A small-area population analysis of socioeconomic status and incidence of severe burn/fire-related injury in British Columbia, Canada

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1. Introduction

Burns are a major public health concern. In the US, it has been estimated that the total direct and indirect costs incurred from burn/fire-related injuries are nearly four to six times the total costs of treating many cancers or heart diseases [1]. The most recent national data from Canada on annual costs attributed to burns was $143 million—roughly 1% of the estimated $14.3 billion in direct and indirect costs attributed to all injuries [2].

As in other countries, efforts to address the frequency and severity of burns in Canada have primarily emphasized the most proximal causes of injury, highlighting risks that occur in the kitchen [3–6], from the misuse of cigarettes or alcohol [7], or resulting from improperly positioned/faulty electrical heaters and wiring [8], while leaving largely underdeveloped any theoretical perspectives of why these risks might vary systematically between socioeconomic groups. Although strategies have emphasized specific populations at an increased risk of burn injury, most notably among Canadian First Nations peoples (see [5,8,9]), children (see [4]), or by occupational setting (see [10,11]), adjustment or direct analysis of more distal social or economic determinants associated with their occurrence have been rather scarce. The absence of these indicators is of critical importance as persons with less control over their employment, household, or social circumstances, coupled with the compounded effect of having...
a lower income, are less likely to be able to change the factors that elevate risk of injury [12,13].

Elsewhere, research has shown that linking health outcomes to relative markers of socioeconomic status (SES) illuminates important challenges for health policy regarding the interrelationship between seemingly modifiable behavioral indicators with factors linked to socioeconomic circumstances [14,15]. Although researchers in Canada have repeatedly documented persistent differences in numerous health outcomes across socioeconomic groups, the rationale for its exclusion here likely parallels prevailing sentiment among prevention epidemiologists that attributes these barriers to data constraints, resources limitations, a lack of generalizability of indicators of SES, as well as the presumption that aspects of SES are not amenable to public health intervention [16,17].

Using Census and patient data from the provincial trauma registry, our research objective was to (i) investigate the strength in association between SES and risk of severe burn injury in the province of British Columbia (BC), (ii) examine if these variations are generalizable across different geographic regions, which in BC cover a full spectrum of rural, resource-based communities to highly clustered and often socio-economically divided urban metropolitan centres, and (iii) contextualize our discussion on SES and offer suggestions for future research linking more proximal indicators within the context of SES. In doing so, our research aim is to gain a better understanding of why some populations continually experience higher risks of burn injury than others and contribute to the growing literature on the social determinants of injury.

1.1. Socioeconomic variations in injuries

Researchers from the UK and USA have shown that indicators of increased risk of scalding injury among both children and older adults disproportionately parallel broader factors attributed to individual markers of SES [18–20]. Runyan et al. previously illustrated that alcohol and poor housing conditions were associated with increased instance of fire injury and mortality—factors which are both known to be further amplified when linked to SES [21–23]. These conclusions form part of a growing understanding that social factors are a significant characteristic associated of an increased risk of burn injury, with clear outcome variations as one moves stepwise from patient’s in the lowest social spectrum upward [15,20,24]. Few studies in Canada – albeit with two recent and important exceptions pertaining to occupational-related injuries (see [10,25]) – have specifically examined the relationship between SES and burn/fire-related injury as the primary research focus. Similarly, of the few past or recent published studies on ecological patterns of burn injuries throughout BC, the most detailed information is published in work-related injury reports, listing burns among the most serious and costly injuries occurring within resource-based occupations throughout the province [11].

Yet, one of the principle findings in health disparities research over the past two decades has been the relationship between individual indicators for a vast array of diseases and health outcomes and their persistent link to social or economic circumstance [26–31]. In the last decade, these findings have fueled a growing demand to disentangle the determinants of injury, which has been consistently and persistently assessed against individual and contextual measures of income [32], social status [20], education [33], family structure [34], and unemployment [35] using both micro-level and small-area data derived from national censuses. The ensuing research models strive to condense multiple indicators of relative social and economic deprivation into either ‘social’ or ‘material’ constructs—two separate but interconnected dimensions of class or socioeconomic position considered as key determinants of health from the influential findings first published in the UK in the Report of the Working Group on Inequalities in Health, more widely referred to today as The Black Report [36]. This evidence, in turn, is then used to quantify the extent that health disparities parallel larger effects of a socioeconomic hierarchy or stem from the conditions that lead persons sharing similar behaviors that negatively impact disease or health outcomes to cluster in proximity to one another.

Whilst evidence from this model is widely supported, we posit the influences of SES to be more broadly reflective of the conditions that others have referred to as unequal access to opportunities (e.g. education, social and familial connections) and resources (e.g. employment, wealth, safe housing) in an attempt to frame SES in a context that better allows prevention epidemiologists to understand why some populations may continually experience more injuries than others [37,38]. For instance, persons living in poor and/or overcrowded housing and who depend on the use space heaters may not have the opportunities or the resources that would allow them to eliminate the potential harmful effects of their use, regardless of prevention efforts to minimize these effects. Whilst public health efforts in targeting accessible and tangible factors to reduce the risk of injury is central to ongoing efforts in injury prevention and control, it is equally vital that interventionists also continue to address the broader socioeconomic characteristics associated with the increased prevalence of poor health outcomes [39].

2. Methods

2.1. Patient characteristics

This is a retrospective study of adults (age ≥18 years) who were hospitalized from severe burn/fire-related injury between January 1, 2001 and March 31, 2006. Patient records were obtained from the provincial trauma registry (BCTR). The BCTR collects and maintains data on all severe burn injuries (Injury Severity Score [ISS] ≥ 12 and Abbreviated Injury Score [AIS] ≥ 1) from persons admitted directly or indirectly to any of the provinces eight tertiary, level I, and level II trauma centres as well as persons admitted to BC Children’s Hospital. Patients with severe injuries who were triaged out of province – as well as those who died at the scene or while in transit – are not captured by the registry and are listed separately. Only records where the primary mechanism causing the most severe injury were based on exposure and contact injuries due to chemical, corrosive, electrical, or thermal sources were included in the analysis. Injuries due to
hypothermia were excluded. Both injury morbidity and in-facility mortality outcomes listed in the BCCTR included pre-hospital fatalities from provincial register records were analyzed in order to provide a more complete description of severe injury patterns throughout the province. All work has been approved by the ethical committees at Simon Fraser University and the affiliate ethics committees for the provincial trauma registry affiliated with the University of British Columbia.

2.2. Study area

In 2001, approximately 51% of the 4 million persons in BC resided within the Vancouver Metropolitan Area. The interior and northern regions of the province as well as Vancouver Island contain a number of near and isolated urban centers with population concentrations that range from 10,000 to over 300,000. Single resource towns are located throughout the rural and remote hinterlands in the northern interior and along Pacific outposts running north and south along the coast and contain approximately 15% of the total population. These areas are small, isolated communities largely built around resource-based industries primarily including mining, mill towns, and fishing villages. Fig. 1 is an illustration of the major population centers throughout the province.

2.3. Socioeconomic characteristics

Three measures of SES were based on province-wide comparisons using data obtained from the Census Dissemination Areas (DA’s) that encompassed the patients’ place of residence. DA’s are the smallest administrative unit used by Census Canada and are roughly the size of a small number of neighbourhood blocks within high density urban areas and increase in size when encompassing lower density rural and remote populations. On average, DA’s classified as urban areas (defined below) contain 634 persons (±275 S.D.) while rural areas typically contain 414 persons (±296 S.D.).

A provincial measure of SES was constructed using the Vancouver Area Neighbourhood Deprivation Index (VANDIX). The VANDIX was previously developed by the authors from a survey of provincial Medical Health Officers (MHO’s) as to the census indicators that best characterized health outcomes throughout the province. The VANDIX is based on the aggregation of seven variables taken from the 2001 National Census. Each variable was standardized by subtracting the regional average from the observed value within each DA and then dividing this sum by its standard deviation. The index was normalized before aggregating such that all negative values represented the least deprived scores. Weights were assigned to the individual indicators based on the level of importance originally assigned by the MHO’s. A complete description of the index as well as previous usages can be found elsewhere [40-42]. The indicators and their weights are illustrated in Table 1. While reliance on the census for proximal data on individual SES characteristics has a number of well-known limitations it is often the most feasible given the limitations of conducting retrospective analysis from trauma registry/facility data.

2.4. Data analysis

Age-standardized rates and odds ratios were calculated from aggregated burn injury records, which were derived by linking the patient’s postal code of residence to the DA that encapsulated its boundary. Outcome variations were further adjusted according to work-related injuries as well as for an urban or rural residence. Rural and urban population areas were defined using statistics Canada coding provided in the 2006 national postal code conversion file (PCCF). The PCCF classifies all populations in Canada into one of six codes to describe the population geography of its location, including: urban core (1), urban fringe (2), rural fringe inside metropolitan/census areas (3), urban areas outside CMA/CAs (4), rural fringe outside CMA/CAs (5), and secondary urban core (6). For this analysis, incidence counts for urban or rural burn injuries were dichotomized into dummy variables with a rural location characterized by areas 3 and 5 and urban areas characterized by all other classes. Incidence ratios were directly standardized by weighting incidence rates using the 1996 Canadian Standard Million population. Dummy variables were constructed from the SES scores and recoded into high, medium-high, medium-low, and low SES categories. High SES quartiles (e.g. least deprived) were used as the reference category. To minimize the effects of ecological fallacy our analysis was not adjusted by gender as there is no unique identifier linking the BCCTR to socioeconomic data within the Census. Patient’s who resided in DA’s with a population of less than 250 persons were excluded from the analysis to further protect confidentiality as well as reduce the effects of sampling error and data suppression in the census.

3. Results

Between January 1, 2001 and March 31, 2006, for injuries with the mechanism causing the most severe injury categorized as thermal, there were a total of 205 patients treated in hospital for severe burn injury (ISS ≥ 12, AIS ≥ 1) in BC. Of these, 35 records were missing or contained incomplete postal code identifiers, 9 cases were due to hypothermia, and 12 occurred in areas that contained less than 250 persons, leaving 149 records remaining for the analysis. Additionally, Foothills Hospital (Calgary, AB) responded to surge demands for 14 patients requiring access to emergency surgical services for burn-related injuries between 2001 and 2005 calendar years and these patients were not captured in the registry. Though this number is small, it represents a significant majority of burns in eastern BC whereby the nearest trauma centre is located outside the province. An additional and significant number of records were recorded in the provincial coroner’s office during the study period whereby 137 persons either died at the scene or while in transit from severe burn-related injury. However, the level of detail of provincial coroner records is substantially coarser than BCCTR and data can only be mapped at the census subdivision (CSD) geography, which is roughly equivalent in size to a municipality or large urban city. A total of 119 records had complete records and could be linked to the CSD geography, with 72 occurring within urban regions and 36 within CSD’s coded as rural. However, 34% of
provincial CSD’s contain DA’s classified with more than one of the six PCCF urban/rural classification schemata, which make accurate estimations of rural/urban injury variations highly susceptible to error using pre-hospital fatality data.

3.1. The geographies of burn/fire-related injury in British Columbia

At the DA geography, the age-adjusted severe burn injury morbidity and mortality rate for non-work-related injuries for adults across BC was 3.10 per 100,000 (95% CI 0.77) and 3.90 per 100,000 (95% CI 1.23) for all burn/fire-related injuries, respectively. When itemized by type, inhalation-related injuries were the leading cause of hospitalization among all persons, accounting for 50% of hospitalizations from burns throughout the province over a 5-year and 3-month period. Mechanical explosions accounted for 20% of all burns, of which nearly 60% were caused by propane or an unclassified mechanism in the home. Both scolding and intentional injury were the third and fourth leading causes of hospitalization from burns in BC, each accounting for roughly 12% of all remaining hospitalizations (Table 2).

When stratified by area SES, the magnitude of the age-adjusted injury rates among all non-work-related injuries increased from 2.36 for persons in the highest SES strata to 4.01

<table>
<thead>
<tr>
<th>Census indicators</th>
<th>Weight (%)</th>
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<tbody>
<tr>
<td>Average income</td>
<td>0.089</td>
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<tr>
<td>Home ownership</td>
<td>0.089</td>
</tr>
<tr>
<td>Single parent family</td>
<td>0.143</td>
</tr>
<tr>
<td>No high school completion</td>
<td>0.250</td>
</tr>
<tr>
<td>With a university degree</td>
<td>0.179</td>
</tr>
<tr>
<td>Employment ratio</td>
<td>0.036</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>0.214</td>
</tr>
</tbody>
</table>

Table 1 – Seven individual census variables used to construct the VANDIX. Variables weights are based on the proportion of MHO responses from the original survey. A full description of the VANDIX can be found elsewhere [39].
among persons in the lowest SES strata (2.36–4.01), with a stepwise increase across all SES classes. Overall, this pattern widened when unspecified by work-related incidence, with rates increasing upward from 2.95 to 5.54. The gradation between burn/fire-related injuries and SES class was primarily linked to inhalation-related injuries, which rose stepwise across each SES strata (1.08–3.02). Rates were highest among persons in the lowest SES class among both scalds and injuries from explosions, but the gradations between the highest and lowest SES class were mixed. The rate of intentional injury from burns (including both self-inflicted and assault-related injuries) was highest among the high SES cohort, with a stepwise decrease across all SES groups (0.61–0.30) (Table 3).

3.2. Burn/fire-related injury in urban areas

Similar incidence pattern across SES classes persisted among urban areas throughout the province when itemized by region (2.29–3.69). Overall, rates were primarily reflective of inhalation-related injuries, with a stepwise rate across each stratum (1.06–2.80), with nearly 75% of these injuries occurring in the home. Again, rates were highest among persons in the lowest SES class among both scalds and injuries from explosions, but the gradations between the highest and lowest SES class were mixed. Though small in number and susceptible to error when stratified across four SES classes, rates of hospitalization from intentional burn-related injuries were twice as high among persons in the highest SES strata from the lowest (0.74–0.30).

3.3. Burn/fire-related injury in rural areas

Injuries occurring to persons living in rural areas throughout BC accounted for 16% of all hospitalizations for severe burn/fire-related injury between 2001 and 2006. Among all non-work-related injuries, morbidity and mortality rates for persons in the lowest SES strata were over three-times higher than among persons in the highest SES strata (8.19 vs. 2.54), though with an attenuated stepwise gradation in SES class as well as a wider variance in the rate when compared to incidence rates within urban areas. Inhalation-related injuries accounted for 44% of all hospitalizations within rural areas, with estimated rates highest among persons in the lowest SES class. There was no demonstrable effect between injury incidence and SES when assessed against burn injuries caused from explosions, intentional mechanisms (either self-inflicted or through assault), or scalds.

3.4. Odds ratios

Generalized log-odds ratios describing the relationship between SES, urban/rural variations, and overall burn injury incidence are listed in Table 4. Among all burn injuries there was a minimum increase of 33% of risk of burn injury for each stepwise increase in socioeconomic disadvantage (OR 1.0–2.24). This association was attenuated when itemized by specific burn type and region, though was most pronounced among unspecified and inhalation-related injuries for persons living in urban areas. In contrast, rural areas exhibited a similar but non-significant association between increased injury incidence and lower SES persisted across all classes, though no itemized stepwise gradation in burns were observed to the same extent as either unspecified or inhalation-related injuries in urban areas.

4. Discussion

In this analysis, we examined both incidence of unspecified and subclasses of severe burn/fire-related injuries across both rural and urban areas throughout BC. There was a statistically significant social gradation in unspecified burn injury with each increase in SES disadvantage. When itemized by burn injury mechanism, this relationship was most pronounced among inhalation-related injuries primarily occurring in the home and within urban areas throughout the province. Although persons in the lowest SES class, on average, were found to experience both higher rate and relative odds of severe burn injury, the significance and gradation in this relationship was less pronounced and in many cases absent among persons living within rural areas. The data also illustrated an inverse though non-significant statistical relationship relative to all other analyses between intentional burn injuries and SES, with rates highest among persons in the least deprived SES class.

The purpose of this study was to examine burn injuries in light of the broader social context surrounding their occurrence in attempt to elicit a better understanding for why some populations continually experience higher rates of injury than others. These initial results fill an important gap with respect to injury prevention and control as burn injury surveillance to date within Canada has primarily focused on the most proximal, causal indicators of injury and with relatively few attempts to draw linkages between these indicators with more distal social and economic conditions. Elsewhere, researchers have shown that burns consistently and persistently follow a social gradient from patients in the lowest social spectrum upward, and, though difficult to generalize across all injury subclasses in BC, we have shown that similar patterns persist to some effect in Canada.

Importantly, the results from this analysis also suggest that SES may not necessarily serve as a universal indicator for increased or reduced prevalence of all burn injuries. Throughout BC there was little commonality as well as significant variability according to VANDIX and injury incidence across both urban and rural populations. Examples from the literature have pointed to general distinctions as to the strength of particular SES mechanisms in predicting injury
Table 3 – Age-standardized injury rates (per 100,000) of major burn injuries in British Columbia across SES classes subclassified by the leading causes of severe injury.

<table>
<thead>
<tr>
<th>Region</th>
<th>All injuries</th>
<th>Non-work related</th>
<th>Inhalation</th>
<th>Explosions</th>
<th>Scalds</th>
<th>Intentional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age-adjusted rate</td>
<td>3.1 (2.33–3.87)</td>
<td>3.9 (2.66–5.13)</td>
<td>1.94 (1.44–2.44)</td>
<td>0.77 (0.45–1.08)</td>
<td>0.46 (0.38–0.53)</td>
<td>0.53 (0.15–0.91)</td>
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<tr>
<td>Provincial</td>
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<tr>
<td>High SES</td>
<td>2.95 (1.89–4.01)</td>
<td>2.36 (1.33–3.38)</td>
<td>1.08 (0.71–1.45)</td>
<td>0.73 (0.48–0.99)</td>
<td>0.32 (0.28–0.35)</td>
<td>0.61 (0.08–1.31)</td>
</tr>
<tr>
<td>Med-high SES</td>
<td>3.27 (2.03–4.5)</td>
<td>2.73 (1.78–3.68)</td>
<td>1.45 (1.03–1.87)</td>
<td>0.75 (0.36–1.15)</td>
<td>0.29 (0.09–0.48)</td>
<td>0.53 (0.18–0.89)</td>
</tr>
<tr>
<td>Med-low SES</td>
<td>3.96 (2.8–5.12)</td>
<td>3.38 (2.4–4.36)</td>
<td>2.21 (1.55–2.87)</td>
<td>0.57 (0.11–1.03)</td>
<td>0.59 (0.41–0.78)</td>
<td>0.5 (0.21–0.79)</td>
</tr>
<tr>
<td>Low SES</td>
<td>5.54 (3.53–7.55)</td>
<td>4.01 (3.3–4.72)</td>
<td>3.02 (1.98–4.05)</td>
<td>1.08 (0.55–1.61)</td>
<td>0.62 (0.54–0.7)</td>
<td>0.45 (0.07–0.83)</td>
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<tr>
<td>Urban areas</td>
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<tr>
<td>High SES</td>
<td>2.93 (1.83–4.02)</td>
<td>2.29 (0.96–3.62)</td>
<td>1.06 (0.81–1.3)</td>
<td>0.36 (0.15–0.57)</td>
<td>0.39 (0.34–0.43)</td>
<td>0.74 (0.1–1.57)</td>
</tr>
<tr>
<td>Med-high SES</td>
<td>3.04 (2.22–3.86)</td>
<td>2.78 (2.23–3.33)</td>
<td>1.16 (0.95–1.37)</td>
<td>0.83 (0.31–1.36)</td>
<td>0.38 (0.12–0.64)</td>
<td>0.37 (0.15–0.6)</td>
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<tr>
<td>Med-low SES</td>
<td>4.01 (3.34–5.68)</td>
<td>3.82 (2.1–5.54)</td>
<td>2.61 (1.53–3.7)</td>
<td>0.38 (0.15–0.62)</td>
<td>0.24 (0.1–0.38)</td>
<td>0.65 (0.27–1.02)</td>
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<tr>
<td>Low SES</td>
<td>4.9 (3.17–6.63)</td>
<td>3.69 (2.31–4.18)</td>
<td>2.8 (2.04–3.55)</td>
<td>0.95 (0.52–1.39)</td>
<td>0.54 (0.33–0.75)</td>
<td>0.3 (–0.04 to 0.64)</td>
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<td>Rural areas</td>
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<tr>
<td>High SES</td>
<td>5.03 (0.66 to 10.73)</td>
<td>2.54 (0.33 to 5.41)</td>
<td>0 (0–0)</td>
<td>0.29 (0–0.4)</td>
<td>0 (0–0)</td>
<td>0 (0–0)</td>
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<tr>
<td>Med-high SES</td>
<td>6.33 (0.31–12.35)</td>
<td>4.56 (0–6.97)</td>
<td>4.08 (0.58–7.57)</td>
<td>0 (0–0)</td>
<td>0 (0–0)</td>
<td>0.29 (0–0.4)</td>
</tr>
<tr>
<td>Med-low SES</td>
<td>4.62 (3.88–5.36)</td>
<td>2.73 (1.14–4.31)</td>
<td>0.58 (0.08 to 1.24)</td>
<td>0.36 (0–0.05 to 0.78)</td>
<td>0.4 (0.12–0.68)</td>
<td>0 (0–0)</td>
</tr>
<tr>
<td>Low SES</td>
<td>8.19 (0.25–11.13)</td>
<td>8.19 (0.25–11.13)</td>
<td>5.17 (2.54–7.81)</td>
<td>0.27 (0–0.04 to 0.58)</td>
<td>0 (0–0)</td>
<td>0.25 (0.1–0.41)</td>
</tr>
</tbody>
</table>

Table 4 – Odds ratios for burn injury prevalence by SES class and urban/rural residence.

<table>
<thead>
<tr>
<th>Region</th>
<th>All injuries</th>
<th>Inhalation</th>
<th>Explosions</th>
<th>Scalds</th>
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<tr>
<td>Provincial</td>
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<tr>
<td>High SES</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Med-high SES</td>
<td>1.33 (0.79–2.26)</td>
<td>1.92 (0.84–4.39)</td>
<td>0.75 (0.24–2.34)</td>
<td>1.01 (0.23–4.42)</td>
<td>1.50 (0.46–4.9)</td>
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<tr>
<td>Med-low SES</td>
<td>1.67 (1.01–2.74)</td>
<td>2.34 (1.09–5.02)</td>
<td>1.24 (0.40–3.85)</td>
<td>3.00 (0.79–11.48)</td>
<td>0.99 (0.3–3.24)</td>
</tr>
<tr>
<td>Low SES</td>
<td>2.24 (1.39–3.61)</td>
<td>3.67 (1.75–7.67)</td>
<td>1.38 (0.48–3.95)</td>
<td>1.33 (0.33–5.38)</td>
<td>1.44 (0.41–5)</td>
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<td>Urban areas</td>
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<tr>
<td>High SES</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
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<tr>
<td>Med-high SES</td>
<td>1.05 (0.6–1.85)</td>
<td>1.01 (0.41–2.47)</td>
<td>1.87 (0.51–6.85)</td>
<td>1.01 (0.23–4.4)</td>
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<td>Reference</td>
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<tr>
<td>Med-high SES</td>
<td>1.22 (0.28–5.25)</td>
<td>4.22 (0.23–78.43)</td>
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<td>0.47 (0.01–23.65)</td>
<td>2.35 (0.11–48.87)</td>
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<td>Med-low SES</td>
<td>1.20 (0.29–5.02)</td>
<td>1.20 (0.05–29.42)</td>
<td>0.56 (0.11–2.84)</td>
<td>2.80 (0.14–54.15)</td>
<td>0.40 (0.01–20.13)</td>
</tr>
<tr>
<td>Low SES</td>
<td>1.97 (0.5–7.83)</td>
<td>6.11 (0.34–108.37)</td>
<td>0.47 (0.08–2.71)</td>
<td>0.47 (0.01–23.67)</td>
<td>2.35 (0.11–48.91)</td>
</tr>
</tbody>
</table>

*p ≤ 0.05.
risk (see [20,43]) in addition to a lack of generalizability of the indicators between rural and urban areas (see [44] for a Canadian example) and both factors may be attributable to findings here. A possible explanation for the latter observation may rest in differences in both market values and the predominant resource-based economy outside of urban areas throughout the province as the VANDIX is heavily weighted by both educational attainment and home ownership, with the availability and necessity of both variables strikingly different between both areas.

While further analysis of rural and urban SES variations according to all injuries and specific injury subclasses both in BC and elsewhere in Canada is of critical importance within ongoing injury prevention and control, the low frequency of burn injury morbidity and mortality within rural areas make statistical inferences from these regions difficult due to the high level of variability associated with the small numbers. As this and other studies typically separate burn injuries into 4 or 5 class strata associated with area SES scores, the small numbers problem is exacerbated. This shortcoming points to the difficult need of having to conduct injury surveillance using a large number of historical records that may or may not be feasible given the ongoing delays transforming patient records into digital form. Moreover, data limitations in provincial coroner records in BC limit more complex and sensitive analysis of significant proximal or distal socio-economic conditions associated with pre-hospital injury mortality below a municipal scale, thereby contributing to the difficulty of monitoring rural/urban injury variations. These limitations are compounded by a significant – though unavoidable – limitation in the use of areal SES as proxy measure for individual socioeconomic position, which may have further affected our analysis in rural areas where the spatial extent of DA’s may be too large to reflect the scale and scope of SES differences in BC. These limitations are well-known and difficult to minimize in absence of more robust prospective studies, but these results should nevertheless be interpreted with some importance given the well-known association between variations in SES and burn documented elsewhere.

Symptoms from severe burn injuries significantly impact a patient’s ability to return to work, with post-injury rates of recovery in most instances requiring at least 6–12 months for full or partial neurological, and musculoskeletal recovery, of which may be further amplified due to the added strain of accepting the recurrent mental and social stigmas from suffering a physically debilitating injury [45–48]. Factors such as depression and anxiety also intensify as a result of changes to or loss of employment after injury [49]. Coupled with the added barriers of poorer educational, social and employment hardships, burn injuries are all likely to be significantly compounded as ones level and access to opportunities and social resources wanes.

Importantly, the impact of burns has been shown to not only affect those faced with substantially more social and economic barriers, but has produced a demonstrable effect across social scales [50]. Within the context of this analysis, the risk of inhalation-related injuries among persons in the lowest SES class throughout urban areas in the province does provide some indication that these populations may be at further risk of unnecessary and potentially deteriorating health and economic outcomes as a result of suffering a severe burn. However, current data limitations in provincial health care records and access delays limit a more robust analysis pairing patient outcomes with other indicators, such as the use of smoke alarms, space heaters, or faulty/poor electrical wiring that might otherwise be available within registry data from other jurisdictions. Nonetheless, these initial results provide an entry point in examining burn injury incidence in light of broader SES conditions and should be considered in future analyses.

5. Conclusion

Despite significant improvements in the prevention and treatment of injuries, premature mortality as a result of sustaining severe injury is the leading causes of death among Canadians under the age of 45 [51]. A limited but growing number of studies within Canada have demonstrated the intransigent relationship between SES and injury disability and mortality (see for example [39,52–54]); yet little is still known as to the extent that these indicators are generalizable among severe injuries stemming from burns. While conservative, the results from this analysis suggest that burn/fire-related injuries stemming from inhalation injuries continually and disproportionately affect persons at a greater socioeconomic disadvantage. Broadening future injury prevention efforts to also examine broader socioeconomic conditions alongside more proximal indicators associated with severe burn injury is likely to be more effective than targeting individual behavior alone when trying to reduce and eliminate their occurrence.

Conflict of interest

None.

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