Ethnicity and Etiology in Burn Trauma

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The purpose of this study was to retrieve data from the British Columbia Professional Firefighters Burn Unit registry, with a focus on ethnicity and how it is involved in burn trauma. It is hypothesized that mechanism, severity, and other patient characteristics are significantly different among different ethnic groups. Furthermore, it is believed that these data can be used to augment burn prevention strategies. Data for burn patients admitted from 1979 to 2009 were reviewed from the burn registry. The main focus was with differences seen among the four main ethnicities throughout the analysis, Caucasian, Aboriginal, Asian, and Indoasian, reflecting the population distribution of the region. Age and sex were also considered when looking at burn mechanism, severity, contributing and copresenting factors. Caucasians were the largest group (79.1%) and included the largest male:female ratio (3.3:1), with high numbers of flame injury (53.9%). Caucasians presented with the highest mortality (6.6% compared with 4.1% for all other ethnicities; $P < .006$). Asian patients (8.1%) showed significantly higher occurrences of urban (64%) and workplace (28.9%) injuries with a larger proportion of scald injury (38.9%). Indoasian patients included larger numbers of women (36.4%) and household scald injuries (33.9%) whereas Aboriginals suffered the most flame injuries (60.1%) in rural areas with more frequent contributing factors such as alcohol. The study found multiple significant differences in the burn injury population when segmented by ethnicity. Though the exact reasons for these differences are difficult to say with certainty, it allows a unique opportunity to focus communication and prevention efforts to specific communities. (J Burn Care Res 2014;35:e99–e105)

The study of ethnicity trends in trauma has allowed better advocacy for injury prevention programs within different demographic groups.[1,2] Research continually shows variances in the mechanism of injury among those of different ethnic origins.[3–10]

Although socioeconomic status, age, and sex play a determining role in patient population variation, these demographic categories are considerably more difficult to engage for the purpose of injury prevention initiatives. Ethnicity, however, allows for effective targeting of communications within a population that shows an increased risk for preventable injury.

Burn prevention is a critical part of health advocacy campaigns, yet studies on how these patients stratify ethnically are limited. This is possibly because of burn centers that lack an adequate ethnic diversity or whose patient demographic data collection is too limited for such a study. Exceptions exist, and significant differences in burn injury by ethnicity have been found,[11–13] indicating a continued value in this area of research.

Vancouver, Canada, stands as a region of significant ethnic diversity. Approximately one half of Vancouver's population is what Statistics Canada[14,15] describes as a visible minority, and this is projected to increase steadily. Vancouver also boasts a trauma and burn unit at Vancouver General Hospital (VGH) that serves the entire province of British Columbia and maintains a detailed database of its patient population, which features comprehensive demographics including ethnicity. This combination provides an excellent opportunity to address a significant absence in burn literature regarding ethnic trends in burn injury.

It is reasoned that significant differences in mechanism exist within the ethnicities of the VGH burn patient population. This study was developed to assess burn admissions at VGH during a 30-year period (1979–2009) and determine how ethnicity plays a role in burn trauma. Furthermore, it is believed this

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information can be used to augment burn prevention literature within various communities, with the intent of reducing morbidity and mortality of those at risk.

METHODS

This retrospective study was approved by the University of British Columbia Clinical Research Ethics Board. Data were derived entirely from the British Columbia Professional Firefighters Burn Unit burn registry database, which includes details of its burn population from 1973 to present. As of 1979, ethnicity has been included in the database. For this study, the data set included all burn admissions to VGH from 1979 to 2009. The number of pediatric patients decreased significantly in the 1990s with expansion of British Columbia Children's Hospital; however, small numbers of older children were admitted as recently as 2008. Burn patients with only outpatient clinic visits were not included in this study.

Ethnicity was derived from patient charts and categorized as Caucasian, Asian, Indoasian, and Aboriginal with remaining ethnicities, including African, Hispanic, Filipino, and noncategorized, condensed as Other. Caucasian included those of European decent. Asians consisted mostly of those from China but also included countries such as Korea. Indoasians are primary those from India and also surrounding countries in the south Asian region. Aboriginals are those indigenous to North America. In addition to ethnicity, other patient demographics were analyzed, including age and sex.

Key supporting variables in the analysis included context of the trauma such as of geographic region of injury, mechanism, instigating events, contributing factors, as well as associated injuries. Severity of the injury was also included, as well as extent and depth of injury, inhalational involvement, survival, and length of stay in intensive care unit and hospital.

Data were analyzed using SPSS 17 (SPSS Inc, Chicago IL) and STATA (StataCorp LP, College Station TX), using standard statistics to describe the total sample and compare relevant subgroups. For all multiple group comparisons a χ^2 test was used. For continuous variable comparison of multiple groups, analysis of variance test was used.

RESULTS

Beginning with a total of 5107 records, entries where ethnicity was not identified were removed for a total number of 4197. This represented 82% of the total data set. Burn admissions at VGH show a continuous drop over time, 980 (an average of 196 patients per year) during 1980–1984 to 403 (an average of 81 patients per year) in the last 5 years (2005–2009; Table 1). Patient ethnicity reflected regional demographics, showing a majority of patients identified as Caucasian (79.1%), Asian (8.1%), Indoasian (5.8%), and Aboriginal (5.4%) whereas less than 2% included people of African, Hispanic, or other descent. Consistent with census trends, non-Caucasian patients grew in proportion to Caucasian patients (18.9–23.1%) during the study period.

Patient age ranged from infant to 99 years. The mean age for pediatric (less than 17) was 6.8 years, with 33.1% being 1 year old or younger. Adult patients represented the majority of the patient population (78.5%) with a mean age of 42 years among those 18 years and older. The largest age group was patients 45 to 64 years old (Figure 1).

Burn trauma by sex shows a ratio of 3:1 male to female, a finding that was stable over time. However, this finding dissolves at the extremes of age (Figure 2). Two thirds (64.7%) of patients who were 12 years or younger were male, whereas sex among those aged 65 years or more was even (54.3% male). Differences in ethnicity were seen with a higher number of female patients among Asians (30.1%), Aboriginals (32.5%), and most prominently Indoasians (36.4%) compared with Caucasians who had

Table 1. Five-year trend for burn admissions by ethnicity

Years	Total Admissions	Aboriginal, %	Asian, %	Caucasian, %	Indoasian, %	Other, %
1980–1984	980	6.4	7.1	81.1	4.7	0.6
1985–1989	908	6.4	8.8	79.3	5.1	0.4
1990–1994	652	6.3	9.0	77.3	5.5	1.8
1995–1999	552	4.3	9.8	77.2	6.7	2.0
2000–2004	472	2.8	9.5	75.4	8.9	3.4
2005–2009	403	14.7	5.7	78.7	6.5	4.5
Total	3967	218	331	3118	233	67
		5.5	8.3	78.6	5.9	1.7

*1979 data not included to facilitate 5-year trend tabulation.

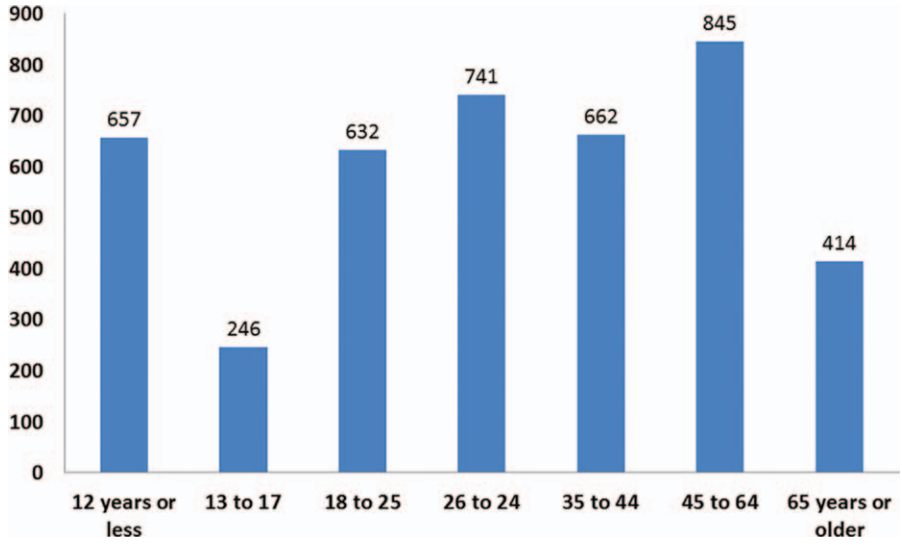

Figure 1. Patient admission by age.

a significantly lower presence of females (23.2%); $P < .0001$ (Figure 3).

Context of Injury

Region. Region of injury was concentrated in the Greater Vancouver area (59.5%) with a third (36.4%) of burn trauma occurring in the immediate Vancouver city area. Another third (35.5%) came from regions elsewhere in British Columbia and only a small percentage (2.6%) from areas outside the province. These findings were consistent across most ethnicities and sex, with the exception of Asian patients who were almost twice (64% Asians vs 31.2% all others; $P < .0001$) as likely to have been injured in Vancouver. Conversely, Aboriginal patients showed an increased presence in regions of British Columbia outside Greater Vancouver (55.7% Aboriginals vs 31.2% all others; $P < .0001$). Region of injury shifted over time. Although Vancouver city saw a decrease in admitted burn patients from 44.9% of total patient population during the 1980s to 19.2% in the last decade ($P < .0001$), the remainder of British Columbia saw a proportional increase in the same period.

Etiology. In all patients the mechanism of injury was predominately flame (51.6%) and scalds or steam injury (22.8%). The remaining sources included

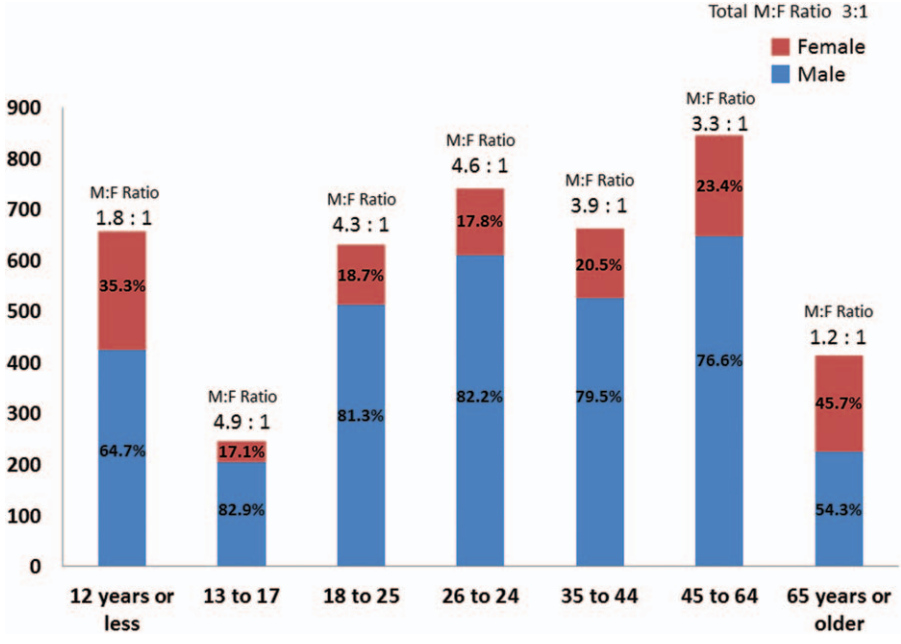

Figure 2. Patient age with sex.

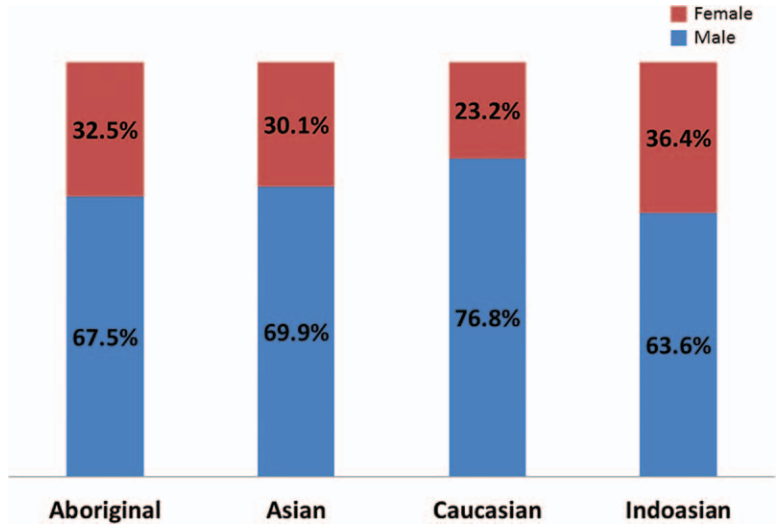

Figure 3. Patient ethnicity with sex.

grease (6.1%), electrical (5.6%), and thermal contact (5.2%). Although most male and female patients were injured by flame (54.4 and 41.6%, respectively), females showed a higher percentage of injury via scald or steam (35.4% compared with 18.6% in males; $P < .0001$), thermal contact (7.5% compared with 4.4%; $P < .0001$), and grease (9.4 and 5.1%; $P < .0001$). Given the large proportion of female sex among Asian and Indoasian patients, it was not surprising to see this pattern repeated when looking at mechanism by ethnicity. Significant differences among ethnicities exist for mechanism of injury. More than half of Caucasian (53.9%) and Aboriginal (60.1%) patients were injured by flame, whereas Asian and Indoasian burn patients were more evenly distributed; Asian patients experienced flame and scald/steam injury 33.6 and 38.9%, respectively, whereas Indoasian patients were reported at 37.6 and 33.9%, respectively (Figure 4; $P < .0001$). Young children, 12 years and younger, suffered scalds the most (58.6%) followed by those of advanced age (35.0% among patients aged 65 years and older). Flame was the most common etiological factor among teenagers (70.3%).

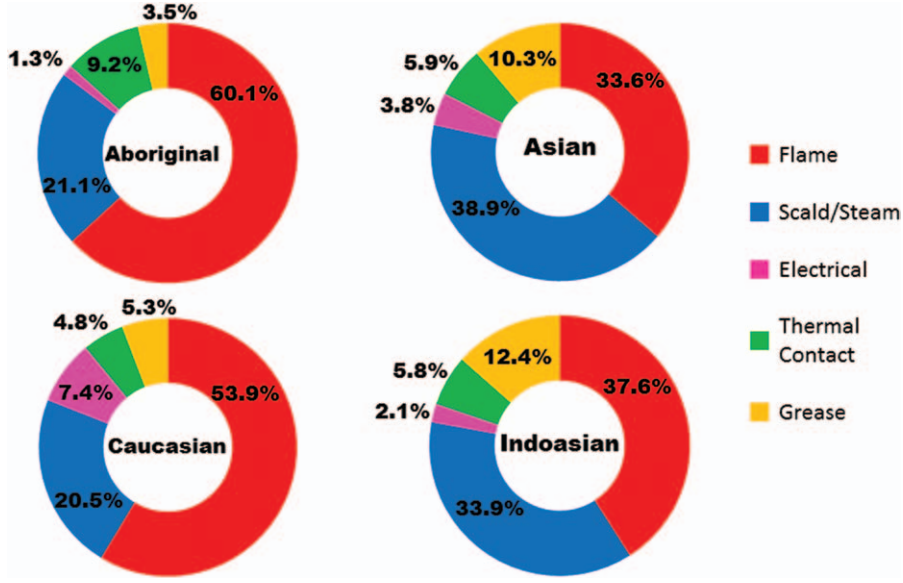

Figure 4. Mechanism of burn by ethnicity.

Burn trauma was mostly an exclusive injury for patients; however, a small group (7.7%) presented with accompanying trauma, males being twice as likely as females (8.8% compared with 4.5%; $P < .0001$) to present in this manner. These injuries consisted mostly of fractures (44.3% of this group) and ocular injury (23.2%).

More than half (54.5%) of burn injuries occurred at home. Although 21.8% of injuries occurred at work, fewer (16.2%) were suffered in a recreational outdoor setting. The remaining injuries were caused by vehicle collisions (4.3%) or in some other setting, such as an institution (3%; Table 2). Asian patients reported the highest percentages of injury at work (28.9%), whereas Aboriginal and Indoasian patients were injured at home (64.5 and 64% respectively; $P < .0001$). Those youngest and oldest patients were mostly injured at home (76.1 and 82.9%, respectively), whereas youth in the age range of 13 to 17 years were injured recreationally and at home in equal numbers (40.2 and 39.4%, respectively). Workplace injuries correlated with those of working age being highest among ages 26 to 34 years ($P < .0001$) and was higher among males (26.9% compared with 6.3% of women; $P < .0001$).

Instigating factors were almost exclusively accidental (94.3%) in nature. Non-Caucasian ethnicities showed higher numbers of self-harm or assault compared with all others (9% compared with 4.5%; $P < .0001$). No discernable difference was noted across sex, whereas occurrences of self-harm and assault peaked in the 35- to 44-year-old patient group (8.3%) and was lowest at either end of the age distribution. The frequency of self-harm or assault increased during the study period (7.8% in the past decade from 4.5% in the 1980s; $P < .0014$).

More than a third of patients (36.8%) presented with documented contributing factors to their burn injury, and a quarter (24.3%, 8.4% of total) of this group presented with two or more factors. This trend increased with time, with 45.6% of admissions in the past decade (2000–2009) presenting with contributing factors compared with 31.2% in the first decade (1979–1989; $P < .0001$). The majority of total cases involved being under the influence of alcohol or drugs (48%) as well as use of accelerants such as gasoline or propane (49.3%). Other precipitants included cigarettes (17.6%), psychiatric conditions (10%), and epilepsy (3.3%). Those of Caucasian or Aboriginal ethnicity were more likely to present with contributing factors (38.7 and 54.8%) compared with other ethnicities ($P < .0001$) as were males (39.2% compared with 29.4% of females; $P < .0001$). The highest occurrence of alcohol involvement is among those who were 45 to 64 years of age (47%). The 13- to 17-year olds were more likely (63.6% of those with a contributing factor) to identify using gasoline as a contributing factor to their injury.

Severity of Injury

The mean TBSA burn was 14%; this remained stable over the study period. More than a third (38.6%) presented with TBSA greater than 10% and 19.5% of patients with greater than 20% TBSA burns. Significant differences by ethnicity were identified; Caucasians and Aboriginal ethnicities presented with a significantly higher TBSA compared with those of other ethnicities: 40.3 and 42.1%, respectively, with 10% TBSA or greater compared with 26.5% for Asian and 28.9% Indoasian patients ($P < .0001$). Young children had smaller burns (31.7% had greater than 10%), whereas TBSA had no significant differences across other age groups and sex. Two thirds (69%) of patients suffered full-thickness burns and 31.6% had full-thickness burns greater than 5% TBSA. Females were more likely to present with full-thickness burns, 75.4% compared with 66.9% in males ($P < .0001$). As patient age increased so did the percentage of full-thickness burns; 87.4% patients aged 65 years or more reported full-thickness burns, whereas only 59.4% of children aged 12 years or younger presented with similar injury ($P < .0001$). Asian and Indoasian patients suffered full-thickness injuries at similar numbers as that of Caucasian patients; however, the severity was less, with 18.3 and 25.6%, respectively, reporting full-thickness burns greater than 5% compared with 32.8 and 41.2% for Caucasians and Aboriginals, respectively ($P < .0001$).

Mean length of stay was 24 days (days stayed in hospital was 3.5 for each percentage of TBSA burn)

Table 2. Location of burn trauma by ethnicity

Location	Total, %	Aboriginal, %	Asian, %	Caucasian, %	Indoasian, %
Home	54.5	64.5	53.7	53.2	64
Recreational/outdoors	16.2	21.5	11.5	17.2	4.1
Work	21.8	8.8	28.9	21.6	24.8
Other	7.5	5.3	5.9	8.0	7.0
Total	4197	228	339	3320	242

with a mean ICU stay of 14 days (1.4 days in ICU per percentage of TBSA burn) among those requiring ICU admission (14% of total patients). Inhalational injury was identified in 16.3% of burn patients. This was highest among Caucasians (17.4%) and Aboriginals (18.0%) compared with Asians (9.4%) and Indoasians (9.9%; $P < .0001$). Patients aged 45 to 64 years had an increased percentage (22.6%) of inhalational injury compared with those younger than 17 years (5.4%; $P < .0001$). The majority of deaths occurred either within the first 24 hours of admission or among those requiring hospitalization for more than 3 weeks (32 and 31.6% of deaths, respectively). Significant differences were found in length of stay among ethnicities; Aboriginal patients required the longest stay, with a mean of 31 days, whereas Asians and Indoasians had the shortest stays of less than 20 days ($P < .0001$) driven primarily by the size of burns within those populations.

The majority of patients (93.9%) at VGH survived their burn trauma over the study period, a trend that remained consistent over time Mortality increased with age, with 28.7% of those aged 65 years or older dying from their burn injuries. Patient mortality was consistent across sex. Caucasians reported higher fatalities than other ethnic groups as a whole (6.6% compared with 4.1%; $P < .006$). Mortality was 3.7% for Indoasian, 4.4% for Asian, and 4.8% among Aboriginal patients. Those suffering flame injury were less likely to survive their injuries (9.2% deaths compared with 6.1% of total ($P < .0001$). Accordingly, inhalational injuries correlated with higher mortality (23.6% deaths compared with 2.6% without inhalation injury; $P < .0001$).

DISCUSSION

VGH has seen a steady decline in burn admissions during the past 30 years. Numbers of burn injury dropped approximately two thirds despite the population almost doubling during the same amount of time.[15] It is clear that burn prevention has had an effect on increased safety within and outside the home. However, there remain significant areas of the population that would benefit from further efforts to reduce the occurrence of burn trauma. Although most burn traumas continue to occur in urban areas, rural areas show a steady increase over time, indicating rural advocacy strategies may not be keeping up with the success seen in cities. Burn trauma shows considerable diversity among the region's ethnic populations with more than 20% of the VGH burn patient population from an ethnicity other than Caucasian. This is consistent with provincial statistics that identify about one quarter of the province's population as a visible minority.[16] It is the investigators' opinion that ethnicity offers a unique opportunity to reach out to target population via language-specific literature and regional communication strategies.

Burn trauma predominantly occurs in younger males, with flame mechanism being most common. Burn trauma is not blind, however; strong ethnicity differences appear within mechanism, region, and whether the injury occurs domestically or in the workplace. Four ethnic groups emerged in the analysis: Caucasian, Aboriginal, Asian, and Indoasian. Though some similarities exist, each group was found to have specific differences that make them unique and suggest different approaches for future burn prevention advocacy.

Aboriginals are more likely to suffer flame injuries than their counterparts and include more females injured than average. This is despite a higher amount of pediatric injuries that tend to present more often with scalds. Aboriginals are more evenly distributed in rural areas and suffer the majority of their burn injuries at home. The majority of Aboriginals have contributing factors, namely alcohol and drugs. Aboriginals tend to present with the most severe injuries both in surface area and extent of depth as well as inhalational injury resulting in longer hospital stays. The paradoxical lower mortality among Aboriginals compared with mortality of Caucasians despite the high severity of their injuries may indicate increased preadmit fatalities, given the rural concentration of this ethnic group.

In this study Asian patients were the largest ethnic group apart from Caucasians. Asian patients included higher rates of pediatric injury and higher numbers of female patients. They were predominantly injured in urban areas, reflecting geographic distribution, and had the highest occurrences of workplace burn injury. With a higher proportion of scald injuries, Asians suffered less extensive injuries and required shorter hospital stays.

Indoasian ethnicity also had a higher number of pediatric patients and the highest proportion of females compared with any other ethnic group. As with Asian patients, higher numbers of scald injuries were observed. This is likely driven by the high numbers of female patients and reflected a higher number of injuries at home. As among Asian patients, in Indoasian patients complicating factors were less common as was the extent of injury including less inhalational injury as well as shorter length of stay. Of note was a stable number of burn injuries in this group during the past 20 years, whereas other groups showed a steady decline.

Caucasians represented the majority of the patient population though this modestly dropped over time as other ethnicities increased in number across the

province. Being mostly male, Caucasians presented with more flame burns, more severe injury, and a lower survival though their injuries tend more often to be accidental in nature. These injuries are more often precipitated by alcohol, drugs, or accelerants. Their exposure to flame injury makes them more likely to suffer inhalational injury. Caucasians are older on average, and the lower numbers of pediatric patients may reflect cultural differences in numbers of children in the household.

It is understood that analysis by ethnicity is prone to the challenges faced with properly identifying patients by their correct lineage. Ethnicity was defined based on multiple details including photographic record in chart reviews as well as directly from patient and family. Patients not satisfying a threshold for reliable identification were not labeled with an ethnicity and thus were omitted from the study. This may have created a selection bias for ethnicities that are more difficult to discern and as such a potential gap in the analysis. It is also noted that other factors not accounted for in the study, such as social and economic status, may have had an influence where differences by ethnicity have been identified. This does not change the fact that clear patterns exist, regardless of the causative factors. Changes in the triage and transfer of burn trauma, specifically surrounding the establishment of British Columbia Children's Hospital, have likely affected aspects of the study's findings. As a result, analysis of the pediatric population is incomplete. A follow-up study focusing on Vancouver's Children's Hospital would better identify ethnicity trends in the pediatric burn population.

Burn advocacy requires both an effective message and an appropriate audience. In addition to current efforts the study conducted points to several strategies to reduce burn trauma in the region. These include WorkSafe programs focusing on Asian-speaking workers and an increase in resources to rural areas, given the steady rise in these regions with a focus on Aboriginal households. Though fire-involving mechanisms result in more severe injury and higher fatalities, this should not be the limit of prevention measures, injury from hot liquids should continue to be a focus, especially among ethnic groups other than Caucasian. Despite males being the dominant sex in burn trauma, a focus on female patients is needed, especially in Indoasian households as well as other ethnic groups in the province as well as at the youngest and oldest age groups. Most important is continued study on the nature of burn trauma in all regions to maintain a pulse on how our population is changing and the resulting injuries they incur.

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