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Prevalence of Cooking-Related Burns in Peri-Urban Cameroon, Ghana, and Kenya by Fuel Type

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Background: Over 70% of Africans rely on polluting sources of energy for cooking. There is a paucity of epidemiological evidence on the burden of cooking fuel–related burns (CRBs) among women and children in low- and middle-income countries.

Objectives: We estimated the prevalence of CRBs and association with main fuel choice among primary cooks and children 0–5 years of age in peri-urban areas in Kenya, Cameroon, and Ghana.

Methods: We conducted a multisite cross-sectional survey in Mbalmayo, Cameroon; Obuasi, Ghana; and Eldoret, Kenya. Standardized questionnaires were administered between April 2019 and February 2020 to primary cooks. Questions included sociodemographic characteristics, primary fuel choice, and experience of burns within the previous 12 months. Overall and site-specific prevalence of CRBs were calculated, and their association with primary cooking fuel type was determined.

Results: Overall, 128 out of 1,240 primary cooks [10.3%, 95% confidence interval (CI): 8.7, 12.2] reported at least one CRB during the previous 12 months. Most primary cooks had been burned multiple times (median number of burns = 3, interquartile range: 2–5). CRB prevalence among primary cooks in Mbalmayo (23.3%, 95% CI: 19.4, 27.5) was significantly higher than in Obuasi (3.3%, 95% CI: 1.7, 5.8) and Eldoret (3.2%, 95% CI: 1.7, 5.3). Among children, the overall prevalence of CRBs was 5.1% (95% CI: 3.7, 6.9; $n = 42$) and was comparable across sites: Mbalmayo, 6.5% (95% CI: 4.0, 10.0); Eldoret, 4.7% (95% CI: 2.5, 7.9); and Obuasi, 3.9% (95% CI: 1.9, 7.1). Overall, there was no significant difference in CRB prevalence among liquefied petroleum gas primary users compared with exclusive biomass users considering primary cooks (11.8% vs. 9.2%, $p = 0.17$) and children (4.4% vs. 5.5%, $p = 0.95$). Older age [adjusted odds ratio (aOR) = 0.6; 95% CI: 0.3, 0.9; $p = 0.03$] and higher income (aOR = 0.3; 95% CI: 0.2, 0.5; $p < 0.01$) significantly lowered odds of CRBs.

Conclusions: CRB prevalence among primary cooks between communities was high but was not related to the main choice of fuel for cooking across the selected study sites. Older age and higher income significantly reduced the risk of CRBs among both primary cooks and their children. https://doi.org/10.1289/JHP1095

Introduction

Globally, over 2.3 billion people (>70% of the African population) are dependent on polluting energy sources, such as firewood or charcoal, for household cooking and lighting.[1] Polluting household energy sources are associated with an increased burden of respiratory and cardiovascular disease from household air pollution (HAP)[2] and an increased risk of premature mortality[3,4] in low- and middle-income countries (LMICs).[5,6] The use of open fires with biomass fuels or kerosene for cooking is estimated to cause at least 25% of burns globally, which occur in open or closed-door kitchens with the most common etiologies being flame burns, explosions, or scalds from the cooking stoves.[6,7] Despite cooking-related burns (CRBs) contributing to over 90% of all burns in LMICs,[6] there is a dearth of epidemiological evidence documenting their prevalence across settings. Additionally, while it is known that CRBs comprise a majority of the burns reported among women and children 0–5 years of age in LMICs,[6,8,9] there are few data on potential determinants of susceptibility to CRBs. CRBs are also causally linked to significant psychosocial abuse, stress, and stigma resulting in mental disorders such as anxiety, stress, and depression,[10,11] and therefore, there are important social impacts to consider while providing clean cooking interventions.[12]

Previous epidemiological evidence from LMICs document that female primary cooks were at a higher risk of CRBs caused by flames and scalds compared to men.[13–15] Most pediatric CRBs occur among children 0–5 years of age,[13,16,17] and are more frequent among boys than girls,[14,17] where scalds and flames are the leading causes.[13,16] Increased susceptibility to CRBs among women and children can result from living in crowded households, low socioeconomic status, low maternal education, the use of polluting biomass fuels including kerosene, and lack of child supervision when cooking.[5,14,17] However, none of the studies considered the association between the type of primary cook-fuel type and the prevalence of CRBs.

Community-specific evidence on the prevalence of CRBs can help us to understand additional potential health benefits associated with the utilization of clean cooking fuels. The current study evaluated whether the choice of primary cooking fuel was associated with the prevalence of CRBs in three peri-urban communities in

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Cameroon, Ghana, and Kenya. We assessed whether the prevalence and severity of CRBs characterized by scarring varied across study sites and among primary adult cooks and children (<5 years of age) depending on the primary cooking fuel. We also sought to determine whether the age, sex, and income levels of the primary cooks were associated with the prevalence of CRBs. This multisite survey is part of a larger multiphase research program [CLEAN-Air (Africa)],[18] selected because of their respective governmental targets of improving health and environmental outcomes through the adoption of clean energy sources.[19,26] The selected countries have set up ambitious national policies and targets for scaling up liquefied petroleum gas (LPG) to preserve forests, reduce harmful exposure to HAP, and foster gender empowerment.[19–21] The larger research program informed the selection criteria for the peri-urban communities that had a fairly well-distributed LPG market including access to retail points.[10] Few studies have been conducted on burns with this being the first multinational study in sub-Saharan Africa (SSA) to assess whether the burden of CRBs among primary cooks is associated with the type of primary cooking fuel used in the household.

Methods

Setting, Design, and Participants

We conducted a multisite cross-sectional survey between April 2019 and February 2020 in three peri-urban communities in SSA: Mbalmayo in the Cameroon Central region, Obuasi in the Ashanti Region of Ghana, and Eldoret in the western region of Kenya. In each study site, 1–2 wk of community engagement and sensitization occurred. We used a two-phase sampling process to identify eligible households/participants for the surveys. In phase one, a random sample of about 2,000 households in each community was selected from an administrative list of all eligible households for the "census survey" administered by trained enumerators. The census survey, which took ∼20 minutes, served as a sampling frame for the identification of participants for the longer phase two survey. All households chosen in phase one were then stratified into two groups based on their survey responses—that is, households using LPG as the primary cooking fuel ("primary LPG users") and households that exclusively used polluting biomass fuels ("exclusive biomass users").

For the phase two survey, we randomly selected 1,240 households from each of the two strata (525 primary LPG users and 715 exclusive biomass users) to obtain a comparable representation of both primary LPG users and exclusive biomass users from all households identified in the phase one census survey. Taking about 40 min, the phase two survey was completed by either the primary cook or the head of the household and contained specific questions on self-reported health, CRB occurrence, and cooking fuel usage. The survey was administered using mobile devices or tablets, with a bespoke survey data collection software—Mobenzi Researcher (https://www.mobenzi.com/) in Kenya and Cameroon and Research Electronic Data Capture—RedCap (https://projectredcap.org/software/) in Ghana. All field enumerators received in-person training on either Mobenzi or RedCap before data collection as applicable to their study sites.

Data Collection and Variables

The World Health Organization defines burns as thermal injury of the skin or any organic tissue following exposure to flames, hot liquids, or hot solids.[8] In this study and based on phase two surveys, the primary outcome was "cooking-related burns," referring to injuries among primary cooks and children 0–5 years of age caused by hot surfaces, flames, or hot liquids (scalds) resulting from fuel use in cooking settings (indoor or outdoor kitchens or cooking with open fires),[6,9] reported by the primary cook or the head of the participating household within the previous 12 months. The primary cook refers to the household member who prepared most of the meals using the preferred fuels and cook stoves. Phase two surveys also sought information about the frequency of burns, scarring (whether the burn left a small scar or larger scar estimated by the size of a coin from the denominations in each focus country, which was about 20 mm across the three study sites), causes, and location in the house where the burns occurred. We also obtained information on the age, sex, and income levels of the primary cook or household head and the type of primary fuel used for cooking, lighting, and heating from phase two surveys. Households were classified for analysis as either primary LPG users or exclusive biomass users (including firewood, agricultural or crop residues, charcoal briquettes or pellets, unprocessed charcoal, sawdust, or wood chips) based on validated data on fuel use obtained from both phases of the surveys.

Statistical Analysis

All in-depth survey data from the three countries were aggregated into a single dataset and analyzed using R: A Language and Environment for Statistical Computing (version 4.2.1; R Development Core Team). We calculated overall estimates using aggregated data from the three study sites, separately for primary cooks and children 0–5 years of age. The overall prevalence of burns among primary cooks was calculated as a proportion, where the numerator was the total number of primary respondents reporting CRBs in the in-depth surveys while the denominator was the total number of survey participants in all three study sites. Subsequent data analyses involved stratification of primary cook–level data by country and fuel type to determine the differences in the prevalence and the level of scarring caused by burns. We also stratified the data on the prevalence, the level of scarring, and causes of burns by fuel type among children by country. We calculated 95% confidence intervals (CIs) for prevalence estimates using a one-sample proportions test without continuity correction. We used the χ^2 test of independence to measure the difference in proportions when the sample sizes were sufficiently large and Fischer's exact test when the sample sizes were <10 in a group. We fitted separate univariable binary logistic regression models to assess the independent associations between the ages of the primary cook (11–25, 26–35, 36–45, and 46–83 years old), sex (male, female), income level (categories: "low/2" included income <$85 USD, "3/4" included $85 USD ≤income ≤$500 USD, and "5/high" included income >$500 USD), primary fuel type (LPG primary, biomass exclusive), cooking location (either in the main house with or without a separate room or outside in the open air, veranda, or in a separate room), and study site (Eldoret, Mbalmayo, and Obuasi) and the outcome—occurrence of CRBs among both primary cooks and children (0–5 years of age). Only variables significantly associated with the occurrence of CRBs in the univariate models (age, sex, income, and study site) were included in the final multivariable model, from which we reported the odds ratios (ORs) and their 95% CIs after meeting the assumptions (independence of observations and no multicollinearity) for multiple logistic regression.

Ethical Considerations

We obtained ethical approval from local ethical committees in each country (Institutional Research and Ethics Committee for Moi Teaching and Referral Hospital and Moi University in Kenya, Central Ethics Committee for Human Health Research in Cameroon, and Kintampo Health Research Centre Institutional Ethics Committee and Ghana Health Service Ethics Review

Board in Ghana) and the University of Liverpool, United Kingdom. Written informed consent was obtained from each participant before data collection.

Results

Characteristics of Study Participants

This multisite study included 1,240 primary cooks, of whom 438 (35.3%) originated from Mbalmayo, Cameroon; 360 (29.0%) from Obuasi, Ghana; and 442 (35.6%) from Eldoret, Kenya. Stratified random sampling resulted in a comparable number of exclusive biomass users ($n = 715$, 57.7%) and primary LPG users ($n = 525$, 42.3%) across the three communities. Across the three study sites, 66.0% ($n = 819$) of the households had at least one resident child 0–5 years of age, with the majority of households with children (61.5%) being exclusive biomass users, amounting to 504 out of 819 households. Nearly all primary cooks ($n = 1{,}182$, 95%) were women with a median age of 33 years [interquartile range (IQR): 26–42 years]. There were 21 primary cooks aged 18 years and below and 20 primary cooks aged 65 years and above. About half of the primary cooks ($n = 647$, 52.2%) had a secondary-level education, and a few ($n = 189$, 15.2%) had post-secondary education (Table 1).

Prevalence of CRBs among Primary Cooks

A total of 128 primary cooks (119 women and 9 men) reported CRBs, resulting in an overall prevalence of 10.3% (95% CI: 8.7, 12.2) across the three study sites (Figure 1). The prevalence of CRBs among primary cooks was significantly higher in Mbalmayo ($n = 102$; prevalence = 23.3%, 95% CI: 19.4, 27.5) than in Obuasi ($n = 12$; prevalence = 3.3, 95% CI: 1.7, 5.8) and in Eldoret ($n = 14$; prevalence = 3.2, 95% CI: 1.7, 5.3), respectively. Most of the participants ($\sim 70\%$) across the three sites were medium- and low-income earners ($\leq$\$500 USD per month), and <30% of the households had income exceeding \$500 USD per month (Table 1).

Prevalence of CRBs among Children

The overall prevalence of CRBs among children (5.1, 95% CI: 3.7, 6.9; $n = 42$ out of 819) was significantly lower than that among primary cooks (Figure 1). The prevalence of children's CRBs was similar across sites, with the proportion in Mbalmayo, Eldoret, and Obuasi being 6.5 (95% CI: 4.0, 10.0; $n = 19$), 4.7 (95% CI: 2.5, 7.9; $n = 13$), and 3.9 (95% CI: 1.9, 7.1; $n = 10$), respectively. The prevalence of CRBs among children was higher than that of primary cooks in Obuasi and Eldoret but much lower than that of primary cooks in Mbalmayo.

Scarring among Primary Cooks and Children

Over two-thirds of primary cooks reporting a CRB ($n = 94$, 73.4%) indicated that it left either a small or big scar across the three study sites (Table 1). The largest proportion of scarring among primary cooks was observed in Mbalmayo ($n = 81$, 79.4%) followed by Obuasi ($n = 8$, 66.7%) and Eldoret ($n = 5$, 35.7%). Over four-fifths ($n = 35$, 83.3%) of children across the three study sites who had CRBs reported scarring. All children from Obuasi ($n = 10$, 100%), slightly above four-fifths ($n = 11$, 84.6%) from Eldoret, and close to three quarters ($n = 14$, 73.7%) from Mbalmayo experienced scarring from CRBs.

CRBs and Scarring by Fuel Type among Adults

There was no significant difference in the overall occurrence of CRBs among primary cooks using LPG ($n = 62$; 11.8%, 95% CI: 9.2, 14.9) and exclusively using wood ($n = 66$; 9.2%, 95% CI: 7.2, 11.6) ($\chi^2 = 1.91$; $p = 0.17$). While the prevalence of CRBs among primary cooks was higher among primary LPG users ($n = 48$, 30.2%) than exclusive biomass users (54 out of 279, 19.4%), the difference was

Table 1. Sociodemographic characteristics and occurrence of cooking-related burns among primary cooks and children from Kenya, Ghana, and Cameroon stratified by fuel use.

	Primary cooks ($n = 1{,}240$)		LPG primary users ($n = 525$)		Biomass exclusive users ($n = 715$)		
Characteristic	*n*	%	*n*	%	*n*	%	*p*-Value[a]
Socio-demographic characteristics for primary cooks							
Age							
11–25 years	275	22.2	126	24	149	20.8	<0.001
26–35 years	463	37.3	230	43.8	233	32.6	—
36–45 years	256	20.6	105	20	151	21.1	—
46–83 years	246	19.8	64	12.2	182	25.5	—
Sex							
Female	1,182	95.3	488	93	694	97.1	0.001
Male	58	4.7	37	7	21	2.9	—
Income[b]							
Category low/2	445	35.9	148	28.2	297	41.5	<0.001
Category 3/4	413	33.3	194	37	219	30.6	—
Category 5/high	318	25.6	153	29.1	165	23.1	—
Missing	64	—	30	—	34	—	—
Occurrence of cooking-related burns							
Burns among primary cooks (in the past 12 months)	128	10.3	62	11.8	66	9.2	0.168
Frequency [med (IQR)]	3	2.0–5.0	3	2.0–5.0	2.5	1.3–5.0	0.609
Proportion of scarring	94	73.4	50	80.6	44	66.7	0.112
Prevalence of scarring	94	7.6	50	9.5	44	6.2	0.835
Households with a child	819	—	315	—	504	—	—
Burns among children (in the past 12 months)	42	5.1	14	4.4	28	5.5	0.945
Proportion of scarring	35	83.3	10	71.4	25	89.3	0.197
Prevalence of scarring	35	4.3	10	3.2	25	5	0.904

Note: —, no data; IQR, interquartile range; LPG, liquefied petroleum gas; med, median.

[a]*p*-Values for the categorical variables age, sex, income, and proportions/prevalence of burns and scarring were obtained using the χ^2 test of independence; the Kruskal-Wallis test was used to obtain the *p*-values for the difference in the frequency of burns among primary cooks.

[b]Income categories: Category low/2 includes those reporting an income <\$85 USD (United States dollars) per month; category 3/4 includes those with an income $\geq$\$85 USD but $\leq$\$500 USD; and category 5/high includes those earning >\$500 USD across the three study sites.

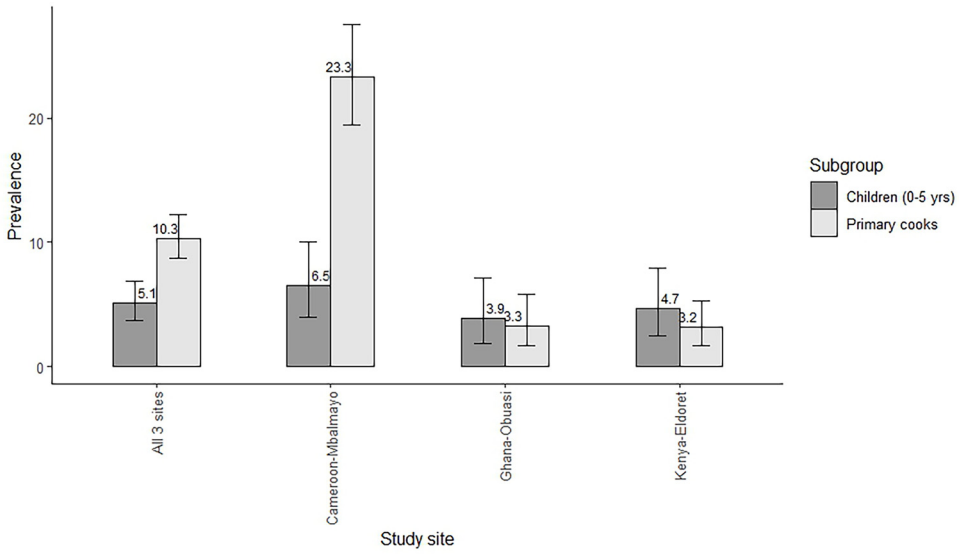

Figure 1. Overall and site-specific prevalence of cooking-related burns among primary cooks ($n = 1{,}240$) and children 0–5 years of age ($n = 819$) in Mbalmayo (primary cooks, $n = 438$; children, $n = 289$), Obuasi (primary cooks, $n = 360$; children, $n = 255$), and Eldoret (primary cooks, $n = 442$; children, $n = 275$), based on a cross sectional survey conducted between 2019 and 2020 in the three study sites. Note: The numbers on the bar graph are the prevalence point estimates while the error bars are the 95% confidence intervals of the point estimate for both primary cooks and children. Prevalence was calculated as the absolute number of either primary cooks or children reporting cooking-related burns (numerator), while the denominator was the total number of either primary cooks or children participating in the multisite cross-sectional survey.

only statistically significant for cooks in Mbalmayo, where a much higher prevalence was observed ($\chi^2 = 6.06$; $p = 0.01$). Scarring from CRBs was not significantly higher in primary LPG compared to exclusive biomass users in any community (Mbalmayo, $p = 0.60$; Obuasi, $p = 0.60$; Eldoret, $p = 0.74$).

CRBs and Scarring by Fuel Type among Children

Similarly, there was no statistically significant difference in the occurrence of CRBs in children from primary LPG-using households ($n = 14$, 4.4%) and those with exclusive use of biomass ($n = 28$, 5.5%) ($p = 0.95$). This lack of association was observed in each setting [Mbalmayo ($p = 0.81$), Obuasi ($p = 0.12$), and Eldoret ($p = 0.99$)]. The proportion of scarring in children was not associated with the choice of cooking fuel overall ($p = 0.20$) or by study location [Mbalmayo, Obuasi, and Eldoret ($p > 0.10$)].

Causes of CRBs among Children

Overall, in children, the proportion of CRBs caused by contact with flames ($n = 15$, 35.7%) and touching hot objects ($n = 14$, 33.3%) was comparable to the proportion of CRBs caused by contact with hot liquids ($n = 12$, 28.6%) (Figure 2). However, most CRBs reported from Mbalmayo were caused by flames ($n = 9$, 47.4%)

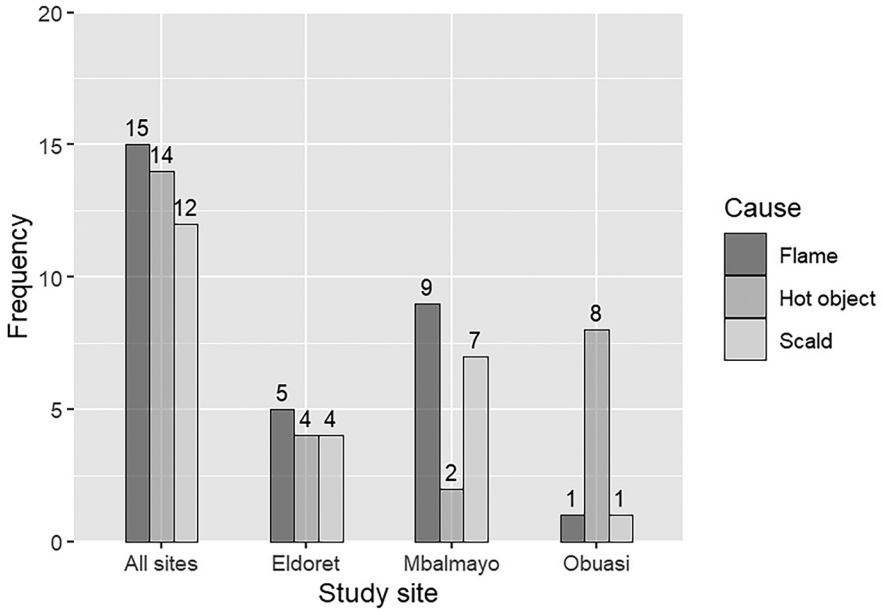

Figure 2. The frequency of cooking related burns among children 0–5 years of age ($n = 42$) grouped by specific cause across the three study sites in Eldoret, Kenya ($n = 13$); Mbalmayo, Cameroon ($n = 19$); and Obuasi, Ghana ($n = 10$), respectively. Note: There was no cause of burns data for one child from Mbalmayo, Cameroon.

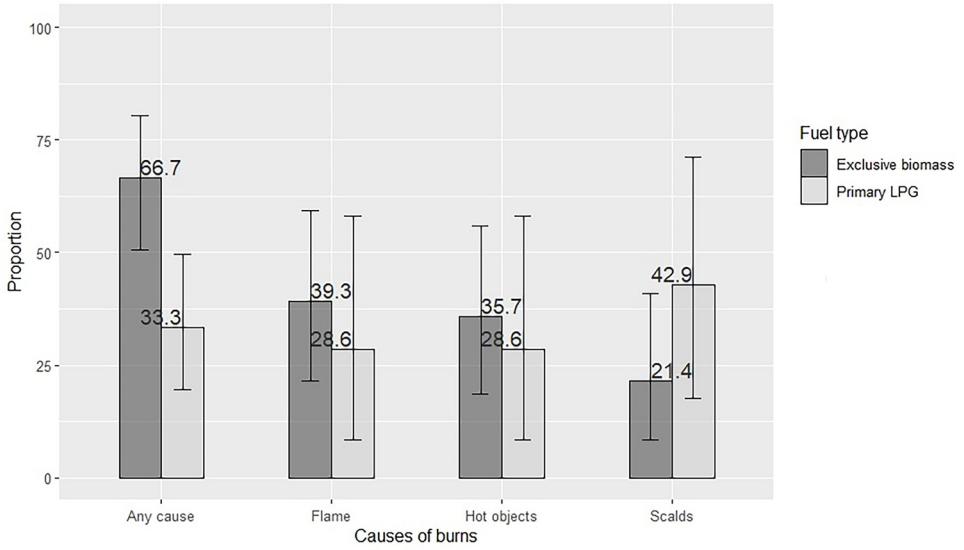

Figure 3. The proportion of cooking-related burns in children 0–5 years of age ($n = 42$) grouped by fuel type across the three cause categories for Kenya, Cameroon, and Ghana. Note: The point estimates are the proportions/percentage while the error bars are the 95% confidence intervals for the proportions.

and scalds ($n = 7$, 36.8%). By contrast, most children's CRBs ($n = 8$ burns, 80.0%) in Obuasi were caused by contact with hot objects (Figure 2). In Eldoret, the proportion of child CRBs caused by contact with flames ($n = 5$, 38.5%), touching hot objects ($n = 4$, 30.8%), and contact with hot liquids (30.8%) were comparable.

Further disaggregation of the causes of burns by fuel type showed that the proportion of child CRBs was higher among exclusive biomass users [28 out of 42 (66.7%), particularly among users of traditional stoves or open fires] compared to primary LPG users ($n = 14$, 33.3%) (Figure 3; Table 2). It is noteworthy that there were more child CRBs caused by contact with flames and touching hot objects among exclusive biomass users [$n = 11$ (39.3%) and 10 (35.7%) burns, respectively] compared to primary LPG users [$n = 4$ (28.6%) for both contact with flames and hot objects]. However, the proportion of scalds was higher among primary LPG users ($n = 6$ or 42.9%) compared to that among exclusive biomass users ($n = 6$ or 21.4%) across the three study sites (Figure 3).

Logistic Regression Results

Two age categories (26–35 and 46–83 years old) exhibited significantly lower odds of experiencing CRBs compared with the age group 11–25 years old, among both primary adult cooks and children at the univariable levels (Table 3). It is noteworthy that primary cooks between 46 and 83 years of age had close to two-fold lower odds of experiencing CRBs [adjusted OR (aOR) = 0.55; 95% CI: 0.32, 0.94; $p = 0.03$] after adjusting for sex, income, and study site. Income levels exhibited a dose–response relationship where the highest income levels were associated with the lowest odds of CRBs at both the univariable and multivariable logistic regression models. The primary fuel used in the household was not associated with the occurrence of CRBs as determined in the univariable and final multivariable models (Table 3). The odds of CRBs among primary cooks and children were about six times higher in Mbalmayo than in Eldoret and Obuasi at univariable and multivariable models (Table 3).

Table 2. Frequency of cooking-related burns among primary cooks and children (0–5 years of age) grouped by type of cook stove used across the three study sites in Cameroon, Ghana, and Kenya.

Type of cook stove	Primary cooks burns ($n = 128$) [frequency (%)]	Child burns ($n = 28$) [frequency (%)]
Exclusive biomass users	66 (51.6)	28 (66.7)
Three stones/open fire	33 (25.8)	10 (23.8)
Traditional solid fuel stove (non-manufactured)	10 (7.8)	11 (26.2)
Manufactured solid fuel stove	9 (7.0)	7 (16.7)
Did not report	14 (10.9)	—
LPG stove, one or more burners	62 (48.4)	14 (33.3)

Note: —, no data; LPG, liquefied petroleum gas.

Discussion

An understanding of the occurrence of cooking-related burns, the contribution of socio-economic factors, and the differential risk by fuel type is needed for the development of appropriate preventive and harm minimization interventions and policies across sub-Saharan African countries. While the overall self-reported prevalence of CRBs was 10.3% among primary cooks across the three communities, the prevalence was about seven times higher in Mbalmayo, Cameroon than in Eldoret, Kenya and Obuasi, Ghana, respectively. Overall, increasing age and higher income levels significantly lowered the odds of experiencing CRBs in the three study sites.

Older age of the primary cooks was associated with significantly lowered odds of occurrence of CRBs among either children or primary cooks across the three study sites. Similarly, higher income levels were also protective against the occurrence of CRBs. Our findings agree with previous studies[5,14,17] that low socioeconomic levels are associated with an increased risk of CRBs. Older primary cooks seem more likely to take precautionary measures based on previous experiences with CRBs. However, and more important, is that higher income might be associated with the adoption of clean energy and technologies that are generally safer and protective against the occurrence of CRBs. The variables age and income levels were not correlated [variance inflation factors (VIF) = 1.06 and 1.12, respectively] based on regression modeling using our primary data. However, in general, it seems highly likely that increasing household income levels will lead to the adoption and cleaner and safer sources of energy and technologies, which may prevent the occurrence and severity of CRBs in LMICs.

Table 3. Sociodemographic, primary cooking fuel, and cooking location and the univariable and multivariable odds ratios (OR) for the occurrence of cooking-related burns (CRBs) among adult cooks and their children (<5 years) in Eldoret (Kenya), Mbalmayo (Cameroon), and Obuasi (Ghana).

Independent variable	Univariable OR (95% CI)	*p*-Value	Multivariable OR (95% CI)	*p*-Value[a]
Age of primary cook				
11–25 years	Ref	—	—	—
26–35 years	0.61 (0.40, 0.94)	0.025	0.71 (0.45, 1.13)	0.143
36–45 years	0.69 (0.42, 1.12)	0.139	0.83 (0.49, 1.40)	0.487
46–83 years	0.60 (0.36, 0.99)	0.048	0.60 (0.34, 1.02)	0.064
Sex				
Male	Ref	—	—	—
Female	0.79 (0.40, 1.74)	0.517	0.85 (0.40, 1.98); 0.93 (0.44, 2.19)	0.861
Income[b]				
Category low/2	Ref	—	—	—
Category 3/4	0.40 (0.26, 0.61)	<0.001	0.47 (0.30, 0.73)	<0.001
Category 5/high	0.44 (0.28, 0.69)	<0.001	0.29 (0.18, 0.46)	<0.001
Main fuel				
LPG primary	Ref	—	—	—
Biomass exclusive	0.88 (0.63, 1.24)	0.479	0.69 (0.47, 1.00)	0.051
Cooking location				
Main house, no separate room	Ref	—	—	—
Main house, separate room	1.14 (0.63, 2.18)	0.678	—	—
Outside, open air	1.15 (0.54, 2.46)	0.721	—	—
Outside, separate room	1.41 (0.77, 2.71)	0.288	—	—
Veranda or covered porch	0.59 (0.29, 1.22)	0.15	—	—
Study site				
Eldoret, Kenya	Ref	—	—	—
Mbalmayo, Cameroon	5.80 (3.73, 9.34)	<0.001	6.62 (4.22, 10.8)	<0.001
Obuasi, Kenya	0.98 (0.53, 1.79)	0.951	0.98 (0.52, 1.82)	0.945

Note: —, no data; CI, confidence interval; LPG, liquefied petroleum gas; Ref, reference.
[a]*p*-Values were obtained from either univariable or multivariable logistic regression models; only the variables age, sex, income, and study site were included in the final multiple logistic regression model.
[b]Income categories: Category low/2 includes those reporting an income <$85 USD (United States dollars) per month; category 3/4 includes those with an income ≥$85 USD but ≤$500 USD; and category 5/high includes those earning >$500 USD across the three study sites.

The higher occurrence of CRBs in Mbalmayo might be explained by the higher reliance on biomass fuels, which are associated with a higher risk of experiencing CRBs,[5,22] and the type of local cuisine, which includes frequent frying. Frying foods in oil can increase the likelihood of hot liquid coming into contact with the cook's skin. For example, a previous study found that fried foods like French fries and fried chicken had the highest burn risk.[23] Also, potential over-reporting of CRBs may have resulted from different interpretations of what constituted a burn given that this study relied on self-reports and the fact that the burn questions did not specifically ask the type of fuel that caused the burn. A related study from Cameroon found out that some participants may have worked as food vendors in open markets frying fish, where it is unlikely that LPG was used as cooking fuel. (M. Shupler, personal communication)

Generally, there was no association between the occurrence of CRBs and fuel type using either aggregated or disaggregated data across the three communities. Also, most primary cooks and children reported scarring caused by CRBs, which was used as a proxy indicator for burn severity since clinical assessment and classification of burns (i.e., first-degree, second-degree, and third-degree)[24] were not feasible. The high proportion of scarring among children (83%) may have occurred due to lack of direct child supervision during cooking activities by the primary cooks. Compared to adults, children are usually more susceptible to scars after burns because their growth potential impacts the process of scarring and healing.[25] While the current study does not provide conclusive evidence on burn severity, the high proportions of scarring among children 0–5 years of age indicates that CRBs are an important public health issue that needs to be addressed through appropriate prevention and harm-minimization approaches.

The overall prevalence of child CRBs (5.1%) (Figure 1; Table 1) is comparable with the prevalence (6.2%) from a similar study conducted in Ethiopia.[22] However, the Ethiopian study reported that using traditional biomass cook stoves increased the odds of child CRBs. Elsewhere, the use of kerosene also has been shown to increase the risk of CRBs among children in LMICs.[6] Additionally, higher levels of education among caregivers, the presence of a separate kitchen room, and supervision are protective factors for child CRBs in LMICs.[5,17]

Overall, contact with flames, touching hot objects such as cooking pots, and contact with hot liquids were the ubiquitous causes of burns for children 0–5 years of age. However, there were some variations by study site where contact with flames was more common in Mbalmayo and Eldoret, and scalds were more common in Obuasi, Ghana, which might reflect different cooking patterns and stove types used. Considering the causes of burns by fuel type as investigated in other studies,[5,22] there was a significantly higher proportion of CRBs among exclusive biomass users than primary LPG users for children. Contact with flames and touching hot objects were more common among exclusive biomass users while contact with hot liquids was more common among primary LPG users. The cause of burns among children by fuel type provides useful information that may be used to tailor guidelines for interventions to prevent CRBs among children.

To the best of our knowledge, this is one of the first multinational studies in SSA to investigate the prevalence of CRBs among primary cooks and children 0–5 years of age and to determine whether the prevalence was associated with cooking fuel type. We standardized the design and implementation of this multisite survey through consistent training activities for the study enumerators.

However, there are a few limitations to our study. First, the use of self-reporting of the occurrence of CRBs may have introduced information bias due to potential interpretation of what constitutes a burn and a severe burn. Second, we were unable to ascertain the actual causes of CRBs among primary cooks since

the survey did not collect information on secondary cook stoves or secondary cooks in relation to when the CRB event occurred. The primary assumption in this study that CRBs occurred in the main home of residence and were caused by the primary type of fuel used in the household may not always be true. It may be possible that there was more than one cook in the family and the very young children and very old women may not have cooked as many meals (especially meals involving hot fluids/frying, etc.) as the primary cooks in the other age groups. Besides, many households use different fuels at different times (which can also vary seasonally),[27] and CRBs may have occurred when using a nonprimary fuel in the previous 12 months. Finally, the higher prevalence of burns may be related to the use of additional cooking fuels for occupational activities, rather than household cooking, a subject that was beyond the scope of the current survey.

This multisite study provides important baseline information on the prevalence, severity, causes and contexts, risk factors for CRBs, and their variability by primary fuel type among primary cooks and children under the age of 5 years. Future studies in unresearched sites in SSA may further explore associations with fuel use, novel aspects on the burden, severity and causes, outcomes, and the health care options and challenges to provide a basis for preventive and curative interventions to prevent mortality and morbidity associated with CRBs. Our study also identifies substantial between-community variation (that is, CRB risk may be higher in Mbalmayo, Cameroon compared to the other two communities). The large variability in risk signals the need to monitor CRB prevalence across multiple communities in SSA to characterize its health burden better and identify potential hot spots to prioritize for prevention and care. Additionally, the regression analysis identified other possible risk factors, including lower-income individuals and those of younger age.

Conclusions

The prevalence of cooking-related burns and scarring was high among primary cooks and children living in peri-urban communities. Increasing age of the mother and higher income levels were associated with reduced odds of the occurrence of cooking-related burns. Individuals experiencing cooking-related burns were susceptible to multiple burns within 12 months, suggesting that burns from cooking can be a frequent occurrence. There is a need for additional studies using standardized clinical criteria to better characterize cooking-related burns and to understand the main causes and determinants among primary cooks from different settings in LMICs. A multifaceted spectrum of interventions including socioeconomic empowerment, the transition to the adoption and use of cleaner and safer fuels for cooking, and adequate supervision while cooking might reduce the occurrence and impact of cooking-related burns among children in LMICs.

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