

## Research Article

# Severity of Burn Injury and the Relationship to Socioeconomic Status in Nova Scotia, Canada

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**Objective.** Few Canadian studies have examined the relationship between socioeconomic status (SES) and incidence of burn injury. We seek to evaluate this relationship using median income as a measure of SES in Nova Scotia, Canada. **Methods.** Nova Scotia residents admitted to the Queen Elizabeth II burn unit in Halifax, Nova Scotia, from 1995 to 2012, were included in the study. SES was estimated by linking the subject's postal code to median family household income via Canadian population census data at the level of dissemination areas. Four equal income groups ranging from lowest to highest income quartile were compared (average total burn percentage). Likelihood ratio was calculated to evaluate the effect of median family income burn injury in each income quartile. **Results.** 302 patients were included in the analysis. Average percent total burn surface area was 19%, 15%, 15%, and 14% ( $p = 0.18$ ) per income quartile (Q1: lowest, Q4: highest), respectively. Likelihood ratios for income quartile Q1–Q4 were 1.3 (0.8–1.6), 1.2 (0.6–1.4), and 0.7 (0.6–1.2), respectively. **Conclusion.** Contrary to findings in other geographic regions of the world, severity or incidence of burn injury in Nova Scotia, Canada, does not change in relation to SES when using family median income as a surrogate.

## 1. Introduction

Burns are a significant public health issue due to their associated morbidity and mortality. Globally, an estimated 265,000 deaths occur yearly from burn injury [1]. However, this burden is not equally shared, with 95% of burns occurring in low- and middle-income countries [2]. Low-income and middle-income countries are defined as nations whose gross national income per capita is less than 1045\$ and 12,476, respectively [3].

Socioeconomic status (SES) is a risk factor for both the burn incidence and burn severity [4, 5] and can be measured using a variety of epidemiological markers including GDP median household income, property values, and housing quality [6].

The relation median household income to the incidence of severe burns in the province of Nova Scotia is unknown.

Nova Scotia is Canada's second smallest but second most densely populated province, with an area of 55,284 km<sup>2</sup> and a population of 921,727. Out of the ten provinces and three

territories, Nova Scotia ranked second to last in GDP per capita in 2013 [7]. Nova Scotia is similar to other Canadian provinces in terms of other established risk factors for burns such as education level (high school diploma or equivalent) and percentage of low-income individuals by province [8, 9].

The objective of this study is to perform an analysis of the relationship between percentage total burn surface area (TBSA) and socioeconomic status of patients using median family income as a method of assessment. The Halifax Infirmary Burn Unit is the largest tertiary care unit in the Maritime Provinces. It is dedicated to the treatment and rehabilitation of patients with severe thermal injuries from Nova Scotia. Data for this study was obtained from the Burn Unit Database.

## 2. Methods

Patient information was collected retrospectively from 1995 to 2012 on all patients who were admitted to the Halifax Infirmary Burn Unit, Nova Scotia, Canada. Patients were excluded

TABLE 1: Average % of total burns from lowest to highest adjusted median family income.

Variable	Q1 income: <\$49377 (n = 75)	Q2 income: ≥\$49377 to <\$55885 (n = 77)	Q3 income: ≥\$55885 to <\$60323 (n = 75)	Q4 income: >\$103564 (n = 75)	p value
Average % TBSA	19	15	15	14	0.18

Q: quartile, TBSA: total burn surface area.

from final analysis if they did not possess a postal code from Nova Scotia or if postal codes were not obtainable from patients charts.

**2.1. CPI Adjusted Annual Income.** Socioeconomic status was estimated by linking the subject’s postal code to median family household income via Canadian population census at the level of dissemination areas (a dissemination area (DA) is a small, relatively stable geographic unit composed of one or more adjacent dissemination blocks; it is the smallest standard geographic area for which all census data are disseminated [10]) from 1995 to 2012. In order to remove the economic inflation factor, we adjusted the annual income by incorporating consumer price index (CPI) reported by Statistics Canada. Year 2005 was used as the base year and all observations from the year other than 2005 were adjusted accordingly.

Median family income was divided into 4 equal income groups ranging from lowest to highest income quartiles. Percentage of total burn surface area (TBSA) per each income quartile was compared. Kruskal-Wallis chi-squared test was used to evaluate significance of the results.

**2.2. Beta Regression.** A beta regression model was generated to analyze the effect of median income on likelihood of causing burn injury. The statistical analysis was implemented by software R (Version 3.1.1).

### 3. Results

Three hundred and two patients were included in the study, with one-quarter of the patient population in each income quartile ranging from lowest income (<\$49377) to highest income (>\$103564). Adjusted for inflation, total average percentage TBSA was 19%, 15%, 15%, and 14% ( $p = 0.18$ ) for each income quartile (Q1–Q4), respectively (Table 1).

A beta regression model was created to evaluate the effect of median family income on likelihood of causing burn injury. Likelihood ratios for income quartiles Q1–Q4 were 1.3 (0.8–1.6), 1.2 (0.6–1.4), and 0.7 (0.6–1.2) with Q4 being the reference value (Figure 1).

### 4. Discussion

Socioeconomic status is often measured using a combination of education, health, income, and occupation variables to define the social standing or class of an individual or group [11]. In rural settings specifically, median income alone is an unreliable measure of SES. A study examining a population from western Canada reports the relationship between low

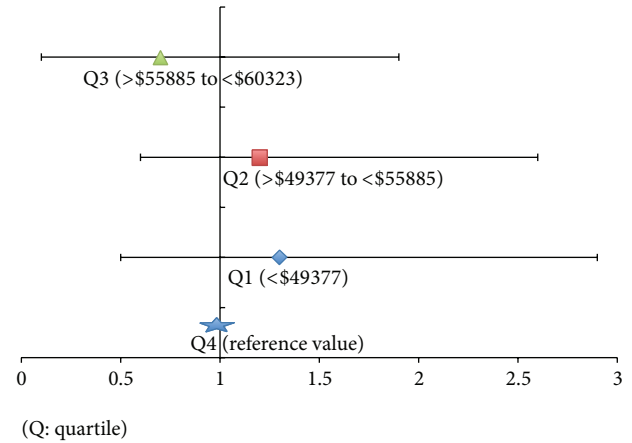


FIGURE 1: Adjusted odds ratio for prediction of burn injury based on median family income quartile.

SES and incidence/severity of burns was less pronounced and in many cases absent with individuals living in rural areas [12]. A similar study analyzing a population from the Republic of Korea concluded income was not a meaningful descriptor of the relationship between low SES and burn severity for the self-employed and those with job instabilities [13]. In Nova Scotia, 43% of its population lives in a rural setting. Rural setting is defined as towns and villages with less than 1000 individuals that lie outside population centers [14, 15].

Nova Scotians experience difficulty in obtaining stable employment (unemployment rate 8.4%; national average 6.6%; seasonal employment 5.8%; national average 2.4%) [16, 17]. This difficulty is further compounded by a weak economic performance relative to the rest of Canada [18].

The incidence of burns is most influenced by poverty, lack of education, and unemployment according to a meta-analysis of 34 studies. In addition, substandard housing and family dynamics (large families or single parent families) emerged as risk factors [19]. Perhaps one of the aforementioned variables or available alternative proxies of wealth and social strata would be more representative to the unique economical and geographical landscape.

It should be noted that though we found that percentage of TBSA does not change in relation to median income in the context of a rural community setting, it does not imply that data on household income is not a potentially valuable measure. In Canada, low-income cut-off (LICO) equation calculates if a family needs to spend a greater proportion of its income on necessities than the average family of the same size. Low-income status is based on the calculated LICO [20].

Perhaps an approach in which the LICO equation is utilized in rural communities as a surrogate for low socioeconomic status would result in a greater accuracy in reporting.

Beta regression modeling showed decreasing income does not increase burn risk (Figure 1). These results suggest that, in Nova Scotia, median income (as surrogate for SES) is not associated with burn risk.

The authors recognize that this study has limitations. With a population of 940,000, the amount of burn-injured patients admitted from 1995 to 2012 in Nova Scotia may not constitute a large enough sample size to properly power the study. The Halifax Infirmary Burn Unit is the only tertiary care unit in the Maritime Provinces and thus constitutes the only collection of burn patient data available in Nova Scotia. In contrast, a larger study conducted in the Republic of Korea involving 870,411 burn cases demonstrated that patients arising from low-income households or areas with high poverty were at increased risk of burns [13].

## 5. Conclusion

Severity of burn injury in Nova Scotia, Canada, does not change in relation to increasing socioeconomic status when using family median income as a surrogate. Our statistical model demonstrated no decrease in likelihood of burn injury relative to increasing median family income.

## Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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