lower odds of childhood burns (OR 0.95; 95%CI 0.61–1.49).

The odds of burn injury was higher for children of families that cooked outside of the house (OR 1.13; 95%CI 0.60–2.14) compared to those that cooked indoors (50% of households that cooked indoors used natural gas stoves compared to 29% of households that cooked outside;  $p < 0.001$ ).

#### 4. Discussion

This study examined the prevalence of household risks for burn injury faced by children in a semi-urban community in Ghana. By so doing, we hoped to identify risk factors that could be modified and, in turn, be amenable to strategies aimed at preventing childhood burn injuries. Our data suggest that childhood burns were common, particularly in households with young children, households that lived in uncompleted accommodation, and households where cooking occurred outside. Each of these risk factors may be amenable to targeted prevention strategies.

The growing number of semi-urban households in LMICs may have unique risk factors for childhood burn injury compared to urban or rural households, for which burn risk factors are well established [3,4,15]. However, our findings suggest that some risk factors are similar. For example, younger children and children from poorer families were more likely to have suffered a burn injury than their counterparts. These associations have been well described in urban and rural communities in sub-Saharan Africa, as well as globally [16,17].

However, our findings also suggest that other risk factors, which might be preventable, need more consideration in semi-urban households. First, the cooking area is the most common location of household burn injuries [6]. Having living areas separate from the cooking area has been reported to be protective against childhood burns in rural areas [4]. However, findings from this study suggest that cooking outside of the house was not protective in Asawase. This is likely explained by the fact that majority of households (72%) that cooked outside of the house used open fire or a coal pot for cooking. In contrast, 45% of households that cook indoors used natural gas-fueled stoves for cooking. Using open fire or a coal pot for cooking, often with very little barriers for playing children, is a serious risk for childhood burn injuries in many LMICs [17]. Given that semi-urban households are close together with little space to separate the place of cooking from children, this risk might be amplified in these communities. To prevent injuries related to outdoor cooking, community safety education campaigns regarding the creation of a safe cooking space and/or provision of subsidies for safer stoves could be piloted [16].

Next, households that lived in uncompleted structures had greater odds of childhood burns than those that lived in completed, rented rooms. This raises the need to define and implement housing codes in rapidly growing semi-urban areas that reflect our current knowledge of healthful housing. In a low-income economy with variable inflation rates, the 'slow building' of a home over time is a common form of savings [18]. Thus, our findings suggest that instituting a pro-poor housing finance system that supports low-income households in their pursuit of affordable and safe housing in the short-term might prevent burns, and potentially injuries more broadly [19].

**Table 3 – Potential risk factors for childhood burn injury in Asawase sub-metropolis of Kumasi, Ghana.**

	Odds ratio	95% CI
Caregiver age	0.90	(0.83–0.97)
Wealth index (quintiles)	0.95	(0.61–1.49)
Age of child in years	0.82	(0.68–0.99)
Number of children <5 years under caregiver's care		
1	Referent	
2–3	2.81	(0.60–13.24)
Number of children 5–18 years under caregiver's care		
None	Referent	
1–2	1.41	(0.22–9.05)
≥3	0.49	(0.04–5.67)
Gender of child		
Male	Referent	
Female	0.71	(0.25–1.99)
House structure and ownership		
Rented room	Referent	
Rented flat	5.16	(1.23–21.62)
Uncompleted accommodation	11.29	(1.48–86.18)
Main type of fuel used		
Charcoal	Referent	
Kerosene	–	–
Natural gas	1.86	(0.38–9.04)
Cooking arrangement		
Open fire or coal-pot	Referent	
Stove*	1.32	(0.27–6.52)
Cooking place		
Inside the home	Referent	
Outside of the house**	1.13	(0.60–2.14)
Height of stove or cooking surface		
Not within reach of child <5 years	Referent	
Within reach of child <5 years	1.65	(0.31–8.67)

\* Stove—open/closed stove, usually uses natural gas or kerosene; all reported burn injuries occurred in children whose caregivers had some level of education or were the mother of the child.

\*\* Outside of the house: outdoors or in a separate structure outside the house.

A review of the epidemiology of childhood burn injuries in LMICs identified several other household risk factors for burn injury, including low caregiver education, overcrowding and lack of supervision [15]. Forjuoh et al. reported factors that influenced the occurrence of burns in children under-five years in the Ashanti region, Ghana [20]. Although existing impairment in the child, history of burn in a sibling, and storage of a flammable substance in the house were found to significantly increase burn injury risk, potentially modifiable household characteristics were not considered. We did not find evidence for a predictive relationship between caregiver characteristics or the number of children in the household and recent childhood burn injury. This could be due to the relatively small number of each of the risk factors among the burned children reported in our population, and presents an opportunity for future study.

While this was a population-based randomized household survey, the number of respondents was not powered specifically for childhood burn injuries and risk-factor sub-groups. Additionally, data were gathered by self-report; we could not

verify the accuracy of information provided by caregivers. However, other surveys of injury in LMICs have demonstrated high correlation between household report and physical exam findings [21]. Participants may have given socially desirable responses, particularly with regards to the incidence and cause of childhood burns. Nonetheless, the physical attributes of the household that posed potential burn risk were confirmed visually, reducing the impact of social response bias. Despite these limitations, our findings allow reasonable conclusions to be drawn about the prevalence of modifiable household risk factors for childhood burn injury and the potential to reduce the dangers they pose.

## 5. Conclusion

This study identified a high prevalence of potentially modifiable risk factors for childhood burn injuries among households in semi-urban Ghana. In addition to known risk factors, such as young age and low socioeconomic status, we found

other potentially modifiable risk factors. Households that lived in uncompleted accommodation and those that cooked outside of the house had greater odds of childhood burns than households that lived in completed, rented rooms or cooked indoors, respectively. Thus, more robust building codes and pro-poor safe housing initiatives may reduce childhood burn injuries and improve household health more broadly in rapidly growing semi-urban communities. In addition, pilot studies of community-based education campaigns that teach the importance of creating a safe cooking place, as well as safe stove subsidies might be considered. Given these findings may represent features unique to semi-urban households, further work is needed to understand the association between household characteristics and childhood burn injury in semi-urban communities so that context-specific and effective interventions can be developed.

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### Conflict of interests

None.

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