ORIGINAL ARTICLE

Risk factors for burns in children: crowding, poverty, and poor maternal education

J Delgado, M E Ramírez-Cardich, R H Gilman, R Lavarello, N Dahodwala, A Bazán, V Rodríguez, R I Cama, M Tovar, A Lescano

Injury Prevention 2002;**8**:38–41

See end of article for authors' affiliations

Correspondence and reprint requests to: Dr Robert H Gilman, Asociación Benéfica PRISMA, Av Carlos Gonzales #251, Lima 32, Perú; rgilman@prisma.org.pe

Objective: To characterize the presentation of burns in children and risk factors associated with their occurrence in a developing country as a basis for future prevention programs.
Design: Case-control study.
Setting: Burn unit of the National Institute of Child Health (Instituto Nacional de Salud del Niño) in Lima, Peru.
Methods: A questionnaire was administered to all consenting guardians of children admitted to the burns (cases) and general medicine (controls) units during a period of 14 months. Guardians of patients were questioned regarding etiology of the injury, demographic and socioeconomic data.
Results: 740 cases and controls were enrolled. Altogether 77.5% of the cases burns occurred in the patient's home, with 67.8% in the kitchen; 74% were due to scalding. Most involved children younger than 5 years. Lack of water supply (odds ratio (OR) 5.2, 95% confidence interval (CI) 2.1 to 12.3), low income (OR 2.8, 95% CI 2.0 to 3.9), and crowding (OR 2.5, 95%CI 1.7 to 3.6) were associated with an increased risk. The presence of a living room (OR 0.6, 95% CI 0.4 to 0.8) and better maternal education (OR 0.6, 95% CI 0.5 to 0.9) were protective factors.
Conclusions: To prevent burns interventions should be directed to low socioeconomic status groups; these interventions should be designed accordingly to local risk factors.

Burns are one of the most physically and psychologically devastating forms of trauma in children. They are also one of the most common household injuries and thus an important cause of morbidity and mortality.[1–6] In both developed and developing countries, children under age 5 experience greater mortality from burns than any other age group.[5 7] Implementation of preventive measures is especially important in developing countries where there is an increased risk for burns and treatment is more difficult because of the lack of medical care resources or their high cost when present.

To develop effective prevention programs, a determination of risk factors may prove helpful. Unfortunately, well designed studies investigating possible risk factors are scarce. Previous epidemiological studies have used small samples and, in some cases, did not include all age groups.[8–12] Therefore, we conducted a case-control study to investigate burn injuries in a pediatric population in Lima, Peru.

METHODS

Study design and location

A case-control study was performed over 14 months from 1998 to 2000 in the National Institute of Child Health (Instituto Nacional de Salud del Niño, INSN), a 450 bed hospital which is the major referral center for the treatment of children. The majority of patients are of low and mid-low socioeconomic status. The burn unit has 35 beds and ambulatory facilities for treatment of lesser severity burns and follow up evaluation.

Study population

Cases

Cases were defined as children under age 18 who came to the hospital with burn injuries and were seen between December 1998 and January 2000.

Controls

One age and sex matched control was selected for each case. For outpatient cases, a control was selected from patients in the ambulatory care unit and for inpatients, controls were selected from other inpatients in the same hospital. For cases less than 12 months of age, controls were enrolled with a maximum age difference of one month, for cases 1–5 years old, this difference was two months, and for cases 5–17 years old, the age difference was three months.

Data collection

Parents or guardians of study subjects (herein referred to as guardians) gave their oral consent under a protocol approved by the INSN and Benefit Association (Asociación Benéfica) PRISMA ethics committees. A structured questionnaire was administered with questions regarding the age, gender, birthplace, race, and birth order of the child; the level of education, occupation, and monthly income of the parents and the relation of the child to the head of household. Data concerning living conditions (for example quality of housing, access to running water) was also recorded. A clinical history was obtained for each case in collaboration with physicians of the pediatric burn unit. The etiology of the burn trauma (date, hour, location, injury related events), burn type, percentage of affected body surface area and burn depth were noted. Crowding was arbitrarily defined as more than three people sharing a bedroom in the house.

Data analysis

Statistical analysis was performed using SPSS v 9.0 (SPSS Inc, IL, USA) and STATA v 6.0 (STATA Co, College Station, TX, USA) and χ^2 tests were used to evaluate associations between

Abbreviations: BSA, body surface area; CI, confidence interval; INSN, Instituto Nacional de Salud del Niño; OR, odds ratio

Table 1 Distribution of burns by gender and age

	Cases: frequency (%) (n=720)	Controls: frequency (%) (n=720)
Sex		
Males	398 (55.3)	398 (55.3)
Females	322 (44.7)	322 (44.7)
Age range (years)		
0–4	502 (69.7)	505 (70.1)
5–9	141 (19.6)	138 (19.2)
10–14	60 (8.3)	62 (8.6)
15+	17 (2.4)	15 (2.1)
Mean	3.97	3.96

dichotomous variables. The strength of association between burn injuries and the presence of predisposing factors was evaluated by single and multiple conditional (fixed effects) logistic regression analysis.[13] Independent factors were determined after adjustment for possible confounding factors. Some factors were excluded from the multiple regression analysis due to colinearity with other variables. All analyses were performed at a 95% confidence level.

RESULTS

A total 740 cases and an equal number of age and sex matched controls agreed to participate. Of these, 20 cases and their respective controls were excluded due to incomplete data. Demographic data for cases and controls are shown on table 1. The majority of patients came to hospital within four hours of the injury (table 2). Burns accounted for 5.2% of total hospital mortality (26/497) in 1999; over half (61.5%, 16/26) were due to fire.

Burn occurrences

Burns most commonly occurred in the patient's home (77.5%) and in a room used for cooking in more than half of the cases (67.8%). Less often the site was a relative's or neighbor's house, or outside the house.

Burns peaked in the summer season and during school vacations ($p<0.05$). The child was alone at the time of the injury in 5.7% (41/720) of all cases. In over 50% the mother was present at the time of the burn and the father was present in 22%. Alcohol consumption by parents at the time of injury was not a factor.

Burn etiology

Most burns were scalds (table 2). When scalding occurred to those under 4, most were boys; after this age, females were at an increased risk of being scalded (table 3). There was an annual linear increase of 3% in the proportion of females to males with scalding after age 4 ($p<0.001$).

Most commonly scalding occurred when children reached for pots, cups or dishes containing hot liquids sitting on a table. We found that 21.3% (114/535) of scaldings occurred when the child tried to get a cup on a table. Pots with hot liquids on the floors accounted for 16.8% (90/535) of scaldings. Only a small number presented with burns related to bathing (1.1%, 6/535) or the use of electric kettles (0.5%, 3/535).

The second most prevalent cause of burns was fire contact (12.7%, 91/720). These were most frequent in males and children older than 10 (68.1%, 62/91). Over half of these burns (53.2%, 48/91) occurred when both parents were absent.

Firework related burns were common in children 5–9 years old (54.1%, 13/24) and occurred near Christmas or New Year's Eve. During these celebrations, unsafe fireworks are often sold to children.

Associated risk factors

Simple and multiple conditional logistic regression analysis identified several socioeconomic factors associated with burn risk (table 4). Education above high school in either the mother or the father was associated with a decreased risk for burns. Paternal education, however, had a weaker association and was more colinear with other socioeconomic factors, leading us to exclude it from multiple regression analysis.

Absence of water supply, salary less than 28.5 dollars/month per capita, and crowding were the most important risk factors. Another important risk factor was the relation of the child to the household head. Children who were not a son or daughter of the household head had an increased risk for

Table 2 Initial place of attention, time of delay to seek attention, location of the accident and classification of burns by agent, mechanism of exposure to hot liquids, and extension

	Frequency (%) (n=720)
Place of initial attention	
Hospital	489 (67.9)
Health post	196 (27.2)
Other	35 (4.9)
Delay to seek attention (hours)	
0–4	521 (72.4)
5–9	21 (2.9)
10–14	8 (1.1)
15–19	13 (1.8)
20–24	32 (4.4)
24–48	24 (3.3)
48+	101 (14)
Location	
Patient's house	558 (77.5)
Neighbor's house	16 (2.2)
Relative's house	81 (11.2)
School	7 (1)
Other	58 (8.1)
Site inside the house*	
Living room	38 (5.8)
Dining room	27 (4.1)
Bedroom	57 (8.7)
Room used for cooking	444 (67.8)
Bathroom	12 (1.8)
Other	77 (11.8)
Burn agent	
Hot liquids	535 (74.3)
Hot water	[403 (75.4)]
Meals	[77 (14.3)]
Other	[55 (10.3)]
Fire	91 (12.7)
Hot surfaces	37 (5.2)
Electricity	27 (3.7)
Fireworks	24 (3.3)
Other	6 (0.8)
Mechanism of exposure to hot liquids	
Projection	426 (79.7)
Immersion	109 (20.3)
Extension (% of BSA†)	
0–1	149 (20.6)
2–3	154 (21.3)
4–5	135 (18.8)
6–9	151 (21.0)
10–14	74 (10.3)
15–19	21 (2.9)
20+	36 (5.0)

*n=655 for this category; †BSA, body surface area.

Table 3 Proportion of burns due to scalding by age and gender

Age group (years)	Males (%)	Females (%)
0–4	235 (56.9)	178 (43.1)
5–9	37 (42.5)	50 (57.5)
10+	9 (25.7)	26 (74.3)

Table 4 Socioeconomic factors related to burn risk identified by simple and multiple conditional logistic regression

Factor	Simple conditional logistic regression OR (95% CI)	Multiple conditional logistic regression OR (95% CI)
Presence of bathroom	0.2† (0.1 to 0.3)	–*
No water supply	7.2† (3.5 to 14.5)	5.2† (2.1 to 12.3)
Presence of living room in the house	0.4† (0.3 to 0.5)	0.6‡ (0.4 to 0.8)
Own house	0.8† (0.7 to 0.9)	0.7‡ (0.6 to 0.9)
Two or more children sharing one bed	2.7‡ (2.1 to 3.4)	–*
Patient is not son or daughter of household head	1.9† (1.4 to 2.6)	2.2† (1.5 to 3.2)
Father with high school or more education	0.2† (0.2 to 0.3)	–*
Mother with high school or more education	0.3† (0.2 to 0.4)	0.6‡ (0.5 to 0.9)
Per capita salary less than $ 28.5 a month	3.6† (2.7 to 4.7)	2.8† (2.0 to 3.9)
Married parents	0.4‡ (0.3 to 0.5)	–*
Crowding	3.9† (2.9 to 5.1)	2.5† (1.7 to 3.6)

CI, confidence interval; OR=odds ratio; *factor excluded from multiple regression analysis; †p<0.01; ‡p<0.05.

burns. Protective factors were a living room in the house, high school or further education of the mother, and ownership of the house by the family—all indicators of higher socioeconomic status.

DISCUSSION

Burns are one of the leading causes of death among children in developing countries. In the present study, poverty, crowding, lack of education, and not being the son or daughter of the household head, were all significant risk factors. Previous studies examining socioeconomic status markers as possible risk factors for burns have reported mixed results. Studies conducted in Brazil, England, and Greece determined a positive relationship with crowding, maternal socioeconomic status, and ethnicity.[10 12 14] In Ghana, however, Forjuoh *et al* observed no significant differences between burn repeaters and non-repeaters based on demographic or socioeconomic indicators.[15] In Holland, van Rijn, *et al* found that children from lower socioeconomic status were at a lower risk for burns.[9]

In our Peruvian population, it is clear that children of lower socioeconomic status have a greater risk for burns. The factor most strongly related to an increased risk was the lack of running water. There is one reason for this: shantytown houses in Lima without running water represent the poorest of the poor. Also in Lima shantytowns water heaters are not affordable, and water needs to be heated for cooking and bathing. This large heated water requirement leads to the boiling of liquids in pots that are often placed on the ground to cool or conserve space. Tea kettles, although much safer as a means of heating water, are more expensive, have a smaller capacity, and are not used as frequently as pots.

Another important factor was maternal education. The relationship between the lack of parental education and burns has been noted previously.[16] Even though education has been repeatedly associated with a risk for burns, it is not clear if this factor is simply a proxy for poverty. Lower incomes and crowding also increased the risk of burns.

Scalding was the most common type of burn noted. This finding concurs with other studies that have reported a higher prevalence of scalds in children[1 3 4 6 9 17 18] compared with adults; the latter have higher rates of fire burns.[19 20] Scalding most frequently occurred when a child reached for a container of hot liquid. Philips *et al* reported similar results among children aged 0–2.[21] Many studies have found that hot water from baths, showers, taps, and kettles were major causes of burns.[21–23] However, the majority of our study population lacks running hot water and also frequently lacks electricity.

The kitchen was the site of the majority of scalds. In Peruvian shantytowns, houses may not contain a separate room for use as a kitchen. Kitchens presumably increase the risk of burns because of the proximity to hot objects such as fire, oil, or boiling water. With the presence of a living room in the house the risk of burns decreased.

After the age of 4, girls were more prone to scalds than boys, which may be due to girls working in the kitchen. Before the age of 4, however, boys were more likely to be burned than girls. This gender difference in the first years of life has been observed in other injuries in children.[1–3]

Finally, it was during the school holidays in the summer (end of December to late March) that the highest proportion of burns occurred. In part this is because the holiday season has an increased rate of burns due to firecrackers.

IMPLICATIONS FOR PREVENTION

Developing countries that improve their population's access to water and electricity and that have a growing middle class should witness a decrease in the incidence of burns. However, the implementation of intervention programs cannot wait until development occurs. Prevention efforts are urgently needed to reduce the rate of this unacceptably common cause of unjury in children, and should be developed on a local level in response to risk factors identified in individual areas.

Authors' affiliations

J Delgado, M E Ramírez-Cardich, R H Gilman, R Lavarello, N Dahodwala, R I Cama, M Tovar, A Lescano, Benefit Assocciation PRISMA (Projects in Informatics, Medicine, Health and Agriculture), Lima, Peru

A Bazán, V Rodríguez, Burns Unit, National Institute of Child Health, Lima, Peru

REFERENCES

1 **Adesunkanmi AR**, Oginni LM, Oyelami AO, *et al*. Epidemiology of childhood injury. *J Trauma* 1998;**44**:506–11.
2 **Rivara FP**, Aitken M. Prevention of injuries to children and adolescents. *Adv Pediatr* 1998;**45**:37–72.
3 **Laffoy M**. Childhood accidents at home. *Ir Med J* 1997;**90**:26–7.
4 **De-Souza DA**, Marchesan WG, Greene IJ. Epidemiological data and mortality rate of patients hospitalized with burns in Brazil. *Burns* 1998;**24**:433–8.
5 **Morrow SE**, Smith DL, Cairns BA, *et al*. Etiology and outcome of pediatric burns. *J Pediatr Surg* 1996;**31**:329–33.
6 **Arslan E**, Dalay C, Çinaroglu E, *et al*. Aetiologies and outcomes of burns in infants under one year old. *Annals of Burns and Fire Disasters* 1999;**12**:81–3.
7 **Germann G**, Barthold U, Lefering R, *et al*. The impact of risk factors and pre-existing conditions on the mortality of burn patients and the precision of predictive admission-scoring systems. *Burns* 1997;**23**:195–203.
8 **Forjuoh SN**, Guyer B, Strobino DM, *et al*. Risk factors for childhood burns: a case-control study of Ghanaian children. *J Epidemiol Community Health* 1995;**49**:189–93.
9 **Van Rijn OJ**, Bouter LM, Kester AD, *et al*. Aetiology of burn injuries among children aged 0–4 years: results of a case-control study. *Burns* 1991;**17**:213–9.
10 **Petridou E**, Trichopoulos D, Mera E, *et al*. Risk factors for childhood burn injuries: a case control study from Greece. *Burns* 1998;**24**:123–8.

11 **Rossi LA**, Braga EC, Barruffini R, *et al*. Childhood burn injuries: circumstances of occurrences and their prevention in Riberao Preto, Brazil. *Burns* 1998;**24**:416–9.
12 **Werneck GL**, Reichenheim ME. Pediatric burns and associated risk factors in Rio de Janeiro, Brazil. *Burns* 1997;**23**:478–83.
13 **Stata Corp**. *Stata reference manual release 6*. Vol 1. Texas: Stata Press, 1999: 201–16.
14 **Learmonth A**. Factors in child burn and scald accidents in Bradford 1969–73. *J Epidemiol Community Health* 1979;**33**:270–3.
15 **Forjuoh S**. Burn repetitions in Ghanaian children: prevalence, epidemiological characteristics and socioenviromental factors. *Burns* 1996;**22**:539–42.
16 **Locke JA**, Rossignol AM, Burke JF. Socioeconomic factors and the incidence of hospitalized burn injuries in New England counties, USA. *Burns* 1990;**16**:273–7.
17 **Van Rijn OJ**, Bouter LM, Meertens RM. The aetiology of burns in developed countries: review of the literature. *Burns* 1989;**15**:217–21.
18 **Hadjiiski O**, Dyakov R, Atanassov N. Epidemiological survey of children's burns in Bulgaria and a burn prevention program. *Annals of Burns and Fire Disasters* 1999;**12**:77–80.
19 **Benito J**, Navarro A, Baena P, *et al*. An analysis of burn mortality: a report from a Spanish regional burn center. *Burns* 1991;**17**:201–4.
20 **Türegün M**, Segezer M, Selmanpakoglu N, *et al*. The last 10 years in a burn center in Ankara, Turkey: an analysis of 5264 cases. *Burns* 1997;**23**:584–90.
21 **Philips W**, Mahairas E, Hunt D, *et al*. The epidemiology of childhood scalds in Brisbane. *Burns Including Thermal Injury* 1986;**12**:343–50.
22 **Fukunishi K**, Maruyama J, Takahashi H, *et al*. Characteristics of bath-related burns in Japan. *Burns* 1999;**24**:272–6.
23 **Sheller J**, Thuesen B. Scalds in children caused by water from electrical kettles: effect of prevention through information. *Burns* 1998;**24**:420–4.

LACUNAE

Differences between US and European students

Specifically designed to be comparable to the US Monitoring the Future (MFT) high school survey, the European School Survey on Alcohol and Drugs (ESPAD) was conducted in 1999 with 10th grade students in 30 participating European countries. According to the 1999 MTF survey, just over a quarter of US 10th graders reported that they had smoked at least one cigarette in the past 30 days, compared with an average of 37% of similarly aged students in the participating European countries (where the proportions ranged from 16% to 67%). Forty per cent of the US students reported using alcohol in the past 30 days, compared with 61% of European students (ranging from 36% to 85%). US students, however, were much more likely to have ever used illicit drugs. For example, 41% of them reported ever using marijuana, compared with 17% of European students (ranging from 1% to 35%). (Contributed by Ian Scott.)

Air safety

Some air navigation charts for pilots in New Zealand are about to be reprinted because of a few editorial errors. The maps to be reprinted because they have incorrect flight paths, flying heights, and air space boundaries and they omit a major airfield (*The Age*, Melbourne, September 2001; contributed by Ian Scott).

Tug-of-war injury

An 11 year old Australian boy suffered a major injury in a school yard game of tug-of-war in September. The game involves two teams pulling in opposite directions on a rope with the winner the one that pulls the other team across a fixed line. The boy was at the front of his team in a supervised game and had wrapped the 12 mm rope around the fingers of his right hand so that two thicknesses of rope were held between fingers and palm. In the to and fro action the rope cut into his palm so badly that it was only held on by tendons. Microsurgery restored the hand and medical reports are that the prognosis is good.

Risk factors for burns in children: crowding, poverty, and poor maternal education

J Delgado, M E Ramírez-Cardich, R H Gilman, R Lavarello, N Dahodwala, A Bazán, V Rodríguez, R I Cama, M Tovar and A Lescano

Inj Prev 2002 8: 38-41
doi: 10.1136/ip.8.1.38