

**Distribution and Neighbourhood Deprivation Patterns of Unintentional Home Injuries in
British Columbia, Canada**

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Abstract

Unintentional injuries occurring in the home represent a substantial and persistent public health burden in Canada, accounting for a large proportion of injury-related hospitalizations, particularly among older adults, children, and equity-owed populations. While prior research has documented socioeconomic gradients in injury risk, limited scholarship has examined unintentional home injuries through population-level analyses of neighbourhood deprivation, spatial epidemiology, and community-engaged qualitative inquiry to understand how structural inequities and lived experiences intersect to shape vulnerability to home injury risks. Recent immigrants and refugees, particularly those navigating resettlement within constrained housing and settlement structures, remain underrepresented in this body of work.

In this manuscript-based thesis, I explored unintentional home injuries in British Columbia (BC) through three stand-alone papers that collectively link structural and spatial patterns of home injury risks and how these risks are experienced by members of Afghan newcomer communities. In the first paper, I examined neighbourhood-level disparities in unintentional home injury hospitalizations across BC between 2015 and 2019 using administrative health data linked with the Canadian Index of Multiple Deprivation (CIMD). I calculated neighbourhood-level unintentional home injury hospitalization rates across CIMD dimensions and observed that injury rates were disproportionately higher in areas characterized by greater situational vulnerability, economic dependency, and residential instability, while lower rates were observed in neighbourhoods with higher ethnocultural diversity.

Building on the findings of the first paper, in the second paper, I applied spatial epidemiological methods to identify geographic hotspots of age-standardized unintentional home injury hospitalization rates across BC. Using hotspot analysis and geographically weighted

regression, I identified significant spatial clustering of home injury risk, with high-risk areas concentrated in the Lower Mainland. Key predictors of elevated unintentional home injury rates included lower educational attainment, lower annual household income, and higher concentrations of low-rise apartment dwellings, with relationships varying across geographic space. These patterns often characterize neighbourhoods where newcomer populations are more likely to reside.

Building on the spatial identification of structurally patterned home injury risk, in the third paper, I examined how these conditions are experienced and navigated by Afghan newcomers in the Greater Vancouver area. Guided by an intersectional framework and community-based participatory research approach, I conducted nine qualitative interviews and a focus group (n=8). Using reflexive thematic analysis, I produced four themes illustrating home safety as a socially negotiated process shaped by vulnerability to unintentional injury risks within structurally constrained and resettlement contexts, and by resilience expressed through collective problem-solving, embodied learning, and community support.

Across the three papers, I demonstrated that unintentional home injury risk in BC is patterned across neighbourhood deprivation and geographic space, and that these place-based risks are experienced and navigated within everyday home environments shaped by resettlement conditions. By integrating spatial epidemiology with community-engaged qualitative research, this work advances injury prevention scholarship and calls for equity-driven, place-based, and culturally responsive interventions that address social and structural determinants of home injury risks.

Dedication

I dedicate this dissertation to my wife, Shaima, and to my parents. My wife's unwavering support, patience, and belief in me carried me through the most challenging moments of this process. She created space for me to think, write, and grow, so I could keep moving forward. I am deeply grateful to walk this path alongside her.

To my parents, whose sacrifices laid the foundation for everything I have been able to pursue – this work is a reflection of their resilience, values, and unwavering commitment to education. Though they did not have the opportunity to pursue formal education themselves, they made sure that I did. Their strength and faith have guided me across countries and through countless challenges, continually reminding me of where I come from and why this work matters.

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I carry all of this with me as I move forward!

Chapter 1

Introduction

Injuries in Canada represent a major and pervasive public health challenge, profoundly impacting millions of people across the lifespan. According to recent Canadian data (Canadian Institute of Health Information, 2025), between 2018 and 2024, unintentional injuries, characterized by the absence of predetermined intent, caused over 17,000 deaths, 231,000 hospitalizations, nearly 5 million emergency visits, and \$25 billion in costs annually. The burden of unintentional injuries in Canada is distributed unequally across the population, with members of communities that are marginalized experiencing disproportionately higher injury risks. These disparities are often influenced by a complex interplay of social determinants of health (Braveman & Gottlieb, 2014). A significant proportion of the unintentional injuries occur within the home setting, and they include, but are not limited to, falls, burns, poisonings, ingestion of foreign objects, smoke inhalation, drowning, cuts, collisions with objects, as well as injuries resulting from structural collapse. My interest in this work is informed by my lived experiences as an Afghan refugee who is now an immigrant to Canada, as well as a nurse navigating health systems in different contexts. These experiences informed the questions I asked, the way I approached this work, and my commitment to centering the perspectives of communities who are often underrepresented in injury research.

The high incidence of unintentional home injuries underscores the need for understanding and addressing the complex and diverse factors contributing to such injuries. Recent national data indicate that falls, one of the most common types of home injuries, are a leading cause of hospitalizations and emergency department visits among children and older adults in Canada (Yao et al., 2024). In the context of British Columbia (B.C.), the rate of hospitalization due to unintentional home injuries was 249.12 per 100,000 population in 2019 (B.C. Injury Research and Prevention Unit, 2023). Several home injury prevention interventions and strategies have

been implemented in B.C., including province-wide social marketing campaigns as well as targeted programs designed for high-risk groups such as children and older adults (Pike et al., 2015). However, their widespread and equitable adoption remains a significant challenge.

Despite the central role of the home environment in shaping injury risk, progress in reducing home injury disparities has been hindered by fragmented approaches and limited analytical frameworks. Injury prevention efforts have traditionally adopted a siloed approach that focuses on single injury mechanisms, resulting in fragmented policies that hinder synergistic action and fail to address the shared structural drivers of the major injury risks (Ma et al., 2021). These challenges are further amplified by gaps in the conceptual frameworks used to analyze injury outcomes and guide prevention strategies, many of which fail to fully account for the social, environmental, and structural determinants that shape home injury risks (Kendi & Macy, 2023). As a result, there remains a lack of comprehensive evidence on how home injuries are distributed across populations and which groups experience disproportionate home injury risks. As such, to facilitate injury prevention efforts, in this dissertation, I provided a comprehensive contextual analysis of unintentional home injuries in B.C., using both quantitative and qualitative approaches. I specifically asked the following three research questions:

1. What is the relationship between neighbourhood deprivation and unintentional home injury–related hospitalizations in B.C. between 2015 and 2019? (Chapter 2)
2. Where are the census subdivision–level hotspots of unintentional home injury hospitalizations across B.C.? (Chapter 3)
3. How do recent Afghan immigrants and refugees in the Greater Vancouver Area experience and navigate the risks of unintentional home injuries? (Chapter 4)

In this introductory chapter, I examine the literature on injuries as a public health issue, with particular attention to populations disproportionately affected and the use of administrative health records and geospatial data to enhance understanding of the epidemiology of unintentional injuries. I also outline the epistemological foundations, theoretical framework, methodologies, methods, and analytical approaches that guided this dissertation.

Review of Literature

Injury, described as the physical damage caused when the human body is briefly or suddenly exposed to unbearable energy levels (Holder et al., 2001), is a complex public health issue. An injury may take the form of a physical wound caused by acute energy exposure at levels beyond the physiological threshold, or it may take the form of a functional impairment resulting from one or more essential elements (such as air, water, or warmth), as in drowning, suffocation, or hypothermia (Horan & Mallonee, 2003; Norton & Kobusingye, 2013). Examples of energy that can cause injury include mechanical or kinetic energy (i.e., falls, motor vehicle collisions, assaults), thermal energy (i.e., burns and scalds), electrical energy (i.e., electrocution or lightning), chemical energy (i.e., corrosive substances or poisoning), and radiation (i.e., sunlight or radioactive materials). Injuries are generally categorized as intentional or unintentional based on the ascribed intent (Norton & Kobusingye, 2013). Unintentional injuries include falls, burns, poisoning, and motor vehicle crashes (Chen et al., 2013; Pike et al., 2015; Yao et al., 2019). Examples of intentional injuries are self-harm, violence, and war (Lozano et al., 2012). Distinguishing whether an injury is intentional or unintentional helps public health professionals identify root causes, design appropriate interventions, and allocate resources more effectively. However, it is critical to note that simple categorization is

challenging because the intent of the injury is often not obvious, as a single injury may entail multiple potential causes (Cheng et al., 1999).

Globally, injuries cause over 4.4 million deaths each year and account for nearly 8% of all global mortality (World Health Organization, 2024). Beyond fatalities, tens of millions more people suffer non-fatal injuries that result in long-term disability, psychological trauma, and significant socioeconomic consequences (Lou et al., 2025). The burden falls disproportionately on young people, men, and individuals in low- and middle-income countries, where weaker infrastructure, limited safety regulations, and inadequate access to emergency and rehabilitation services intensify risks (Schmidt & Sparks, 2018). Road traffic crashes, suicide, homicide, falls, drowning, burns, and conflict-related injuries collectively create a cycle of lost productivity, strained health systems, and intergenerational poverty (World Health Organization, 2024).

Most of the injuries that occur in Canada are unintentional in nature. Unintentional injuries stand as the foremost cause of death, morbidity, and the potential years of life lost within the Canadian context (Yao et al., 2020). In 2018, unintentional injuries resulted in 17,000 deaths, 204,893 hospital admissions, 4.3 million emergency department visits, and 55,395 cases of disability (Parachute, 2021). This burden translates into 333,791 years of life lost, corresponding to 901 years per 100,000 Canadians. Unintentional injuries accounted for 86% of the total injury costs, amounting to \$25.3 billion (Parachute, 2021). Specifically, in 2018, unintentional injuries constituted \$3.8 billion (89%) of the total injury costs in B.C. (B.C. Injury Research & Prevention Unit, 2022).

A combination of behavioural, physical, structural, and social factors contributes to unintentional injuries that occur at home. An individual's behaviours, such as habits, choices, and attitudes within the home environment, affect their risk perception and adherence to safety

measures (Michalsen, 2003). Families in rental or inadequate housing are at higher risk of experiencing unintentional injuries within the home due to a lack of safety measures and potential structural hazards (Mayes et al., 2014). Some of these potential structural hazards include substandard heating or electrical systems and stairways without proper safety features (e.g., too small, inadequate handrails, low lighting, and lack of safety gates). In addition, socioeconomic status, housing conditions, and neighbourhood characteristics can all play significant roles in influencing the risk of home injuries (Braveman & Gottlieb, 2014). Safety features such as fire extinguishers, fire escape plans, and smoke detectors are less prevalent in low-income homes (Ballesteros & Kresnow, 2007).

The home environment has been identified as a key contributing factor to unintentional injuries in low-income households (Burrows et al., 2012). Populations with low income often have no choice but to live in substandard housing conditions, such as those without functional smoke alarms and safe hot water temperatures, which increase the risk of unintentional home injuries (Waterston et al., 2015). In addition, families with the lowest income were found to have poor knowledge in identifying household hazards compared to families with the highest income (Mayes et al., 2014). Unintentional injury mortality is 1.6 times higher among Canadians living in the most materially deprived neighbourhoods than among Canadians living in the least materially deprived areas (Public Health Agency of Canada, 2018).

Unintentional home injuries impact individuals of all age groups, but they are most prevalent among the youngest and oldest segments of the population (Mack & DeSafey-Liller, 2009). For instance, every year in Canada, over 20,000 children visit emergency departments for preventable injuries occurring in their home environments (Parachute, 2022), and approximately 29,000 older adults are treated for a hip fracture resulting from a slip, trip or fall in their home

(Public Health Agency of Canada, 2022). Children are more prone to unintentional home injuries due to various factors that relate to their developmental stage and their environment (Morrongiello, 2004). One of the main factors is their natural inquisitiveness, which drives them to explore and experiment with objects and situations that may pose hazards (Jirout & Klahr, 2012). Another factor is the amount of time spent in and around the home, which increases their exposure to potential sources of injury such as falls, burns, poisoning, choking, and electrocution (Matz et al., 2014). This is particularly evident for children in low-income households, as there may be limited resources for childcare or recreational activities beyond their home environment (Raphael, 2010).

Older adults are at increased risk of experiencing unintentional home injuries as a result of the age-related changes in vision, hearing, balance, strength, and cognition that affect their ability to perceive and avoid risks. One of the major causes of injury and hospitalization among older adults is falling at home (Johnson et al., 2015). The home environment can pose various fall hazards, such as poor lighting, clutter, slippery floors, loose rugs, and stairs (Blanchet & Edwards, 2018). Moreover, the home may not be well-suited for aging residents' changing needs and abilities, as they may require modifications such as grab bars, ramps, or wider doorways to accommodate mobility devices. These renovations can be costly, and not all Canadian older adults can access them, leading to a disparity in injury risk within this population (Jin et al, 2017). The percentage of the population aged 65 years and older rose to 19 percent of the Canadian population in 2022, and according to Statistics Canada's projections, this trend is expected to continue, reaching 22.5 percent by 2030 (Eisen & Emes, 2022). With the aging of the Canadian population, frailty and fall prevention within homes has become an increasingly critical public health concern.

Residential fires are another significant factor contributing to the increased risk of unintentional home injuries. Homes without or malfunctioning smoke alarms compromise and delay emergency response times, thereby increasing the likelihood of severe and fatal injuries (Beaulieu et al., 2019). In addition, certain populations, such as children aged four and under, older adults, those with sensory or physical limitations, and smokers face further challenges in benefiting from smoke alarms in the event of fire due to their limited capacity to act promptly (Istre et al., 2001). Households with income below the poverty level, lower educational attainment, and without young children are less likely to have functional smoke alarms (Ballesteros & Kresnow, 2007). Additionally, groups at heightened risk of fatality in residential fires encompass those individuals residing in substandard housing where emergency egress is often compromised (Gielen et al., 2015). Some other vulnerable groups are at further increased risk in residential fires, such as elderly or disabled individuals, due to their impaired capacity to respond and escape fires. For example, a study conducted in King County, Washington, which included 779 low-income households, showed that while most homes were equipped with smoke alarms, the functionality of these smoke alarms was not continuously monitored (Sidman et al., 2010).

Injuries among Refugees and Immigrants

Migration or displacement in and of itself can act as a determinant influencing disparities in injuries, posing risks to the physical, mental, and social well-being of refugees and migrants (Castañeda et al., 2015). The experience of leaving one's home and community, often abruptly and involuntarily, can profoundly affect the overall health and well-being of individuals and communities as it exposes them to social, economic, and environmental vulnerabilities (Spitzer et al., 2019). In Canada, some of the groups that experience injury disparities are recent

immigrants and refugees, who often encounter challenges and barriers in accessing the resources and opportunities that support good health (Kalich et al., 2015).

Immigrants and refugees are diverse groups that have different backgrounds, experiences, and needs (Setia et al., 2010). In the Canadian context, a refugee is a person who has fled their country because of a well-founded fear of persecution and is unable to return to their home (Canadian Council for Refugees, n.d.). Refugees are forced to flee for their lives and seek protection in another country. In contrast, a recent immigrant is defined as an individual who has permanently arrived in Canada within the five years preceding the most recent census (Statistics Canada, 2019). Immigrants come to Canada for various reasons such as economic opportunities, family reunification, or education – most often voluntarily. Refugees and recent immigrants are generally differentiated based on the voluntariness of their decision to emigrate (Immigration and Refugee Board of Canada, n.d.).

Refugees and recent immigrants in Canada are disproportionately affected by health inequities due to systematic and structural barriers (De Maio, 2010). Some of these barriers include language and cultural differences (Mianji et al., 2020), lack of information and awareness about navigating healthcare services (Ferdous et al., 2019), discrimination by healthcare providers (Zibrik et al., 2018), and legal and administrative hurdles (Campbell et al., 2012). Language barriers may also hinder injury prevention providers from effectively communicating with these population groups about safety measures (Mack et al., 2015). These factors can affect recent immigrants' and refugees' physical and mental health and their ability to integrate into Canadian society more generally. In addition, the Canadian healthcare system presents numerous obstacles for refugees and recent immigrants to access equitable and culturally appropriate care (Raynault et al., 2020). Some of these barriers include eligibility

criteria, cost-sharing arrangements, geographical accessibility, and provider attitudes (Tsai & Ghahari, 2023). Barriers to accessing social and economic resources among refugees and recent immigrants have been associated with a higher risk of unintentional injuries, including those occurring within the home environment (Potter et al., 2005). These factors create disproportionate disadvantages for refugees and recent immigrants and affect their ability to achieve and maintain good health throughout their new lives in Canada (Braveman & Gottlieb 2014).

While scholars have increasingly examined injury risks among immigrant populations (Lay et al., 2018), it is equally important to situate these debates within the broader context of the “healthy immigrant effect” (HIE), a phenomenon wherein newcomers to host countries generally arrive with better overall health than native-born populations (Saunders et al., 2018). However, the HIE varies substantially across health outcomes, immigrant categories, and contexts of reception, and does not extend uniformly to injury patterns (Kwak, 2018; Lu & Ng, 2019). The effect appears to be more pronounced in some immigrant subgroups than others, particularly among non-refugee migrants or those who are more positively selected (Lu & Ng, 2019). Moreover, the HIE is often more evident in mortality and certain chronic conditions than in broader morbidity indicators (Zheng & Yu, 2025). In addition, the HIE also varies by health outcome, as self-rated health, mental health, disability, functional limitations, and health-related behaviors do not consistently follow the same pattern (Lin, 2023). As such, any generalized claim of an “immigrant health advantage” may obscure meaningful subgroup differences and underlying health inequities.

The HIE is a dynamic pattern shaped by individuals’ age, race, gender, socioeconomic status, and country of origin. The HIE is usually strongest in adulthood, particularly among

recent working-age immigrants, but it is less consistent in childhood, adolescence, and later life (Vang et al., 2016). For immigrant children and adolescents, health outcomes are shaped less by migration alone and more by family socioeconomic resources, developmental stage, length of residence, and the broader social and institutional contexts in which immigrant youth live (Salami et al., 2022; Saunders et al., 2017). Among older adult immigrants, the initial health advantage may diminish or disappear as aging, cumulative disadvantage, and chronic disease accumulation increasingly offset the selection effects associated with migration (Gubernskaya, 2014). Notably, the HIE is gendered, as immigrant women arrive with a weaker health advantage and experience a faster, more severe physical and mental decline than men due to the intersecting burdens of a segmented labor market, systemic discrimination, and domestic caregiving pressures (Kobayashi & Prus, 2012; Trappolini & Giudici, 2021). In addition, within the race–migration nexus, the apparent HIE in health outcomes may be partly sustained by the healthier baseline profiles of White immigrants and by the systematic under-recognition and underreporting of injury risks among racialized newcomers (Lin, 2024).

Injury Prevention Efforts in Canada

Many intervention programs aimed at preventing unintentional injuries globally, including Canada, have been informed by Haddon’s framework, which is considered the scientific and conceptual basis for modern injury control (Haddon, 1970). Initially applied in road safety, the framework was later extended to other areas of human activity, including sports and leisure, occupational settings, and activities of daily living, to help researchers systematically identify risk and protective factors across a timeline of injury. To translate these theoretical insights into practice, various injury prevention strategies in Canada have been implemented based on the 3E’s framework – Education, Enforcement, and Engineering. The paramount

contribution of the 3 E's framework to injury prevention lies in its transformative shift from attributing injuries as solely the responsibility of the injured individual to the recognition of the collective responsibility shared by various partners, including public health practitioners, policymakers, designers of the built environment, and the entire community (Cohen & Swift, 1999). The acknowledgment of this collective responsibility emphasizes the need for multifaceted initiatives employing multiple strategies, which tends to demonstrate the highest likelihood of success. However, despite the widespread adoption of the 3E's framework, certain groups continue to experience a disproportionate burden of injuries, including recent immigrants and refugees. As such, Giles and colleagues (2019) asserted that without incorporating *equity* as a fundamental component of the 3E's approach, which they re-branded as the 4E's, preventable and unjust risks for significant injuries persist amongst vulnerable and deprived populations.

In B.C., various initiatives have been implemented at multiple levels, including raising awareness and promoting behavioural changes to reduce the risk of unintentional injuries, including those occurring in and around the home environment. These initiatives have included the development of the *Preventable* social marketing campaign (Smith et al., 2018), a set of injury indicators (Oakey et al., 2021), as well as the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) - the largest injury surveillance system in Canada (Crain et al., 2016). These system-wide programs are in addition to focused interventions, such as the installation of smoke detectors in higher-risk residential dwellings to encourage people to evacuate the premises promptly in case of fires (Al-Hajj et al., 2023) and campaigns reminding parents of the need for safe storage of medications and poisons, to minimize the risk of unintentional home injuries (Parachute, n.d.). However, despite these accomplishments, preventable injuries continue to occur in and around homes in B.C., indicating the need for

continued understanding of the potential inequitable distribution of injury risks (Yanar et al., 2018). Effective injury prevention with equity-owed population groups requires multidisciplinary, collaborative approaches that are culturally and linguistically sensitive (Scheuer et al., 2026).

Impact of Deprivation on Injuries

Deprivation, defined as the long-term lack of resources that limits individuals' ability to achieve an adequate standard of living or access goods and services that are customary in their society (Gordon, 2006), influences injury risk through multiple pathways. Deprivation is often measured using quantitative approaches that employ composite indices that combine multiple deprivation indicators into a single score (Allik et al., 2019). These indices can include measures of material deprivation, such as income, employment, and housing conditions, as well as measures of social deprivation, such as social support and access to services. While income is an important determinant of living standards, it does not capture the full extent of people's access to resources and opportunities nor their exposure to risks and vulnerabilities (Braveman & Gottlieb, 2014). Therefore, alternative indicators of deprivation have been developed to complement income-based measures and provide a more comprehensive picture of the situation of the diverse population in Canada (Matheson et al., 2012).

There are numerous area-based socio-economic indices available in Canada that can be used to measure social and material deprivation and their association with injury occurrence and outcomes. One such index is the Pampalon Deprivation Index, which has been a highly cited measure of deprivation in Canada (Pampalon et al., 2009). The Pampalon Index is used to measure the socio-economic status of geographic areas and its impact on health outcomes. There is also a regional index called the Vancouver Area Neighbourhood Deprivation Index

(VANDIX), which is a census-based measure of socio-economic status designed to provide a representative and accessible proxy marker of population health status without requiring extensive health data (Bell & Hayes, 2012). The VANDIX has been used in various research and policy settings across the province to examine health status, injury, and access to healthcare services.

Researchers at the MAP Centre for Urban Health Solutions developed the Canadian Marginalization Index (CAN-Marg) using 2006 census data in Canada (Matheson et al., 2012). This index is used to measure the degree of social and economic deprivation experienced by residents of different geographic areas in Canada. In this index, marginalization is considered a complex issue that affects different aspects of individuals' lives, including their access to resources, employment opportunities, housing stability, and social connectedness. Furthermore, in 2016, Statistics Canada released a revised version of the CAN-Marg, called the Canadian Index of Multiple Deprivation (CIMD), which used the same dimensions but with updated norms and methods (Statistics Canada, 2019). Both the CAN-Marg and the CIMD are similar in their foundations and should be considered as complementary. The CAN-Marg, being longitudinal, maintains consistency by using the same census variables across iterations of the index, allowing comparisons over time. In contrast, the CIMD provides a dynamic cross-sectional view of deprivation by accounting for the evolving nature of the variables associated with marginalization. The CIMD allows researchers to investigate difficult-to-measure concepts by collapsing many variables into a few interpretable factors, with each factor capturing a certain amount of overall variation in the observed variables.

Overall, while previous studies have investigated the impact of socioeconomic factors on the occurrence of unintentional injuries, a critical gap existed in a comprehensive understanding

of the multifaceted neighbourhood deprivation patterns of unintentional home injuries in Canada. Furthermore, equity-owed populations, specifically recent immigrants and refugees, did not receive sufficient attention in studies related to unintentional home injuries, despite their constrained access to social and economic opportunities in Canada. Among these populations, Afghan newcomers represent an important group to consider, as intersecting social, cultural, and structural challenges during resettlement, along with mental health concerns shaped by pre- and post-migration experiences, can influence injury risk, prevention practices, and access to health care (Amanzai et al., 2026). By conducting this research in B.C., valuable insights into the complex mechanisms influencing the occurrence of unintentional home injuries were gained, contributing to the injury prevention field by informing the development of culturally relevant injury prevention strategies.

Theoretical Framework

While I approached the quantitative component of my dissertation using a deductive analysis grounded in a post-positivist paradigm, I drew on a theoretical framework in the qualitative phase to guide my research question and analysis. Specifically, I chose intersectional theory. Kimberlé Crenshaw, a Black feminist legal scholar and activist, coined the term "intersectionality" in the late 20th century (Crenshaw, 1989). She argued that women of colour faced a unique form of discrimination that was not adequately captured by either race or gender analysis alone. The fundamental concepts of intersectionality, including social inequality, power dynamics, relationality, social context, complexity, and social justice, are formed within the context of social movements addressing the challenges of colonialism, racism, sexism, militarism, and capitalism (Collins et al., 2021). Scholars employing intersectional theory challenge the dominant narratives and categories that often erase or exclude the voices and

experiences of people who occupy multiple marginalized positions (Nichols & Stahl, 2019). Moreover, researchers employing this theory recognize that social identities do not operate independently but rather intersect and influence one another, creating unique experiences of privilege and oppression (Collins et al., 2021). As such, researchers using an intersectional lens in their work centre the voices and experiences of equity-owed populations by acknowledging the unique challenges they face due to the interplay of various oppressions and injustice by highlighting the nuanced nature of discrimination and disadvantage (Cho et al., 2013; Lacombe-Duncan, 2016).

Intersectionality theory offers a useful framework to critically examine how social identities such as race, gender, religion, xenophobia, and immigration status interact with structural and systemic inequalities to produce differential patterns of injury risks among refugees and recent immigrants. The intersectional framework is highly relevant to my work with Afghan newcomer communities as it highlights the importance of considering both historical and contemporary social contexts, recognizing that different forms of oppression and discrimination have deep roots and cumulative impacts over time (Collins et al., 2021). In addition, by applying an intersectionality lens, scholars can prevent essentializing or homogenizing recent immigrants and refugees as a monolithic group and instead recognize the diversity and complexity of their lived realities and needs.

Although intersectionality has been widely applied across disciplines, some scholars have critiqued its use in analyzing health inequities for relying on subjective and arbitrary classification of social categories, which may inadvertently reinforce oppressive structures (Mountian & Calvo-Gonzalez, 2018; Staunæs, 2003). For instance, Kanwal (2026) argued that using simplified racial categories can obscure the social, political, and economic forces that

shape migrants' health, ultimately flattening diversity and diverting attention from the structural drivers of health inequities. However, to enhance the explanatory power of intersectionality theory, researchers can critically engage with its core tenets, consider multiple consciousnesses in conceptualizing social identities, and practice reflexivity to destabilize oppressive hierarchies (Nash, 2008; Samaradiwakera-Wijesundara, 2022). The major strength of intersectionality theory lies in its ability to offer a multidimensional and temporal perspective into understanding the complex social and structural inequities that lead to disparities in injuries among marginalized population groups (Bowleg, 2012; Heard et al., 2019; Kelly et al., 2021). In this research, intersectionality informed both the framing of the interview and focus group questions and the interpretation of findings in the third phase, enabling me to move beyond single-axis explanations of injury risk and instead examine how overlapping social, structural, and migration-related factors shaped the experiences of Afghan newcomers.

Methodologies

This dissertation was structured in three phases. In the first two phases, I employed quantitative methodologies, including a population-based cross-sectional design and a spatial epidemiological approach. For the third phase, I used a community-based participatory research approach. Below, I outline each approach.

Population-based Cross-sectional Approach

To address the first research question, a population-based cross-sectional research approach (Hippisley-Cox, 2002) was taken to determine the rates, dominant mechanisms, and neighbourhood deprivation pattern of unintentional injuries occurring at home leading to hospitalizations in the population of all age groups in B.C., between 2015 and 2019. A population-based cross-sectional approach is an observational quantitative study in which

researchers examine data from an entire population or a representative subset at a specific point in time (Capili, 2021). This approach is commonly employed to measure the prevalence of health conditions, identify health determinants, and describe population characteristics. For example, Saunders and colleagues (2017) conducted a population-based cross-sectional study to determine the rates of unintentional injuries among children and youth (aged 0-24 years) residing in Ontario during the period from 2008 to 2012. This approach was suitable for the first objective of my dissertation because it allowed for the examination of the prevalence of unintentional home injuries and their associated factors in a large and diverse population without influencing them.

In the context of this dissertation, this approach was particularly useful because it enabled the analysis of large, population-level administrative data to quantify the burden of unintentional home injuries, identify high-risk groups, and examine geographic and socioeconomic patterns across B.C. without influencing the population under study (Wang & Cheng, 2020). It also allowed for the simultaneous consideration of multiple factors, such as neighbourhood deprivation and demographic characteristics, which supported a more comprehensive understanding of home injury patterns and informed hypothesis generation for subsequent analyses (Capili, 2021). At the same time, the limitations of this approach shaped how the findings were interpreted. Because exposures and outcomes were measured at the same point in time, it was not possible to establish causal relationships between neighbourhood deprivation and injury occurrence (Mann, 2003). In addition, the reliance on administrative hospitalization data meant that injuries not resulting in hospital admission, as well as contextual details about the home environment, were not captured. These limitations informed the need for subsequent spatial and qualitative analyses within this dissertation to further examine the contexts and mechanisms underlying the observed patterns.

Spatial Epidemiology

To address the second research question, I used a spatial epidemiological approach (Elliott & Wartenberg, 2004) to map and visualize the spatial distribution of unintentional home injury hospitalizations across B.C. Researchers using spatial epidemiology apply a spatial perspective to the design and analysis of studies examining the distribution, determinants, and outcomes of health phenomena of interest (Kirby et al., 2017). Spatial epidemiology and geographic statistical methods were first and most prominently developed and applied in infectious disease research, such as for studies of cholera, malaria, and HIV (Morrison et al., 2024), and then expanded into other areas such as chronic diseases and injuries (Hu et al., 2025; Singh et al., 2016). Recent improvements in data availability and analytical techniques now allow researchers to examine how disease rates vary at much finer, small-area geographic scales (Morrison et al., 2024). Researchers employing a spatial epidemiological approach use a geographic information system (GIS), which is a computerized platform that integrates diverse data sources into a unified spatial framework and enables management and examination of spatial relationships among geographic, environmental, and population factors (Rosenkrantz, 2022).

The use of spatial methods in this phase of my dissertation enabled the identification of statistically significant clusters of unintentional home injuries, particularly in the Lower Mainland, and supported the examination of how neighbourhood-level factors were associated with these patterns (Khudadad et al., 2026). This was important for highlighting areas where home injury risk was concentrated and where prevention efforts could be prioritized (Edelman, 2007). This approach presented several challenges. In the initial stages of the analysis, using CIMD indicators at the dissemination area level resulted in multicollinearity across variables,

which limited my ability to model their relationships with home injury rates. To address this, I shifted to using social profile data at the census subdivision level, which allowed for more stable modeling and a clearer interpretation of the factors associated with observed clustering (Liverani et al., 2016). This decision involved a trade-off, as it reduced the spatial granularity of the analysis but strengthened the robustness of the regression results. Buzzelli (2020) argued that statistical results and visual patterns in geographic data can change depending on how spatial units are defined, a phenomenon known as the modifiable areal unit problem (MAUP). While working at the census subdivision level introduced the MAUP, I used geographically weighted regression to better capture how the relationship between neighbourhood deprivation and home injury rates varied across places (Li et al., 2022), which made local patterns more visible that would otherwise have been obscured.

Community-based Participatory Research

To address the third research question, I worked collaboratively with the members of the Afghan newcomer communities in the Greater Vancouver Area by engaging with the principles of the community-based participatory research (CBPR) approach (Israel et al., 2005). CBPR is a methodology in which community members, often called co-researchers, are meant to be meaningfully engaged in every phase of the research process (Israel et al., 2005; Minkler & Wallerstein, 2008; Wallerstein & Duran, 2008). Researchers conducting CBPR view “community” as a social entity (Darroch & Giles, 2014) and acknowledge the lived experiences of community members as distinct and important (Frisby et al., 2005). As such, this approach was most appropriate for this part of my research, as researchers employing this approach recognize the subjective nature of the problem and the participants' different lived experiences (Neubauer et al., 2019). As an Afghan refugee who is multilingual (English, Urdu, Hindi,

Persian, and Dari) and an injury researcher in an emergency department in Pakistan for five years before starting this PhD study, I was ideally situated to conduct this research.

Central to this work was my community advisory board (CAB) comprising two co-researchers leading specific Afghan resettlement services in the Greater Vancouver area. They provided critical input on data collection, including recruitment strategies, interview and focus group guides. With their input, I ensured that recruitment materials were accessible to members of Afghan newcomer communities who cannot read by including audio-recorded invitations in Dari and Pashto within the flyer, rather than relying on text-heavy flyer. Reflecting on this process, I recognized how my own literacy privilege as a multilingual researcher could have obscured these needs without CAB guidance. The CAB also prioritized my training in trauma-informed research approaches (Edelman, 2022), recognizing that participants experiencing domestic violence might view our research as a safe venue to share those experiences and seek support. In response, I completed training in trauma-informed research practices and developed a protocol for handling such disclosures to prevent re-traumatization. One challenge emerged when my initial co-researcher from the *Immigrant Services Society of BC* withdrew due to organizational priorities, but another CAB member quickly connected me with a committed replacement who brought essential settlement worker expertise and lived experiences.

Methods

This dissertation comprised three different approaches to understanding unintentional home injuries, each employing its own specific and unique methods for sampling and data collection. For the first and second research questions, I used quantitative methods. The CBPR approach involved the use of qualitative methods that were co-determined with input from the CAB. In the following sub-sections, I describe these quantitative and qualitative methods.

Quantitative Sampling

Sampling is a process through which researchers select a subset of individuals or units from a larger population to examine a social phenomenon or address a specific research question. Quantitative researchers aim to test hypotheses, establish causal relationships, and make statistical inferences about the population (Rovai et al., 2014); therefore, they need to ensure that their sample size is large enough to provide sufficient statistical power, minimize sampling error, and represent the population of interest (Faber & Fonseca, 2014; Anderson et al., 2017). However, in certain specific situations, quantitative researchers may decide to gather data from nearly the entire population they are studying, thereby eliminating the need to estimate the sample size (Khan et al., 2011). This possibility often arises when researchers have access to extensive datasets, like census data or comprehensive administrative health databases, that are routinely collected in electronic health records (Hinds et al., 2016; Lucyk et al., 2015). The significant benefit of these administrative health databases is that they extensively cover the populations of inpatient discharges, emergency department visits, and deaths across Canada (Hinds et al., 2016). As such, for the quantitative phase of my research project, I selected all cases of unintentional home injuries hospitalized in B.C. between 2015 and 2019. While most of the sampling in quantitative research follows a probability-based approach, I employed non-probability purposive sampling to specifically select patients who experienced unintentional home injuries in B.C. that resulted in hospitalization. Purposive sampling involves selecting a sample based on the researcher's judgment and the purpose of the study, which allows the researcher to focus on specific characteristics of the population that are relevant to the research question (Patton, 1990).

Qualitative Sampling

Qualitative researchers engage in a multifaceted decision-making process encompassing not only the determination of the number of participants and the selection criteria but also the contextual conditions governing this decision. Horowitz and colleagues (2009) suggested that community-led sampling and recruitment strategies could be effective in enrolling vulnerable and marginalized populations in research. Community-driven sampling, which relies on social networks and gives the community a central role in recruitment, aligns more closely with the principles of CBPR than random sampling (Tiffany, 2006). Moreover, engaging the community in the sampling process creates opportunities for dialogue and education on issues such as data integrity, informed consent, and the overarching goals of the research. In consultation with members of the community advisory board, for this phase of my dissertation, I used purposive and snowball sampling to identify recent Afghan immigrants and refugees aged 18 years and older living in the Greater Vancouver area. I recruited participants through in-person outreach at community events, word-of-mouth referrals, and posts on the community Facebook page.

Ethics

For the first and second phases of my dissertation, in which I used the secondary data obtained from the BC Injury Research and Prevention Unit, ethics approval was granted by the University of British Columbia Children's and Women's Research Ethics Board (C&W REB; #H22-01297). I received ethics board approval for the third phase of the dissertation from the Research Ethics Board at the University of Ottawa (#H-07-24-10239).

Participant Information

For the semi-structured interviews and focus group discussions addressing research question 3, I recruited Afghan immigrants and refugees who met the following inclusion criteria:

arrival in Canada in or after 2019; residency in the Greater Vancouver area at the time of the study; aged 18-65 years; and having personally experienced, or having a family member who had experienced, an unintentional injury within the home environment. I focused on Afghan immigrants and refugees who arrived in Canada in or after 2019 because this period reflects a marked increase in migration and resettlement following the escalation of the humanitarian crisis in Afghanistan (Immigration Refugees and Citizenship Canada, 2023). This decision is also consistent with Statistics Canada's (2021) approach to defining recent immigrants as those admitted within the five years preceding a census; for the 2021 Census, this included individuals who obtained permanent resident status between January 1, 2016, and May 11, 2021. Please see Table 1 for participant characteristics. Although I attempted to recruit participants of all genders, many Afghan families referred their female members when I approached them, reflecting a gendered perception that issues related to home injuries were primarily women's responsibility or experience.

Table 1. Participant Characteristics

Name	Age	Self-identified Gender	Length of residence in Canada	Residency Status	Education
Semi-structured interviews participant					
Fakhria	45–54	Woman	1–3 years	Permanent resident	Master's degree
Hamida	45–54	Woman	4-6 years	Canadian citizen	High school
Zarif *	55–64	Man	1-3 years	Refugee claimant	No formal education

Khushnood*	55–64	Man	1-3 years	Permanent Resident	No formal education
Parveen*	45–54	Woman	1-3 years	Permanent resident	Secondary school
Sharifa	35–44	Woman	1-3 years	Permanent Resident	Bachelor's degree
Aziza	45–54	Woman	1-3 years	Permanent Resident	Secondary school
Rabea	25–34	Woman	1-3 years	Permanent Resident	Bachelor's degree
Shaista	25-34	Woman	4-6 years	Canadian citizen	Bachelor's degree
Focus Group Participants					
Rooena	18–24	Woman	1-3 years	Permanent Resident	Bachelor's degree
Parwana*	35–44	Woman	1-3 years	Permanent Resident	Master's degree
Qubad	45–54	Man	1-3 years	Permanent Resident	Bachelor's degree
Sweeta	25–34	Woman	1-3 years	Permanent Resident	College diploma
Sikandar*	35–44	Man	4-6 years	Canadian citizen	High school
Mustafa*	45–54	Man	1-3 years	Permanent Resident	Secondary school

Samira	18–24	Woman	1-3 years	Permanent Resident	College diploma
Farahnaz	25–34	Woman	1-3 years	Permanent Resident	Secondary school

* Indicates a pseudonym

Data Collection

The initial two phases of this dissertation encompassed the secondary collection of quantitative data from administrative health records and census profiles. For the third phase of my dissertation, I used semi-structured interviews and focus group discussions.

In Canada, there has been a significant increase in the number of studies using administrative health databases, such as the discharge abstract database (DAD), for research and surveillance pertaining to population health, utilization of health services, and determinants of health (Hinds et al., 2016). Acute care facilities or their corresponding health/regional authorities or ministries/health departments directly provide the data for the DAD (Richards et al., 2002). Administrative health data are valuable for health research because they cover a large population, include a wide range of variables, contain data captured over long periods of time, and provide unique identifiers for individuals (Lucyk et al., 2015). Utilizing administrative health data offers several benefits for research, including increased statistical power, reduced biases from non-response or participant factors, the ability to study trends over time, and cost savings compared to primary data collection (Casey et al., 2016; Jones, 1996; Quan et al., 2012). As such, I obtained the de-identified hospitalization data on unintentional home injuries for the years 2015 to 2019 from the DAD through the BC Injury Research and Prevention Unit. The demographic information in the DAD includes the residential dissemination area (DA) where the injury

happened. DA is the smallest standard geographic area in Canada, with an average population of 400 to 700 persons (Government of Canada, 2023). Additionally, I obtained population data for each dissemination area from Statistics Canada's 2016 Census profiles to capture area-level demographic and socioeconomic characteristics that could help contextualize the observed patterns of unintentional home injury hospitalizations.

From March to August 2025, I conducted semi-structured interviews with participants and offered them the option to take part either in person or through virtual platforms (e.g., Zoom or WhatsApp). In addition, I conducted one focus group discussion (FGD) with eight participants who were different from those who took part in the semi-structured interviews. The use of semi-structured interviews aligned well with the CBPR approach, as it created space for recent immigrants and refugees to share their experiences of injury and the meanings they attributed to these experiences (Adams, 2015). This method also allowed flexibility to move beyond the interview guide through follow-up questions, enabling deeper exploration of issues raised by participants and a more nuanced understanding of their perspectives (Rubin & Rubin, 2011). The interview guide, co-developed with members of the community advisory board, focused on basic demographic questions (cultural background, language proficiency, household composition, community engagement, and settlement status) and included core questions related to understandings and experiences of home-based unintentional injuries, knowledge of safety, and barriers to injury prevention.

Similarly, we co-developed FGD with the CAB to elicit participants perspectives on socioeconomic factors, injury prevention challenges, and community-specific home safety concerns. Focus group discussions enhanced community engagement by creating a culturally familiar space where participants newcomers built on each other's accounts, shared cultural

norms around household safety, and co-constructed meanings around barriers to home injury prevention (Daley et al., 2010). As such, this community-vetted facilitation strengthened trust and helped reduce power dynamics, particularly bridging my position as an "outsider" academic based in Ottawa with participants' trust in CAB members as trusted community leaders (Teufel-Shone & Williams, 2010).

Conducting focus group discussions within a CBPR framework brought few challenges. One challenge during the focus group discussions was that many participants expected that I might be able to support them with their housing needs, particularly as conversations shifted toward issues such as precarious rental conditions, overcrowding, and delays in repairs, which were consistently linked to home injury risks. While these concerns were important to acknowledge as home injury risk factors, I had to clarify that my role was not to address them directly, but to understand how they shape injury experiences. I then gently guided the discussion back to home injury experiences using prompts that built on what participants were already sharing. This required a reflexive approach that balanced participants' expectations with the focus of the study and led to a deeper understanding of how housing conditions shape home injury risks among Afghan newcomers. Another challenge I encountered was that research was not familiar to some of the Afghan newcomers I engaged with and was often perceived as an investigative process. This led to hesitation, particularly around how their information would be used. To address this, I focused on building trust through clear and ongoing communication, taking time to explain how the information would be used and how confidentiality would be maintained. Christopher and colleagues (2008) noted that trust in CBPR develops over time through continued engagement, including being present in the community, listening to

community members, and being clear about academic expectations while acknowledging the context in which the community operates.

Analyses

I used multiple forms of analysis across the different phases of my dissertation to develop a comprehensive understanding of the patterns and determinants of unintentional home injuries in B.C. For the first phase of this dissertation, I analyzed the data by calculating rates of home-related unintentional injury hospitalizations per 100,000 population by calendar year, sex, age group, cause of injury, and dimensions of multiple deprivation. The factor scores within each dimension of deprivation are arranged in ascending order and divided into five equally sized groups called quintiles (Matheson et al., 2012). I also estimated 95% confidence intervals for the rates using the Wilson score method. For the second phase, I analyzed data using multi-stage spatial analytical methods. While injury records were initially coded at the DA level, multicollinearity among deprivation indicators at this level led me to aggregate the injury data to the census subdivision level, which I then linked to census-based sociodemographic and housing data. I employed spatial autocorrelation and spatial regression to examine the patterns, clusters, and spatial distribution of unintentional home injuries across neighbourhoods in B.C. (Bell & Schuurman, 2010).

For the qualitative phase of this dissertation, I used Braun and Clarke's (2019) reflexive thematic analysis. Scholars employing reflexive thematic analysis continually reflect on how their own perspectives, assumptions, and engagement with the data influence the development of themes. Since I collected data in Dari and later translated it into English, reflexive thematic analysis was particularly appropriate, as it allowed me to remain attentive to how this process shaped both what participants shared and how I interpreted their accounts, while acknowledging

how my multilingualism, cultural congruency, and interpretive lens influenced meaning-making (Byrne, 2022). Consistent with Braun and Clarke's (2019) reflexive analytical approach, I began by immersing myself in interview transcripts, paying close attention not only to what participants said but also to how cultural background, migration history, and settlement experiences shaped their accounts. Through iterative cycles of coding, I generated both semantic and latent codes that captured expressed barriers, such as unfamiliarity with housing systems, language-related challenges, or limited access to safety information, as well as underlying patterns related to acculturation and trust. As the analysis evolved, I reorganized and refined codes into themes that illuminated how structural inequalities, cultural adaptation, and lived household realities intersected to shape Afghan newcomers' vulnerability to unintentional home injuries.

While CBPR principles emphasize the involvement of community partners across all phases of the research process (Israel et al., 2010), my CAB chose not to participate in the data analysis phase. From the outset, CAB members identified their strengths in cultural translation, participant recruitment, and the co-design of interview and FGD guides, and they prioritized these contributions over direct involvement in data analysis. Logistical constraints also influenced this decision, as my primary residence in Ottawa made real-time collaborative analysis with Vancouver-based CAB members challenging, despite ongoing virtual communication. Instead, CAB members focused on co-creating knowledge translation products, such as a home safety infographic in Dari and Pashto languages, ensuring that the research remains grounded in community perspectives and responsive to the needs of Afghan newcomers.

Dissertation Format

My dissertation is organized into five chapters, with chapters 2 to 4 comprising three independent, publishable papers derived from the research. In Chapter 2, I examined the

relationship between neighbourhood deprivation and unintentional home injury hospitalizations (published in the *International Journal of Injury Control and Safety Promotion*). In Chapter 3, I identified hotspots of unintentional home injuries across B.C. that resulted in hospitalizations (published in the journal *Scientific Reports*). In Chapter 4, I explored how Afghan newcomers in the Greater Vancouver Area perceived and managed the risks of home injuries within the context of resettlement (under review in the *Journal of Racial and Ethnic Health Disparities*). In the publishable papers, I use the term “we” to acknowledge the contributions of my co-supervisors, who are co-authors on the manuscripts, and others who contributed. Each paper is in the format required of the journal to which it was published (Chapters 2 and 3) or submitted (Chapter 4). In Chapter 5, I present the overall conclusions of my dissertation.

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Chapter 2

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Home injuries in British Columbia: Patterns across neighbourhood deprivation.

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Abstract

The significant burden of home injuries has become a growing concern that affect thousands of people every year across Canada. This study examined the relationship between neighbourhood deprivation and unintentional injuries occurring at home leading to hospitalizations in British Columbia (B.C.) between 2015 and 2019. This study used de-identified hospitalization data on unintentional home-related injuries from the Discharge Abstract Database (DAD) and population data for each dissemination area from Statistics Canada's 2016 Census Profiles. Hospitalization rates were computed for unintentional home-related injuries across four dimensions specified in the Canadian Index of Multiple Deprivation (CIMD) for B.C. For three CIMD dimensions (situational vulnerability, economic dependency, and residential instability), unintentional home injury rates were higher in areas with higher deprivation, while the inverse was observed for ethno-cultural diversity. Understanding socio-economic disparities within neighbourhoods enables injury prevention partners to identify vulnerable populations and prioritize the development and implementation of evidence-based injury prevention interventions.

Injuries that occur within the home setting constitute a significant and widespread health burden on a global scale affecting millions of individuals across the life span (World Health Organization, 2018). Approximately, one-third of all injuries worldwide occur within residential environments (Turner et al., 2011). In the Canadian context of 2015, unintentional injuries including those that occurred at home were the leading cause of death among individuals aged 1 to 34 years, and the sixth leading cause of death across all groups (Statistics Canada, 2015). For every fatal home injury death, there are hundreds of non-fatal injuries that result in significant healthcare costs and productivity losses (Gielen et al., 2015; Yao et al., 2020). A significant proportion of injuries occurring within the home are unintentional in nature and include but are not limited to falls, burns, poisonings, ingestion of foreign objects, smoke inhalation, drowning, cuts, collisions with objects, as well as injuries resulting from structural collapse (Pike et al., 2015). Unintentional home injuries impact individuals of all age groups, but they are most prevalent among the youngest and oldest populations (Mack & DeSafey Liller, 2009). For instance, every year in Canada, over 20,000 children visit emergency departments for preventable injuries occurring at home (Parachute, 2022), and approximately 29,000 older adults are treated for a hip fracture resulting from a slip trip or fall in their home (Public Health Agency of Canada, 2022).

The occurrence of unintentional home injuries is often influenced by a complex interplay of social determinants of health (Potter et al., 2005). According to the World Health Organization (2008), social determinants of health include a wide range of non-medical factors that influence health outcomes, such as income and social protection, education, working conditions, housing conditions, job security, social inclusion, and access to healthcare. The social determinants of health view the main drivers of health as the way society distributes its economic

and social resources (Graham, 2004). These social determinants often interact, creating complex pathways that influence the occurrence of unintentional injuries. As such, socioeconomic status, housing conditions, and neighbourhood characteristics are all associated with elevated risk of home injuries (Braveman & Gottlieb, 2014). Moreover, the structural determinants of health, which include the economic, political, and social structures that shape the distribution of resources and power in society, serve as the primary pathway for increased exposure to home hazards and safety risks (Atlantic Collaborative on Injury Prevention, 2011). Unintentional injury mortality is 1.6 times higher among Canadians living in the most materially deprived neighbourhoods than among Canadians living in the least materially deprived areas (Public Health Agency of Canada, 2018). Moreover, experiences of social and material deprivation can result in a great deal of stress, anxiety, sadness, and hopelessness. In addition to the negative impact of chronic stress on physical and mental health, it may also lead to unhealthy coping mechanisms and risk-taking behaviours, which are known to increase risk for both intentional and unintentional injuries (Pike et al., 2015). Moreover, scholars using data from Statistics Canada and Population Census determined that the risk of death from unintentional injury among Canadian children living in urban areas increased by 12% with every shift from the highest to the lowest income quintile (Birken et al., 2006).

The built environment can have a significant impact on unintentional home injuries (Stauton et al., 2008). Several studies from the US have highlighted that structural deficiencies and design flaws in housing can contribute to a variety of injuries, including falls, fires, burns, drowning, and carbon monoxide poisoning (DiGuseppi et al., 2010; Mack et al., 2013). Lack of safety features such as fire extinguishers, fire escape plans, and smoke detectors can potentially increase the risk of unintentional injuries in homes (Ballesteros & Kresnow, 2007). Furthermore,

while certain safety features may be in place and still require active individual engagement to ensure proper use of safety devices, higher levels of control that focus on elimination and substitution are more effective. Therefore, it is important to promote and implement policies and practices that focus on making homes inherently safer by eliminating hazards, rather than relying solely on individual behavior change.

Over the past two decades in Canada, various initiatives have been implemented at multiple levels, including awareness raising and promoting behavioural changes, in order to reduce the risk of unintentional home injuries (Kendrick et al., 2013; Pike et al., 2015). Specifically, in British Columbia (B.C.), numerous injury surveillance and prevention interventions, and programs have been implemented at different levels of the public health system, including the development of the *Preventable* social marketing campaign (Smith et al., 2018), a suite of injury indicators (Oakey et al., 2021), as well as the *Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP)* - the largest injury surveillance system in Canada (Crain et al., 2016). These system-wide programs are in addition to focused interventions, such as the installation of smoke detectors in higher-risk residential dwellings to encourage people to evacuate the premises promptly in case of fires (Al-Hajj et al., 2023) and campaigns reminding parents of the need for safe storage of medications and poisons, minimize the risk of unintentional home injuries (Parachute, 2023). However, in spite of these accomplishments, preventable injuries continue to occur inside homes in B.C., indicating the need for continued understanding of the potential inequitable distribution of injury risks (Yanar et al., 2018).

Scholars in B.C. have used various socio-economic indices to better understand area-based deprivation and the association with injury disparities (Zandy et al., 2019; Rajabali et al., 2019). The *Canadian Index of Multiple Deprivation (CIMD)* is designed to measure varying

degrees of disadvantage and marginalization observed in different geographic regions across Canada. The CIMD can also be used as a proxy measure for individual measures of deprivation (Statistics Canada, 2019). The CIMD is constructed based on four dimensions of deprivation, which in integration offers a comprehensive and multidimensional representation of the social and economic conditions associated with the well-being of Canadians. The indicators within dimensions of CIMD vary across the different regions of Canada due to varying disparities in factors such as economic opportunities, cultural composition, and situational vulnerabilities, leading to unique and context-specific manifestations of deprivation (Statistics Canada, 2019). In B.C., the four dimensions of deprivation are used in a specific order: (1) ethno-cultural composition, which focuses on the community composition of immigrant populations and the proportion of the population who self-identify as visible minority; (2) situational vulnerability, which accounts for variations in socio-demographic conditions related to housing and education, along with the proportion of the population that identifies as Indigenous; (3) economic dependency, which pertains to reliance on the workforce or a dependence on sources of income other than employment income; and (4) residential instability, recognizes the tendency of neighbourhood dwellings to change over time, considering both housing and familial characteristics. For example, Relova et al. (2022) conducted a study using CIMD for B.C. to capture distinctive community characteristics; the index was used to identify community health service areas which may have a high level of deprivation in one dimension and a low level in another.

Despite research being conducted in B.C. on material and social deprivation using various indices, there remains a lack of understanding of the relationship between unintentional home injuries and neighbourhood deprivation patterns. By investigating this relationship,

researchers can gain valuable insights into the mechanisms by which socioeconomic disparities and the built environment are associated with rates of home injuries, allowing for the identification of areas where targeted interventions may be effective at mitigating the impact of home injuries. The authors of this study aimed to determine the rates, vulnerable groups, dominant external causes, and neighbourhood deprivation patterns of unintentional injuries occurring at home leading to hospitalizations in B.C. between 2015-2019.

Methods

Data sources and characteristics

The present study is based on de-identified data on hospitalizations resulting from home injuries for the years 2015 and 2019 inclusive, retrieved from the Discharge Abstract Database (DAD) (BC Ministry of Health, obtained through the BC Injury Research and Prevention Unit). These years were selected to exclude any variances in data due to the public health measures implemented in BC during the period of the COVID-19 pandemic. The timeframe selected can serve as a baseline measurement for any potential future analyses to investigate the impacts of the COVID-19 pandemic on home injuries. This dataset included a wide range of demographic, administrative, and diagnostic factors for each case, such as sex, age, external cause of injury (e.g., drowning, falls, poisoning, burns), place of occurrence, and the residential dissemination area (DA) where the injury happened.

DA is the smallest standard geographic area in Canada, with an average population of 400 to 700 persons (Statistics Canada, 2023). The *International Statistical Classification of Diseases and Related Health Problems Canadian* version 10 (ICD-10-CA) was utilized to define the cases of unintentional injuries and those occurring in the home (W25-W29, W45, W46, X00-X19, W65, W66, W00-W19, X40-X49, W75-W84, W42, W43, W53-W64, W92-W99, X20-

X39, X51-X57, X85-Y09, and place of occurrence – U98). Additionally, population data for each DA were obtained from Statistics Canada's 2016 Census profiles. This study was approved by UBC C&W Research Ethics Board (certificate # H22-01297).

The CIMD for B.C. was utilized to calculate hospitalization rates for each quintile across four distinct dimensions of deprivation (Statistics Canada, 2019). Each dimension of the CIMD for B.C. is composed of several indicators that are standardized and aggregated using factor analysis (Statistics Canada, 2019). Each dimension is divided into five quintiles, with each representing approximately 20% of the population. The quintiles are categorized such that quintile 1 represents the least deprived areas, while quintile 5 represents the most deprived areas. Each dimension of deprivation was assigned to each patient based on their DA of residence at the time of their injury using data from Statistics Canada's 2016 Census Profile (Appendix A).

Data analysis

Rates of unintentional home injury hospitalizations per 100,000 population based on calendar year, sex, age-group, external cause of injury, and dimensions of deprivation were calculated. Ninety-five percent confidence intervals (95% CI) for rates were developed using Wilson score interval for each quintile of the dimensions of the deprivation (Newcombe, 2012).

Results

Between 2015 and 2019, there were a total of 74,985 home injury hospitalizations in B.C. (annual hospitalization rate: 256.5 per 100, 000 population). The majority of these injuries were unintentional in nature, accounting for 84.2% of the total (Table 1). During the specified period, 60.1% of unintentional home injuries occurred among females compared to males (1,507 per 100,000 females). Moreover, the majority of these injuries were reported among those aged 65 years and older (72.9%), followed by individuals between 45-64 years (15.9%) and 19-44 years

(6.5%). Falls were the leading cause of unintentional home injuries (82.4%); poisoning being the second most common cause (7.2%). Additionally, it is notable that 4.7% of unintentional home injuries resulted in fatalities. In terms of deprivation dimensions, quintile 5 had the highest frequency of unintentional home injuries leading to hospitalization across dimensions of situational vulnerability (21%), economic dependency (32%), and residential instability (29%). Within the ethno-cultural composition dimension, quintile 5 had the lowest proportion of unintentional home injuries leading to hospitalization (14.5%). Table 1 shows the characteristics of unintentional home injuries leading to hospitalization in BC between 2015-2019.

Table 1. Characteristics of unintentional home injury hospitalization in BC, 2015-2019

Variables	Categories	Hospitalizations n (%)
Sex		
	Male	25,179 (39.9)
	Female	37,988 (60.1)
Age-groups (years)		
	0-18	2,957 (4.7)
	19-44	4,137 (6.5)
	45-64	10,018 (15.9)
	65 and above	46,060 (72.9)
Deaths	Yes	3,000 (4.7)
Cause of Injury		
	Falls	52,064 (82.4)
	Drowning	42 (0.1)
	Poisoning	4,559 (7.2)
	Burn	781 (1.2)
	Struck by/ against	824 (1.3)
	Suffocation	580 (0.9)
	Others (cut/pierce, explosion, electrocution, firearm, machinery, overexertion,	4,323 (6.8)

	environmental, and unspecified)	
Deprivation Dimensions		
Ethnocultural composition		
	Quintile 1 (Less diverse)	11,405 (18.1)
	Quintile 2	15,210 (24.1)
	Quintile 3	15,109 (23.9)
	Quintile 4	11,564 (18.3)
	Quintile 5 (More diverse)	9,149 (14.5)
Situational vulnerability		
	Quintile 1 (Best socio-demographic conditions)	12,312 (19.5)
	Quintile 2	12,348 (19.5)
	Quintile 3	11,593 (18.4)
	Quintile 4	12,916 (20.4)
	Quintile 5 (Worst socio-demographic conditions)	13,268 (21)
Economic dependency		
	Quintile 1 (Economically sufficient)	8,819 (14)
	Quintile 2	10,447 (16.5)
	Quintile 3	10,441 (16.5)
	Quintile 4	12,496 (19.8)
	Quintile 5 (Economically insufficient)	20,234 (32)
Residential instability		
	Quintile 1 (More stable neighbourhoods)	8,244 (13.1)
	Quintile 2	9,794 (15.5)
	Quintile 3	11,788 (18.7)
	Quintile 4	14,269 (22.6)

	Quintile 5 (Less stable neighbourhoods)	18,342 (29)
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Table 2 shows the number of unintentional home injuries stratified by demographic variables for first quintile (least deprived) and fifth quintile five (most deprived) across all four dimensions of deprivation in BC, between 2015 to 2019. The number of unintentional home injuries leading to hospitalization among females in both first and fifth quintiles were higher across all four dimensions of deprivation than their male counterparts. Among different age-groups, those aged 65 and above in the most deprived quintile of both the economic dependency and residential instability dimensions experienced a higher number of unintentional home injuries leading to hospitalization, constituting 82% and 76.9%, respectively. In terms of the cause of injury, falls were significantly high in the most deprived quintile in the economic dependency and residential instability dimensions, accounting for 86% and 82.7%, respectively.

Table 2. Demographic stratification of unintentional home injury hospitalization by deprivation quintiles for each dimension of the CIMD for BC, 2015-2019.

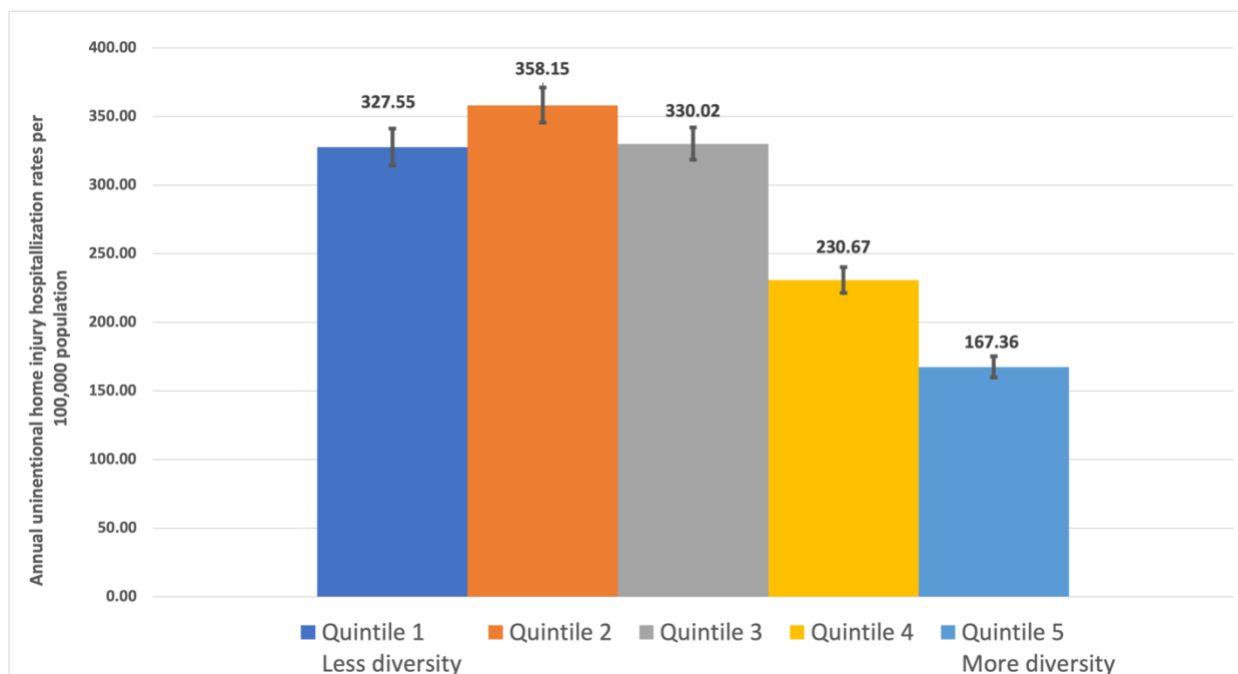
	Ethnocultural composition n (%)		Situation Vulnerability n (%)		Economic dependency n (%)		Residential Instability n (%)	
Demographic Variables	Quintile 1	Quintile 5	Quintile 1	Quintile 5	Quintile 1	Quintile 5	Quintile 1	Quintile 5
Sex								
Male	4800 (42.1)	3784 (41.4)	4674 (38)	5454 (41.1)	3709 (42.1)	7552 (37.3)	3591 (43.6)	6693 (36.5)
Female	6604 (57.9)	5363 (58.6)	7637 (62)	7811 (58.9)	5109 (57.9)	12681 (63)	4653 (56.4)	11644 (63.5)
Age-group (years)								
0-14	452 (4)	438 (4.8)	489 (4)	560 (4.2)	608 (6.9)	371 (1.8)	400 (4.9)	429 (2.3)
15-24	208 (1.8)	179 (2%)	191 (1.6)	279 (2.1)	241 (2.7)	174 (0.9)	184 (2.2)	246 (1.3)
25-64	2657 (23.3)	2071 (22.6)	2168 (17.6)	3483 (26.3)	2508 (28.4)	3117 (15.4)	2028 (24.6)	3553 (19.4)

65 and above	8088 (70.9)	6461 (70.6)	9464 (76.9)	8946 (67.4)	5462 (61.9)	16572 (82)	5632 (68.3)	14114 (76.9)
Cause of Injury								
Falls	9311 (81.6)	7559 (82.6)	10463 (85)	10507 (79.2)	6872 (77.9)	17317(86)	6766 (82.1)	15170 (82.7)
Drowning	6 (0.1)	9 (0.1)	7 (0.1)	30 (0.2)	7 (0.1)	8	6 (0.1)	10 (0.1)
Poisoning	790 (6.9)	721 (7.9)	701 (5.7)	1204 (9.1)	863(9.8)	1127 (5.6)	548 (6.6)	1439 (7.8)
Burn	157 (1.4)	114 (1.2)	103 (0.8)	183 (1.4)	128 (1.5)	202 (1)	97 (1.2)	217 (1.2)
Struck by/ against	180 (1.6)	96 (1)	148 (1.2)	183 (1.4)	124 (1.4)	244 (1.2)	125 (1.5)	196 (1.1)
Suffocation	73 (0.6)	124 (1.4)	104 (0.8)	131 (1)	106 (1.2)	137 (0.7)	73 (0.9)	179 (1)
Others*	613 (5.4)	314 (3.5)	453 (3.6)	671(5)	401 (4.5)	785 (3.9)	410 (4.9)	672 (3.7)

*Cut/pierce, explosion, electrocution, firearm, machinery, overexertion, environmental, and unspecified

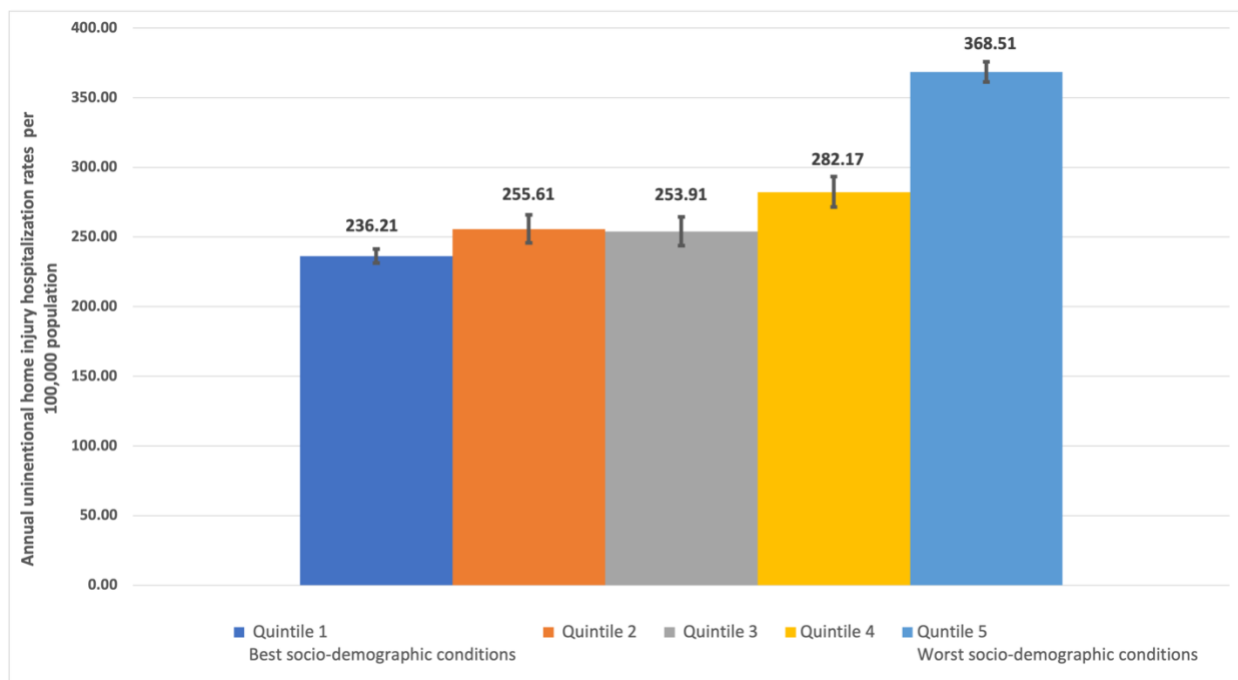
The analysis of multiple deprivation across ethno-cultural composition showed a significant difference in hospitalization rates for unintentional home injuries across quintiles (Figure 1). The rate of hospitalization was lowest in the fifth quintile, which was more diverse in the proportion of population who are recent immigrants, self-identified as visible minority, born outside of Canada, and with no knowledge of either official language (167.4 [95% CI: 159.87 to 175.2] per 100,000 population). It was observed that unintentional home injury rates leading to hospitalizations were significantly higher in the first quintile (327.55 [95% CI: 314.4 to 341.25] per 100,000 population), second quintile (358.15 [95% CI: 345.67 to 371.08] per 100,000 population), third quintile (330.02 [95% CI: 318.48 to 341.98] per 100,000 population), and fourth quintile (230.67 [95% CI: 240.25 to 240.25] per 100,000 population).

Figure 1. Annual hospitalization rates for unintentional home injuries across ethno-cultural composition quintiles in BC, 2015-2019



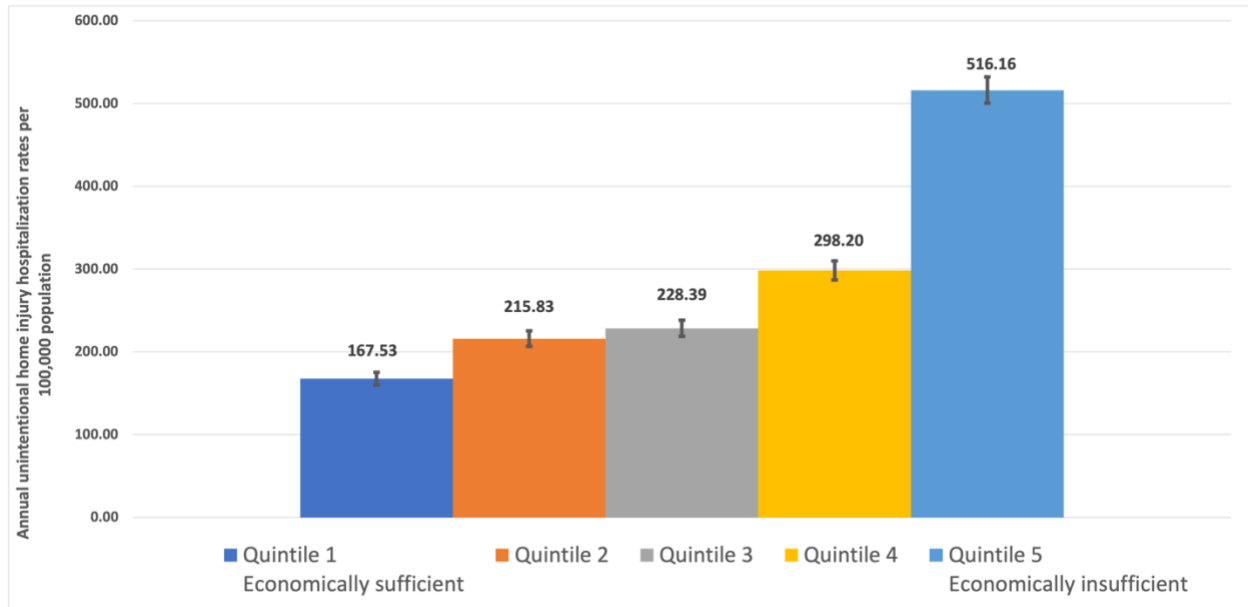
The analysis of multiple deprivation within the dimension of situational vulnerability showed a higher rate of unintentional home injuries per 100,000 population in the most deprived quintile (Figure 2). There were no significant differences observed in rates of unintentional home injuries leading to hospitalization in the first quintile (236.21 [95% CI: 227.08 to 245.5] per 100,000 population), second quintile (256.61 [95% CI: 245.74 to 265.78] per 100,000 population), and the third quintile (253.91 [95% CI: 243.79 to 264.44] per 100,000 population). However, a notable and statistically significant higher rate of unintentional home injuries related to hospitalizations was observed in the fourth quintile (282.17 [95% CI: 271.51 to 293.24]) and fifth (worst socio-demographic conditions) quintile (368.5 [95% CI: 361.38 to 375.78]).

Figure 2. Annual hospitalization rates for unintentional home injuries across situational vulnerability quintiles in BC, 2015-2019



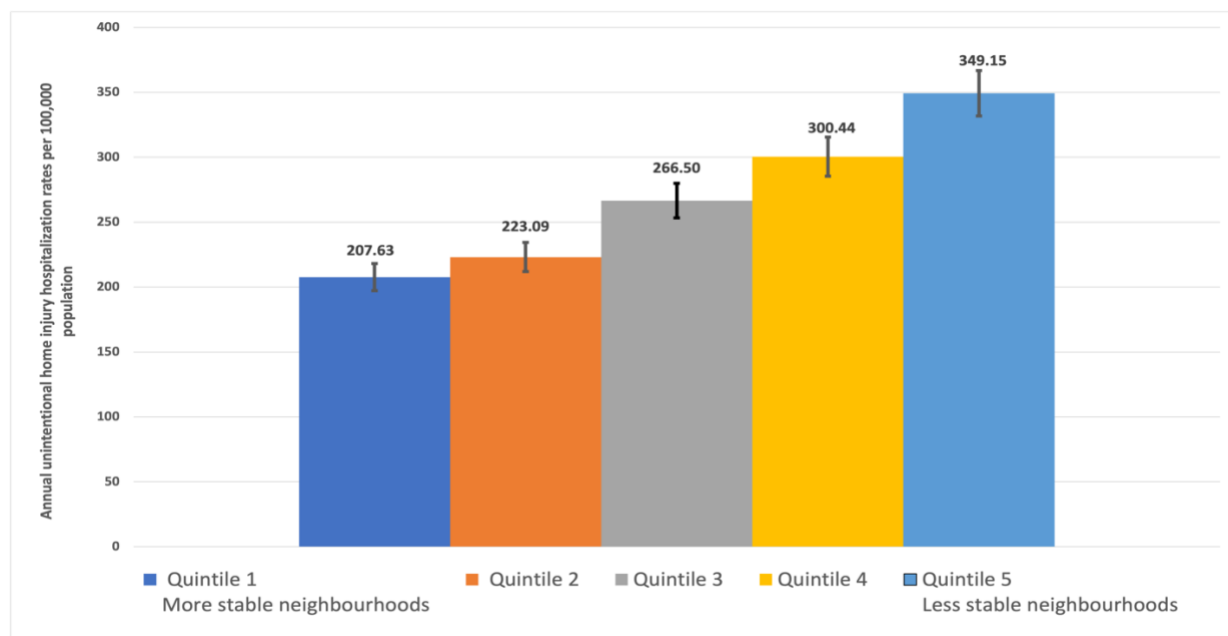
The analysis of multiple deprivation within the dimension of economic dependency revealed higher rates in unintentional home injury hospitalizations in the fifth quintile (Figure 3). Notably, a statistically significant increase in the rate of unintentional home injuries resulting in hospitalizations (516.1 [95% CI: 500.54 to 532.27] per 100,000 population) was observed in the fifth quintile, representing neighbourhoods with the highest economic insufficiency. There were no significant differences in rates of unintentional home injuries leading to hospitalization in the second quintile (215.83 [95% CI: 206.78 to 225.28] per 100,000 population), third quintile (228.39 [95% CI: 218.81 to 238.38] per 100,000 population) and the fourth quintile (298.20 [95% CI: 286.75 to 310.1] per 100,000 population).

Figure 3. Annual hospitalization rates for unintentional home injuries across economic dependency in BC, 2015-2019



The analysis of multiple deprivation within the dimension of residential instability, which considers housing and familial characteristics, showed a significantly higher rate of unintentional home injury-related hospitalization in fifth quintile (349.15 [95% CI: 338.05 to 360.61] per 100,000 population) which represents less stable neighbourhoods in BC (Figure 4). The first quintile which represents more stable neighbourhoods experienced unintentional home injury rates comparatively less than fifth quintile (349.15 [95% CI: 338.05 to 360.61] per 100,000 population).

Figure 4. Annual hospitalization rates for unintentional home injuries across residential instability quintiles in BC, 2015-2019



Discussion

This study determined the demographics, external causes, and hospitalization rates for unintentional home injuries across various dimensions of multiple deprivation in British Columbia over the five-year period from 2015 to 2019. The number of unintentional injuries resulting in hospitalization was greater among females than males. The age group most affected by unintentional home injuries was adults aged 65 and older. The most common external mechanism that resulted in unintentional home injuries requiring hospitalization was falls. The authors observed that greater diversity in the ethno-cultural composition of the neighbourhoods was associated with lower rates of unintentional home injuries leading to hospitalization. The more deprived quintile within the dimensions of situational vulnerability, economic dependency, and residential instability had higher hospitalization rates of unintentional home injuries.

The observed higher incidence of hospitalizations for unintentional home injuries among females in B.C. is consistent with a prior study conducted in US where authors collated national data from multiple sources to determine the prevalence and risk factors of fatal and non-fatal home injuries between 2000-2008 (Gielen et al., 2015). The sex-based disparity in non-fatal

unintentional home injuries observed in our study may be attributed to sex-related differences in risk perception and specific roles and responsibilities that females from certain cultures have at home, which expose them to higher injury risks (Stevens, 2005). Moreover, in Canada, women comprise a larger proportion of older adults due to their tendency to live longer, which exposes older women further to potential risks of home injuries (Bryanton et al., 2021). However, a study from the US, in which authors determined annual average rates for unintentional home injury deaths, showed that males were more susceptible to fatal home injuries compared to females (Mack et al., 2013). While the specific reasons for sex-based differences in the fatal outcomes of unintentional home injuries can be complex and multifaceted, they can be partially attributed to sociocultural conditions, which may lead males to undertake more physically demanding, or higher-risk tasks without complying with safety precautions. For example, trade professionals, who are predominantly males and whose work involves physical labor, such as construction workers, carpenters, and electricians, often face a higher risk of unintentional home injuries due to their tendency to vocationally perform their professional activities within their own homes. Furthermore, Quinlan & Bohle (2008) examined the practice of outsourcing, which has been increasing over the past two decades and has led to the growth of home-based work. They found that home-based work through outsourcing, predominantly undertaken by males, is linked with increased risk of injuries and poor health and occupational safety outcomes due to precarious working conditions, including inadequate training, limited supervision, and isolation. To optimize public health interventions, it is vital to recognize the disparities in unintentional home injuries that can be attributed to sex (Mitchell et al., 2012).

Age has also been shown to be an important factor in this study, indicating a notably higher incidence of unintentional home injuries in the older population (aged 65 years and

above). This finding aligns with a study conducted in Turkey, involving 1,185 individuals aged 65 years and older, which reported a high incidence of home injuries in relation to the rest of the population (Samanci, 2019). Health-related factors, including musculoskeletal disorders, neurodegenerative conditions, and polypharmacy, have been identified as risk factors for home injuries in the older population (Hart et al., 2020; Shi et al., 2015). In addition, the proportion of the older population in B.C. has grown rapidly compared to the national trend (Wister et al., 2019). This demographic shift has significant implications for the well-being of older adults, especially in terms of unintentional injuries including falls within their homes and residential facilities. Moreover, in this study, authors observed that children aged 0-18 years comprised 4.7% of study subjects who were hospitalized due to unintentional home injuries between 2015-2019. A substantial body of literature has documented a high worldwide incidence and prevalence of unintentional home injuries among children (Foettinger et al., 2022; Khambalia et al., 2006; Noujah et al., 2017). Furthermore, in a trauma-focused study, the authors examined 9,345 patients admitted to four urban tertiary care hospitals in India from 2016 to 2018 and determined that injuries sustained within the home environment were associated with higher child and older population mortality, as compared to injuries occurring outside of the home environment (Banerjee et al., 2022). Hence, it is essential to implement effective injury prevention strategies to minimize the risks of unintentional home injuries in vulnerable populations, such as children and older adults.

In this study, it was observed that falls were the predominant external cause of unintentional home injuries leading to hospitalization in B.C. Previous studies have shown that hospital admissions for falls in the older population are associated with socio-economic marginalization, with higher rates in deprived areas (Court-Brown et al., 2010; West et al.,

2004). In addition, Okoye and colleagues (2020) in their study linking 6,489 community-dwelling older participants with social deprivation index in the US observed that household financial strain was associated with a 31% increased risk of falling, and indoor trip hazards with a 14% increased risk, after adjusting for individual factors and neighbourhood social deprivation index. Moreover, lack of home ownership is associated with a higher risk of falls and increased fear of falling among older adults (Do & Kim, 2012). Lack of home ownership can also limit the ability to modify the home environment to suit the needs and preferences of older adults, such as installing grab bars, ramps, or stair lifts. These factors can further increase the risk of falls among elderly people, which can have serious consequences for their health, well-being, and independence (Tsai et al., 2021). Furthermore, social deprivation was found to be an important contributor to the risk of fall among patients age 50 and over presenting with fragility fractures of the distal radius (Johnson & Dias, 2019). Zandy et al. (2019) in their study in B.C., Canada, found that people living in areas with lower income and higher levels of deprivation had increasingly higher mortality rates due to falls compared to their counterparts living in more privileged areas. Falls in homes are also a significant factor contributing to hospital admissions among children (Fridman et al., 2018; Khambalia et al., 2006). These findings suggest that area-based deprivation may be associated with an increased risk of falls in the home by affecting the quality of housing, the availability of safety devices, and the access to social support systems. Therefore, it is important to address socioeconomic disparities in the prevention of falls occurring inside homes.

The authors of this study observed that neighbourhoods with the highest proportion of the population who were recent immigrants, self-identified as visible minorities, born outside Canada, and with poor knowledge of either official language, had the lowest rate of unintentional

home injury hospitalization in B.C. This is consistent with recent studies in B.C. indicating that neighbourhoods characterized by a higher presence of visible minorities and immigrants have shown lower rates of hospitalizations due to unintentional injuries, including falls and road-related injuries (BC Injury Research and Prevention Unit, 2019). The lower rates of unintentional home injuries among recent immigrants and visible minority populations in B.C. may be partially explained by the Canada's immigrant selection and settlement policies (Lu & Ng, 2019). These policies prioritize healthy, highly educated, motivated, and resourceful individuals, potentially reducing the likelihood of such injuries. Furthermore, perceived discrimination among recent immigrants from healthcare providers and cultural incompetence in care could lead to immigrants being hesitant to access acute care services (Zghal et al., 2020); which may contribute to the underreporting of injuries among recent immigrant populations.

In a population-based cohort study, Saunders et al., (2017b) examined residents aged 24-years and younger in Ontario from 2008 to 2012 using health and administrative databases, and it was revealed that immigrant children and youth had a lower risk of unintentional firearm injuries when compared to their non-immigrants counterparts. Moreover, in a study conducted in Denmark, authors estimated the mortality rates for unintentional injuries by migrant status. They found that both male and female immigrants and refugees experienced significantly reduced mortality from unintentional injuries (Norredam et al., 2012). However, in a population-based study among children and youth (aged 0–24-years) from immigrant families residing in Ontario, Canada, from 2011 to 2012, authors observed that refugees had a 20% higher rate of emergency department visits related to unintentional injuries in comparison to non-refugees (Saunders et al., 2017a). It has been observed that immigrants' health status tends to decline over time in the host country, and certain populations of immigrants experience a decline in health status and poorer

health outcomes (Gushulak et al., 2010). While immigration has a protective effect, the process of acculturation affects population in diverse ways. Therefore, it is important to understand the factors that influence the risk of home injuries among immigrants and to design effective interventions that address their specific needs and challenges.

Consistent with previous studies (Dowswell, 2002; Burrows et al., 2012), this study also established a clear link between unintentional home injuries and socioeconomic deprivation. Individuals living in more disadvantaged households were at a greater risk of unintentional home injuries, including falls, poisonings, and suffocation (Kendrick, 2001). In a study involving 173,504 children treated at emergency departments, the researchers concluded that sociodemographic factors, including low income and low education level, were associated with a higher risk of unintentional home injuries among Danish children (Laursen & Nielsen, 2008). As social gradient observed in this study across three dimensions of multiple deprivation, Burton and colleagues (2024) emphasized the need for health equity scholars to understand the patterns and underlying causes of health inequities. As such, it is important to discuss the drivers of health inequities that contribute to these inequities, including disparities in injuries. The drivers of health inequities, such as, systems of oppression and discrimination, income inequality, and unequal distribution of societal power, often interact and reinforce each other, creating complex pathways that lead to disparities in injury occurrences and outcomes (Marmot & Bell, 2012). As such, the analysis of social and structural determinants of health helps in strategizing the ways in which a person's social environment can be influenced to prevent unintentional home injuries (Raphael, 2012). This can be done through strengthening and supporting community-based programs to empower socially and materially deprived people to improve their living conditions.

We ascertained that multicultural and heterogeneous neighbourhoods can be a protective factor for the prevention of unintentional home injuries. We encourage future research to focus on examining the social and cultural dynamics in diverse neighbourhoods to better understand the cultural and communal practices that promote home safety and injury prevention. Understanding how residents of diverse and varied neighbourhoods prioritize and implement safety measures can provide valuable guidance and inform the development of community-based, inclusive injury prevention strategies that resonate with local values and needs.

Limitations

Injured patients were categorized into multiple deprivation quintiles based on their dissemination area of residence, potentially leading to an ecological fallacy where neighbourhood characteristics are applied to individuals. However, this is a common limitation in studies employing this approach and previous evidence has demonstrated that the effects of neighbourhood deprivation do reflect individuals' deprivation conditions (Henery et al., 2021). Moreover, the area-based deprivation index used in this study did not capture the dynamic nature of deprivation, as it relies on static measures of deprivation that do not account for changes over time (Trinidad et al., 2022). As this is an observational analytical study, it cannot establish causal relationships between multiple deprivation and unintentional home injury rates. Moreover, this study focused exclusively on unintentional injuries which were acute enough in nature to warrant hospitalization, and excluded minor injuries that may have occurred but did not lead to hospitalization. Despite these limitations, this study employed the Canadian Multiple Deprivation Index to effectively provide valuable insights into patterns of neighbourhood characteristics and unintentional home-related injury rates, which can guide targeted interventions for injury prevention and public health policy and programming initiatives. In

addition, since the hospitalization data for unintentional home injuries were unavailable beyond 2020, it is likely that recent patterns and trends in unintentional home injuries may have changed. Upon the availability of the home injury data beyond 2020, it will be valuable to examine the potential impact of the COVID-19 pandemic and post-pandemic factors on the home injury rates in BC.

Conclusion

This study in B.C., Canada, is the first to examine the pattern of unintentional home injuries in relation to deprivation. The authors determined that areas characterized with greater diversity tend to have reduced rates of unintentional home injuries. This underscores the complex interplay of ethno-cultural dynamics in shaping public health outcomes. These findings have far-reaching implications for targeted intervention strategies, as they challenge traditional presumptions and call for a more nuanced approach to injury prevention. Moving forward, it is imperative for policymakers, injury prevention stakeholders, and communities to collaboratively harness these findings to design and implement evidence-based initiatives. These initiatives have the potential to reduce disparities, enhance safety, and foster inclusivity in neighbourhoods throughout B.C.

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Appendix A: The four dimensions of deprivation and their corresponding indicators, British Columbia, 2016

Ethno-cultural composition	Situational vulnerability	Economic dependency	Residential instability
Proportion of population who self-identify as visible minority	Proportion of population that identifies as Indigenous	Proportion of population participating in labour force (aged 15 and older)	Proportion of dwellings that are apartment buildings
Proportion of population that is foreign-born	Proportion of population aged 25-64 without a high school diploma	Proportion of population aged 65 and older	Proportion of persons living alone
Proportion of population with no knowledge of either official language (linguistic isolation)	Proportion of dwellings needing major repairs	Ratio of employment to population	Proportion of dwellings that are owned
Proportion of population who are recent immigrants (arrived in five years prior to Census)	Proportion of population that is low-income Proportion of single parent families	Dependency ratio (population aged 0-14 and aged 65 and older divided by population aged 15-64)	Proportion of population who moved within the past five years

Chapter 3

Khudadad, U., McGaughey, T., Zheng, A., Giles, A. R., & Pike, I. (2026). Geospatial hotspots and neighbourhood deprivation associated with unintentional home injuries in British Columbia, Canada. *Scientific Reports*, 16, 6610.

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Abstract

Background: Despite existing prevention initiatives, preventable unintentional home injuries remain a significant public health concern in Canada and are often influenced by the social determinants of health. This study identified census subdivision-area-level hotspots of unintentional home injuries resulting in hospitalizations across British Columbia (B.C.), Canada, from 2015 to 2019, and examined their relationship with sociodemographic factors.

Methods: Unintentional home injury hospitalization data from B.C., Canada (2015-2019) were obtained from the Discharged Abstract Database. These data were then aggregated at the census subdivision (CSD) level and linked to the social profiles of the 2016 for B.C. Spatial autocorrelation and hotspot analysis were performed using Anselin Moran's I statistics. Age-standardized injury rates for each CSD were calculated. Exploratory regression was conducted in ArcGIS Pro to identify the most suitable combination of predictor variables, and the best-fitting model was subsequently retained for geographically weighted regression (GWR) analysis.

Results: Between 2015 and 2019, the average age-standardized rate of unintentional home injuries leading to hospitalization in B.C. was 166.6 per 100,000 population. Statistically significant local spatial autocorrelation in age-adjusted unintentional home injury hospitalization rates across B.C. was observed, with high-high clusters concentrated in the Lower Mainland. Among five models tested, the most stable, featuring low multicollinearity (Max VIF = 1.19) and a significant Koenker (BP) p-value ($p < 0.001$), included no formal education, after-tax income, and low-rise apartment dwellings. The GWR model explained 77% of the variation in age-standardized unintentional home injury hospitalization rates across 428 CSDs in B.C., with injury risk increasing by 7.9% per 1% rise in population without formal education, decreasing by 1.5% per \$1,000 increase in after-tax annual household income, and increasing by 8% for every additional 100 low-rise apartment dwellings.

Conclusion: These findings identify geographic hotspots of unintentional home injuries and a strong association with key sociodemographic factors, which may serve as a basis for further investigation and informing public health planning and place-based intervention strategies in high-risk communities.

Keywords: Geospatial analysis; home; household; unintentional injuries; neighbourhood deprivation; socio-economic disparities.

Unintentional injuries, those for which the intent cannot be predetermined, represent a significant global public health challenge. Unintentional injuries are responsible for an estimated 3.16 million deaths worldwide each year (World Health Organization, 2024). Moreover, each year, tens of millions of non-fatal unintentional injuries result in emergency department visits, hospitalizations, and long-term disabilities (Ferrari et al., 2024). In Canada, unintentional injuries constitute the majority of injury cases associated with deaths (75%), hospitalizations (89%), emergency department visits (95%), and disabilities (90%) (Parachute, 2018a). In the context of British Columbia (B.C.), Canada, unintentional injuries accounted for 86% of total injury costs in 2018, amounting to \$25.3 billion (Parachute, 2018). A significant proportion of these unintentional injuries occurred in or around the home, including but not limited to falls, burns, poisonings, ingestion of foreign objects, smoke inhalation, drowning, cuts, collisions with objects, as well as injuries resulting from structural collapse (Pike et al., 2015). Given these statistics, unintentional injuries represent a significant public health issue that demands critical investigation.

The burden of home injuries varies considerably across different global contexts, reflecting complex interactions between personal risk factors, environmental hazards, and socioeconomic conditions (Jagnoor & Peden, 2021). The occurrence of these injuries varies significantly across age groups and between men and women, with unintentional home injuries disproportionately affecting children and older adults and associated with their unique vulnerabilities and increased time spent at home, which amplifies their exposure to potential hazards in the home environment (Gielen et al., 2015). In the United States (US), the *National Safety Council* reported in 2023 that unintentional home injuries accounted for approximately 52 deaths per 100,000 population among all unintentional injury deaths, with poisoning (including

drug overdose) as the leading cause, followed by falls among older adults (National Safety Council, 2023). European studies have also highlighted the disproportionate burden of home injuries, with nearly 60% of all injury-related emergency department visits among children under 15-years of age resulting from injuries that occurred at home (Sengoelge et al., 2011).

Contextually, every year, over 20,000 children visit emergency departments across Canada due to unintentional injuries sustained at home (Parachute, 2023). In particular, children under 5-years of age are rapidly developing physically and cognitively, but lack mature motor skills and risk awareness, which increases their risk of sustaining unintentional injuries within the home environment (Parachute, 2016). Based on the hospitalization records from 2017-2018, approximately 52% of falls leading to hospital admissions among adults aged 65-years and older occurred in their household residence (Public Health Agency of Canada, 2022b). Older adults face an increased risk of falls due to a combination of age-related physical limitations, chronic health conditions, medication side effects, and environmental hazards in homes not adapted for aging populations (Do et al., 2015). The demographic distribution of home injuries shows remarkable consistency across international contexts (Australian Institute of Health and Welfare, 2024; Kendrick et al., 2013; Public Health England, 2018).

The relationship between neighbourhood socioeconomic conditions and injury risk has been extensively documented in international literature, highlighting consistent patterns across diverse global contexts (Braveman & Gottlieb, 2014; Yuma-Guerrero et al., 2018).

Socioeconomic factors can affect unintentional home injury risks through multiple pathways, including household income, housing conditions, access to resources for injury prevention, and overall community well-being (Rajabali et al., 2019). Large cohort studies in the United Kingdom (UK) showed that the incidence of fractures, burns, and poisonings was significantly

higher among children from the most deprived households compared to the least deprived households, and these gradients persisted over time (Orton et al., 2014). Moreover, a systematic review of 24 studies found that higher socioeconomic status was consistently associated with improved non-fatal outcomes after injury, with education being the most used socioeconomic indicator (Kruithof et al., 2017). Specifically, in B.C., 84% of hospital admissions for injuries that occurred at home between 2015 and 2019 were unintentional, and these injuries were largely influenced by neighbourhood socioeconomic deprivations (Khudadad et al., 2024). In addition, people's exposure to home hazards and safety risks in B.C. is influenced by structural determinants of health, which shape the distribution of resources across the province (Raphael et al., 2020).

The built environment plays a critical role in shaping home injury risks, with architectural and infrastructural elements serving as key determinants of safety outcomes within residential settings. Studies from dense urban centres across developing countries have shown how urban design factors such as housing density, building age, and infrastructure quality contribute to home injury risks (Chan et al., 2009; Maiyapakdee et al., 2025; Soumyadeep, 2018). Using an environmental burden of disease method, it was estimated that structural housing hazards resulted in approximately 7,500 deaths and 200,000 disability-adjusted life years annually across the WHO European Region, with lack of window guards and smoke detectors being major contributors (Keall et al., 2011). A study conducted in the UK found that individuals living in homes requiring major repairs had twice the odds of experiencing an injury compared to those living in homes that did not require such repairs (Newcombe et al., 2005). These studies consistently demonstrated higher injury rates in areas characterized by older housing stock,

inadequate lighting, and poor maintenance, factors that transcend specific cultural or economic contexts.

To address this increasing trend of unintentional home injuries, numerous multi-level initiatives, including social marketing campaigns (Smith et al., 2018), injury surveillance systems (Crain et al., 2016), and the development of policy relevant indicators for evaluating interventions (Oakey et al., 2021), have been implemented in B.C. over the last two decades aimed at reducing unintentional home injuries, yet preventable injuries continue to occur, highlighting the need for sophisticated methodologies to better understand unintentional home injury risks. As such, spatial epidemiological studies have been proposed to facilitate injury prevention strategies (Vaz et al., 2021). Schuurman and colleagues (2008) emphasized the importance of considering spatial scale in injury analysis and illustrated how injury patterns can vary significantly when examined at different geographic levels.

Public health researchers use geospatial methods to link individual health data with the physical space and social community in which an individual resides to map injury locations in relation to other geographical and social attributes (Singh et al., 2016). For example, Kureshi and colleagues mapped the spatial distribution of traumatic brain injuries by major injury causes at the smallest geographical unit across the province of Nova Scotia, Canada, and identified the various pathways through which deprivation influences the risk of differing traumatic brain injury mechanisms (Kureshi et al., 2024). Similarly, studies from the US demonstrated that traumatic occupational injuries cluster spatially by home location in predictable patterns that correlate with community demographics (Forst et al., 2015). Moreover, a retrospective study of hospital records in New South Wales applied GIS mapping and Bayesian spatial statistics to identify areas with elevated risk for different types of home injuries, demonstrating how such

approaches make complex data accessible for planning targeted prevention strategies (Chong & Mitchell, 2009). Methodological advances in hotspot analysis techniques for identifying clustering of spatial phenomena have been successfully applied across multiple countries to reveal similar patterns of injury concentration in areas characterized by educational disadvantage, economic deprivation, and substandard housing conditions (Amiri et al., 2021; Habib et al., 2023; Hovenden & Liu, 2020; Mesic et al., 2024). International studies consistently demonstrate that neighbourhood-level socioeconomic characteristics operate independently of individual risk factors in determining injury mortality, establishing the theoretical foundation for ecological approaches to analyzing spatial injury patterns (Cubbin, 2000; Gotsens et al., 2013).

Despite a growing body of research on the geographic distribution of injuries, the literature on the spatial epidemiology of unintentional home injuries in B.C. is limited. Geospatial methods have been used to investigate regional differences in injury rates and identify hotspots for various types of injuries (Lawson et al., 2015). However, there has been no injury type assessment and no measurement of injury rates that integrate measures of multiple deprivations. The spatial concentration of deprivation, as measured by the Canadian Index of Multiple Deprivation (CIMD) creates neighborhood-level effects that extend beyond individual household characteristics (Statistics Canada, 2019a). Areas with concentrated deprivation may have limited community resources, reduced political influence for infrastructure improvements, and social environments that normalize risk-taking behaviors. The geographic clustering of multiple forms of deprivation creates contexts where injury prevention resources are most needed but potentially least available, while successful injury prevention models may be absent from community experience. The use of large geographic units to represent injury hotspots and their association with deprivation may be useful for identifying broader patterns but does not

provide the level of spatial resolution necessary to identify small-scale variations within neighbourhoods (Schuurman et al., 2008). However, the broad patterns identified through this approach can serve as a starting point for more targeted analyses using smaller geographic units.

Understanding the spatial patterns of unintentional home injury hospitalizations concerning neighbourhood deprivation has important implications for public health practice and policy (Vaz et al., 2021). By identifying vulnerable populations and high-risk areas, this research can help prioritize areas for further investigation and may contribute to informing future injury prevention strategies. Moreover, this research can contribute to broader discussions on health equity and the social determinants of health, highlighting the need for comprehensive approaches that address both individual and community-level factors in injury prevention. As such, this study aimed to identify the geographic hotspots of unintentional home injuries that resulted in hospitalization by dissemination area across B.C., Canada, between 2015 and 2019, and explore the relationship of hotspots with deprivation. Notably, while this study focused on unintentional home injury hospitalizations, the analysis is based on the dissemination area where the injury occurred, as the data are geocoded by the place of occurrence, specifically the home. Although this study used the patient's residential address for DA information, the injury location may be the same as the residential address, but not necessarily the patient's home. In addition, unintentional home injuries that may have occurred during the study period but for which no medical care was sought were not captured in the estimation of burden in this study.

Methods

Study area

B.C. is the westernmost province in Canada, located on the Pacific Coast. It covers a total area of 944,735 km² and had a population of 5,722,318 as of January 1, 2025 (BC Stats,

2025). The province's largest city, Vancouver, has a population of 678,984 in 2024, while the Metro Vancouver area is home to approximately 2.48 million people, representing about 44% of the province's total population. In our study, we used Statistics Canada's Index of Remoteness (IOR) to classify communities in B.C. based on their level of remoteness (Subedi et al., 2020). This classification is based on a combination of population size and estimated travel time to the nearest service centre that meets specific population thresholds. The IOR was primarily used to provide contextual background in the discussion, rather than as a central variable in the main analysis.

Data sources and characteristics

The data for this study were obtained by the B.C. Injury Research and Prevention Unit, based on reported incidents through the Discharge Abstract Database (DAD), maintained by the B.C. Ministry of Health (Canadian Institute for Health Information n.d.). The dataset comprised de-identified hospitalization records for all separations from a hospital following a home injury for the years 2015 through 2019, inclusive. This study included only the primary cause of admission (i.e., the most responsible diagnosis coded in the DAD) to identify unintentional home injury hospitalizations. The dataset included administrative, sociodemographic, and diagnostic variables. The sociodemographic variables were sex, age, and residential dissemination area (DA). The diagnostic variables included external causes of injury (e.g., falls, drowning, or burns) classified according to the *International Statistical Classification of Diseases and Related Health Problems, Canadian version 10 (ICD-10-CA)* (Canadian Institute for Health Information, 2022). ICD-10 CA codes associated with unintentional home injury and DAs associated with B.C. were retained for the purpose of this analysis (Appendix A). It is important to note that DAD includes about 75% of all hospital discharges in Canada and collects data mainly from acute care, chronic

care, rehabilitation, and same-day surgeries (Julie Richards, Ann Brown, Craig Homan, 2002). While core clinical data such as diagnoses and procedures are usually reliable, there remain discrepancies attributed to errors in medical chart documentation, coding practices, and abstraction processes.

In Canada, a Dissemination Area (DA) is the smallest standard geographic area for which all census data are disseminated by Statistics Canada. DAs generally have a population of between 400 and 700 persons, with an average of about 500 people. Based on the 2016 census geography, there are 7,848 DAs in B.C., with an average geographic area of approximately 120.3 km² (Statistics Canada, 2017). However, in rural and remote parts of BC, some DAs may span several hundred square kilometres due to low population density, whereas in urban centres, a DA might be well below 1km². Similarly, based on the 2016 Canadian census, B.C. comprises 751 census subdivisions (CSDs). On average, each CSD covers a geographic area of approximately 3,149 km² and has an average population of 15,875 residents (Statistics Canada, 2017). DAs are designed to remain consistent over time, allowing for comparisons between censuses and analyses of demographic changes. Scholars have used DAs widely in spatial and socioeconomic studies in Canada (Singh et al., 2016) as DAs provide a fine geographic scale for analyzing local patterns and variations that may be obscured at larger geographic levels. In contrast, CSDs serve as fundamental units for disseminating demographic, social, and economic data collected by Statistics Canada and their boundaries are specifically designed to align closely with actual municipal limits or their recognized equivalents across Canada. The population data for each DA and CSD were obtained from Statistics Canada's 2016 Census Profiles (Statistics Canada, 2016). The cartographic boundary data were obtained from Statistics Canada (2021), which depicts the extent of the geographic areas across Canada (Statistics Canada, 2021). Notably, some spatial

areas within our study region may not contain any resident population due to uninhabited status or other factors. Consequently, these areas will lack analytical units for analysis, resulting in their exclusion from calculations involving population-based rates and spatial statistics.

Socioeconomic factors and unintentional home injury rates

While the injury data were originally available at the DA level and could be linked with the Canadian Index of Multiple Deprivation (CIMD) dimension scores for use as independent variables in regression models, this approach led to multicollinearity issues. To address this issue and improve the stability and interpretability of our regression analysis, we aggregated injury counts to the census subdivision (CSD) level and merged these with CSD-level social profile data for B.C. (2016 census), including family structure, household income, age and sex, education, and built environment factors (Statistics Canada, 2019b). This approach allowed for the assessment of injury patterns in relation to broader socio-demographic characteristics, while mitigating the impact of multicollinearity among deprivation dimensions. The CIMD for B.C. is a provincial-level index that measures four distinct dimensions of deprivation and marginalization at the DA level using population census data from 2016 (Statistics Canada, 2019c). Each CIMD domain represents a dimension of deprivation or marginalization that operates at the neighbourhood or household level. These factors often act independently of individual characteristics and can influence the presence of home hazards, the adoption of safety practices, and the capacity to prevent or reduce injury risk. The dimensions are 1) ethnocultural composition, which represents the proportion of recent immigrants, visible minorities, and individuals with limited knowledge of official languages, 2) situational vulnerability encompasses factors that increase vulnerability due to social or demographic circumstances, such as low educational attainment, single parenthood, or disability, 3) economic dependency reflects

reliance on income sources other than employment, indicating areas with higher proportions of individuals not engaged in the workforce or dependent on government transfers and benefits, and 4) residential instability captures housing and family-related characteristics that reflect the likelihood of population mobility or fluctuating residence patterns, such as the proportion of people who have moved recently, proportion living alone, and prevalence of rental housing. The indicators in each dimension are aggregated and combined through factor analysis and standardized to quintiles (1=least deprived, 5=most deprived) (Statistics Canada, 2019c).

Injury rate calculation

Unintentional home injury counts were first merged at the DA level and then aggregated to the CSD level to align with population data. This aggregation involved consolidating unintentional home injury data from 6,889 dissemination areas into 428 census subdivisions, representing a median merger of 5 DAs per CSD. Crude injury rates per 1,000 population were calculated for each CSD using population-weighted counts. To enable comparability across regions with differing age structures, age-adjusted injury rates were also calculated. Age standardization was performed using the World Health Organization's (WHO) standard population as the reference (Omar et al., 2001). Notably, aggregating DAs into CSDs reduced the coefficient of variation in age-standardized unintentional home injury rates from 3.32 per 1000 population at the DA level to 1.36 per 1000 population at the CSD level, reflecting an approximate 59% reduction in small-area variability. This substantial reduction in observed variation represents an inherent methodological trade-off. While aggregation mitigated severe multicollinearity observed at the DA level, it inevitably reduced spatial resolution and obscured within-CSD heterogeneity. The CSD-level analysis therefore captures broader geographic patterns rather than hyper-local concentrations of unintentional home injury risks.

Statistical analysis

Data processing and analysis were conducted in the ArcGIS Pro version 3.3 (ESRI, 2024). To identify the key sociodemographic predictors of age-standardized home injury rates across census subdivisions (CSDs) in B.C., we carried out an exploratory regression analysis. This process involved systematically evaluating various combinations of candidate explanatory variables to determine both their individual and combined effects on the spatial variability of injury rates. The outcome variable was the age-standardized home injury rate per 100,000 population. Candidate predictors were selected from a wide range of census-derived indicators that reflect population structure, socioeconomic conditions, housing features, and patterns of recent immigration. Each regression model was evaluated using several diagnostic criteria: Akaike's Information Criterion corrected (AICc), Variance Inflation Factor (VIF) to assess multicollinearity, and Koenker's BP statistic to check for heteroskedasticity. We retained variables for further modelling if they showed statistical significance ($p < 0.05$) and low multicollinearity ($VIF < 7.5$).

The final model was specified in a global regression framework as:

$$y_i = \beta_0 + \sum_{k=1}^p \beta_k x_{ik} + \varepsilon_i$$

where y_i is the age-standardized home injury rate for CSD i , x_{ik} represents predictor k , and ε_i is the error term.

To account for spatial non-stationarity, we then applied Geographically Weighted Regression (GWR), which is a spatial statistical technique that extends traditional regression analysis by allowing relationships between variables to vary across geographic space, instead of

assuming they are constant everywhere (Warf, 2010). The GWR model was expressed as the following:

$$y_i = \beta_0(u_i, v_i) + \sum_{k=1}^p \beta_k(u_i, v_i)x_{ik} + \varepsilon_i$$

where (u_i, v_i) are the centroid coordinates of each CSD, and $\beta_k(u_i, v_i)$ are location-specific estimates. An adaptive kernel with bandwidth selected via corrected AIC was used for parameter estimation. To assess the local fit of the GWR model, standardized residuals were derived for each CSD. These residuals represent the difference between observed and predicted values of age-adjusted unintentional home injury hospitalization rates, scaled by the model's standard error. The resulting values were categorized into standard deviation ranges and mapped to visualize areas where the model significantly overestimated or underestimated injury rates. The methodological workflow is presented in Appendix B.

Model validation and robustness check

To evaluate the robustness of the GWR model and address concerns of potential overfitting, we performed several diagnostic checks. First, we applied leave-one-out cross-validation to assess predictive accuracy. The cross-validation statistic provides an estimate of the mean squared prediction error across all local regressions (Bates et al., 2024). Second, we compared the performance of GWR with global spatial econometric models, including spatial lag and spatial error specifications, estimated using maximum likelihood procedures. For each model, we report adjusted R^2 , AIC, and Moran's I of residuals. Finally, we tested residuals from all models for spatial autocorrelation using the global Moran's I statistic to ensure that model assumptions were met. Residual autocorrelation in the OLS model was non-significant ($p = 0.083$), indicating that the included predictors had captured much of the spatial structure in

unintentional home-injury rates. However, significant Koenker (BP) and Jarque–Bera statistics demonstrated spatial non-stationarity in the relationships between predictors and the outcome, thereby motivating the use of GWR. The spatial error model accounted for remaining spatial dependence through the autoregressive parameter ($\lambda = 0.42$, $p < 0.01$) but assumed constant coefficients across space. In contrast, GWR allowed coefficients to vary geographically and eliminated residual spatial autocorrelation, as shown by the non-significant Moran's I ($I = -0.0719$, $p = 0.093$). The dramatic improvement in AICc, over 1,400 points relative to the spatial error model and more than 2,400 points relative to OLS, indicated that GWR captured genuine spatial non-stationarity in the determinants of unintentional home-injury rates rather than overfitting the data. A full comparison of OLS, spatial error, and GWR results is provided in Appendix C.

Spatial autocorrelation and hotspot analysis

Spatial autocorrelation is a statistical concept that measures the degree to which a variable is correlated with itself across geographic space. It is based on the principle that observations geographically closer to each other tend to be more similar than those farther apart, which is often summarized by Tobler's first law of geography: "everything is related to everything else, but near things are more related than distant things" (16, p. 236). Global Moran's I was used to assess overall spatial autocorrelation of unintentional home injury hospitalizations across B.C. However, to assess the local spatial autocorrelation of age-standardized unintentional home injury hospitalization rates across census subdivisions (CSDs) in BC, we employed Anselin Local Moran's I statistic. The mathematical and statistical calculations of Anselin Local Moran's I are explained elsewhere (Anselin, 1995). This method identifies specific locations where significant spatial clustering or spatial outliers exist, offering a

localized view of spatial patterns that may be masked in global analyses. The null hypothesis assumes no spatial association in injury rates at the local level, indicating complete spatial randomness. A significant positive local Moran's I value indicates that a CSD has a similar value to its neighbours (i.e., high-high or low-low clusters), while a significant negative value suggests the presence of spatial outliers, where a high-value area is surrounded by low values (high-low), or vice versa (low-high). This local approach provided important insights into the geographic variability of injury risk across the province. To evaluate the robustness of local spatial autocorrelation results, we employed multiple spatial weight matrix definitions in the Local Moran's I analysis. Specifically, we defined spatial relationships using (1) first-order contiguity based on shared edges only (rook contiguity) and (2) K-nearest neighbour weights, where each unit was linked to its k closest neighbours based on centroid-to-centroid distance. Given the absence of a theoretical basis to define "neighbourhood" size, a separate sensitivity analysis was conducted (see Appendix D), where values of k from 2 to 10 were tested. The value of k associated with the highest Moran's I was selected, representing the strongest spatial autocorrelation (Bertazzon & Olson, 2009). These alternative spatial conceptualizations allowed us to assess the sensitivity of detected clustering patterns to the choice of spatial weight structure. The consistency of significant clusters across both methods supports the stability of the observed spatial patterns of unintentional home injury rates.

Results

Table 1 summarizes the characteristics of unintentional home injury hospitalizations in B.C. between 2015 and 2019 (N = 63,172). The number of annual hospitalizations remained relatively stable across the five years, ranging from 12,251 (19.39%) in 2018 to 13,274 (21.01%) in 2016. Females accounted for a higher proportion of hospitalizations (60.13%) compared to

males (39.87%). Older adults represented most cases, with 45.06% of all hospitalizations occurring among individuals aged 85 years and older, followed by those aged 70–79 (20.11%). Children and youth (ages 0–19) comprised less than 5% of the total. The average length of stay was 147 days (SD = 113.96). Falls were the most common cause of unintentional home injuries, accounting for 82.41% of hospitalizations, followed by poisoning (7.22%) and other causes (10.37%). Deaths were reported in 4.75% of all cases. On average, each CSD had 146 injuries (SD = 469.47). A greater proportion of hospitalizations occurred in neighbourhoods with the highest levels of residential instability (29%), economic dependency (32%), and situational vulnerability (21%). In contrast, the distribution of injuries across ethnocultural composition appeared more even, with fewer cases concentrated in the most ethnoculturally diverse areas (14.5%). On average, there were 163 children aged 0–5 years per CSD (SD = 425.8), and families had an average of 1.53 children (SD = 0.50). The average age of the population across CSDs was 43.8 years (SD = 7.87). Educational attainment varied, with a mean of 261 individuals (SD = 375) per CSD aged 15-years and over having no certificate, diploma, or degree. Median household income after taxes was \$41,784 (SD = \$6,867.56). The average age of the population across CSDs was 43.8 years (SD = 7.87). Regarding educational attainment, approximately 261 individuals per CSD aged 15 and older had no certificate, diploma, or degree (SD = 375). The median household income after taxes was \$41,784 (SD = \$6,867.56). On average, across CSDs, there were 366 single-detached dwellings (SD = 229) and 3,339 apartment units in buildings with five or more storeys (SD = 9,820).

Table 1: Sociodemographic characteristics of unintentional home injury hospitalizations in B.C., 2015–2019

Variable	Category	N (%)
Calendar Year	2015	12872 (20.38)
	2016	13274 (21.01)

	2017	12286 (19.45)
	2018	12251 (19.39)
	2019	12489 (19.77)
Sex	Male	25184 (39.87)
	Female	37988 (60.13)
Age Group (years)	0-9	2232 (3.53)
	10-19	837 (1.33)
	20-29	1333 (2.11)
	30-39	1685 (2.67)
	40-49	2316 (3.66)
	50-59	4865 (7.69)
	60-69	8729 (13.81)
	70-79	12708 (20.11)
	80 and above	28467 (45.06)
Average length of hospital stays (SD)		147 (113.96)
Cause of Injury	Falls	52063 (82.41)
	Burns	781 (1.24)
	Poisoning	4559 (7.22)
	Struck by/Against	824 (1.3)
	Other injuries	4945 (10.37)
Death		3000 (4.75)
Average Injury per CSD (SD)		146 (469.47)
CIMD Dimensions		
Residential Instability	Quintile 1	8,244 (13.1)
	Quintile 5	18,342 (29)
Economic Dependency	Quintile 1	8,819 (14)
	Quintile 5	20,234 (32)

Situational vulnerability	Quintile 1	12,312 (19.5)
	Quintile 5	13,268 (21)
Ethnocultural Composition	Quintile 1	11,406 (18.1)
	Quintile 5	9,149 (14.5)
Characteristics of CSDs *		Mean (SD)
	Average age of the population (years)	43.8 (7.87)
	Population aged 15+ with no certificate, diploma or degree	261 (375)
	Household income in 2015 after taxes (Canadian Dollars)	41784 (6867.56)
	Private dwellings in single-detached houses	366 (229)
	Private dwellings in apartments (5+ storeys)	3339 (9820)
	Private dwellings in apartments (<5 storeys)	899 (5261)
	Number of recent immigrants	4 (22.24)

CIMD = Canadian Index of Multiple Deprivation; LOS = Length of Stay; CSD = Census Subdivision; DA = Dissemination Area; SD = Standard Deviation.

Quintile 1 represents the least deprived, and Quintile 5 the most deprived neighbourhoods across each CIMD dimension.

*All averages presented for housing characteristics reflect values calculated at the CD level.

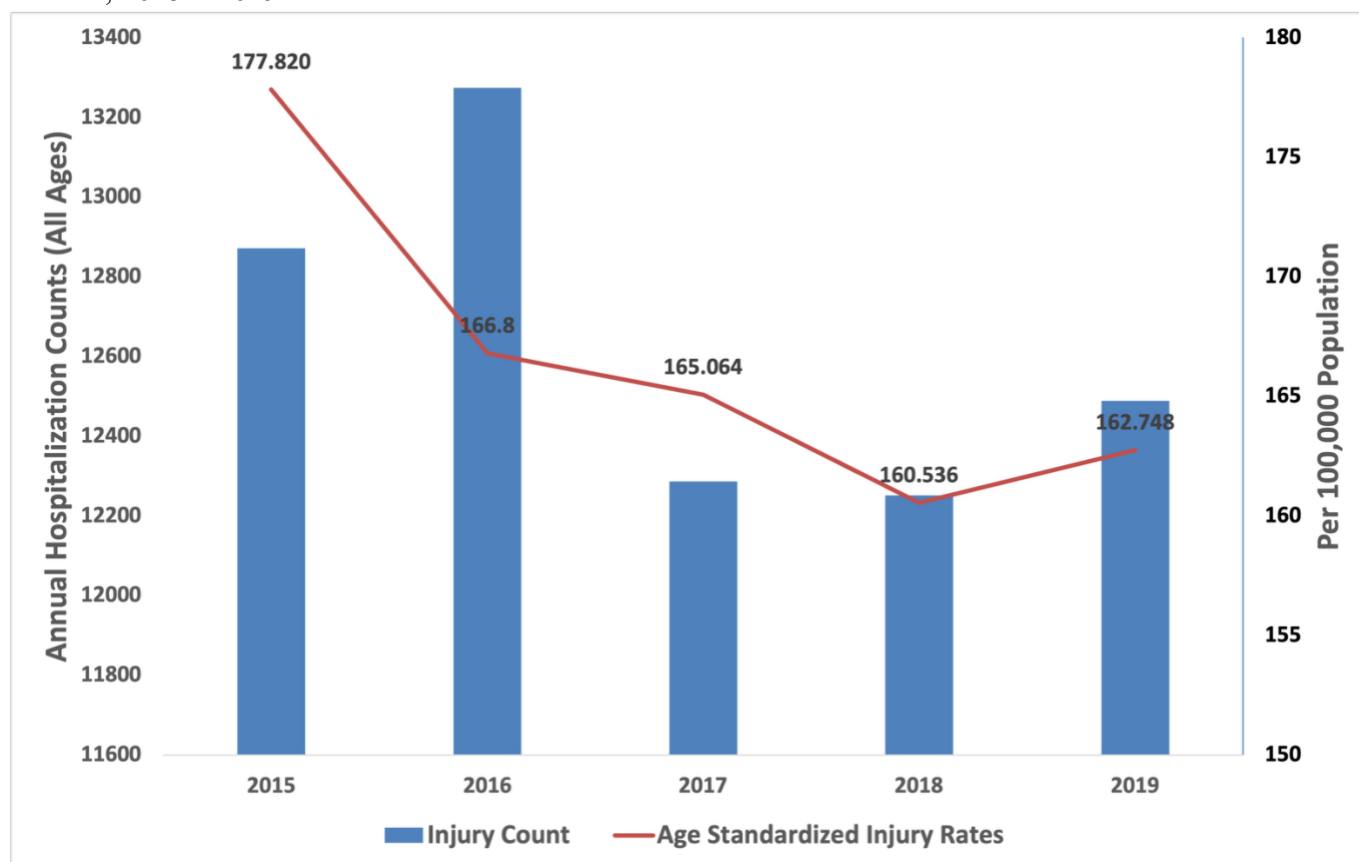
Values represent the mean (standard deviation) across CSDs.

** For the 2016 Census, recent immigrants are those who landed in Canada between January 1, 2011, and May 10, 2016.

Figure 1 illustrates the annual number of unintentional home injury hospitalizations alongside the corresponding age-standardized rates per 100,000 population in B.C. from 2015 to 2019. While the absolute number of hospitalizations fluctuated over the five years, ranging from 12,251 in 2018 to a peak of 13,274 in 2016, the age-standardized rates remained relatively stable. The age-standardized injury rate was 177.82.6 per 100,000 in 2015, increased slightly in 2016 to 46, and then declined over the next two years, reaching a low of 160.53 in 2018. In 2019, the rate

increased modestly to 162.74 per 100,000. These trends suggest that, despite year-to-year variations in crude hospitalization counts, the burden of unintentional home injuries remained relatively constant when accounting for differences in population age structure over time.

Figure 1. Trends in age-standardized rate of unintentional home injury hospitalizations, BC, Canada, 2015 – 2019

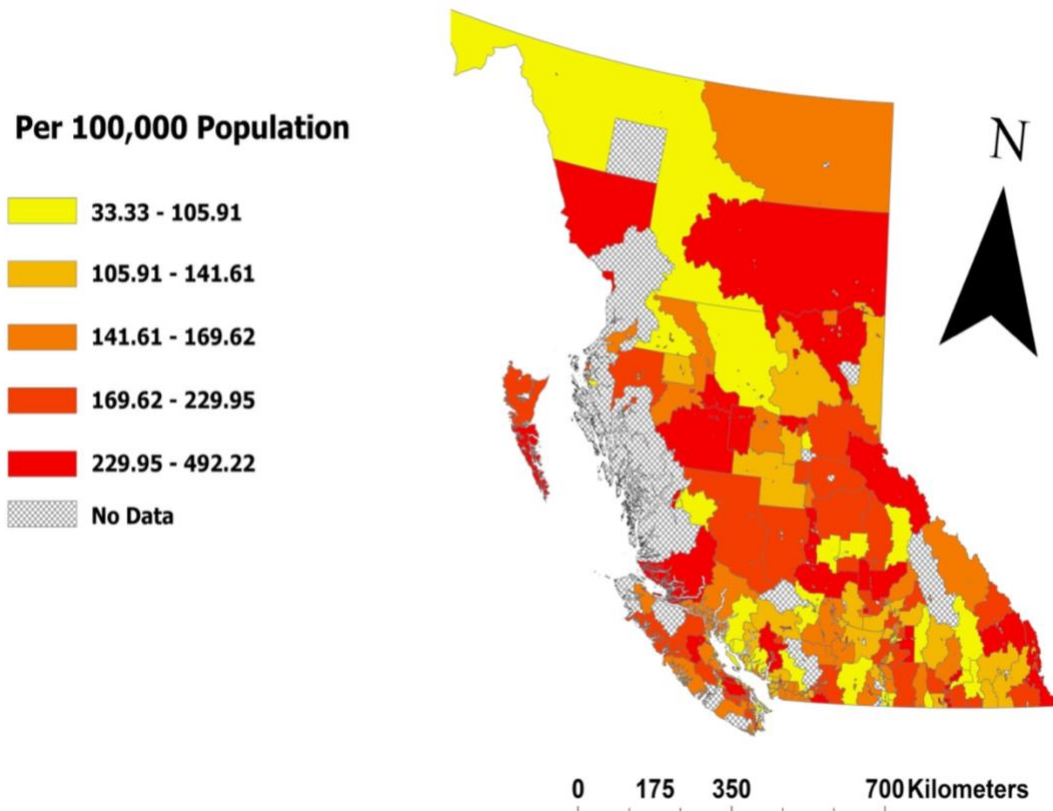


Note: Columns are case counts, while the line graph represents age-standardized rates per 100,000 population.

Figure 2 represents a thematic map illustrating the geographic distribution of age-standardized unintentional home injury hospitalization rate across CSDs in B.C. The rates ranged from 33.33 to 492.22 per 100,000 population. Distinct geographic patterns were evident, with the highest injury rates (229.95-492.22 per 100,000) concentrated in parts of the northern and interior B.C., as well as several rural areas of Vancouver Island and southeastern regions. In

contrast, the lower rates (33.33 – 141.61 per 100,000) were more prominent in certain urban centres with the Lower Mainland and isolated norther parts of the B.C.

Figure 2. Spatial distribution of age-standardized unintentional home injury hospitalization rates, B.C., 2015 – 2019



Map created using ArcGIS Pro 3.3 (Esri, Redlands, CA, USA; <https://www.esri.com/en-us/arcgis/products/arcgis-pro>).

Global and local Moran's I analysis

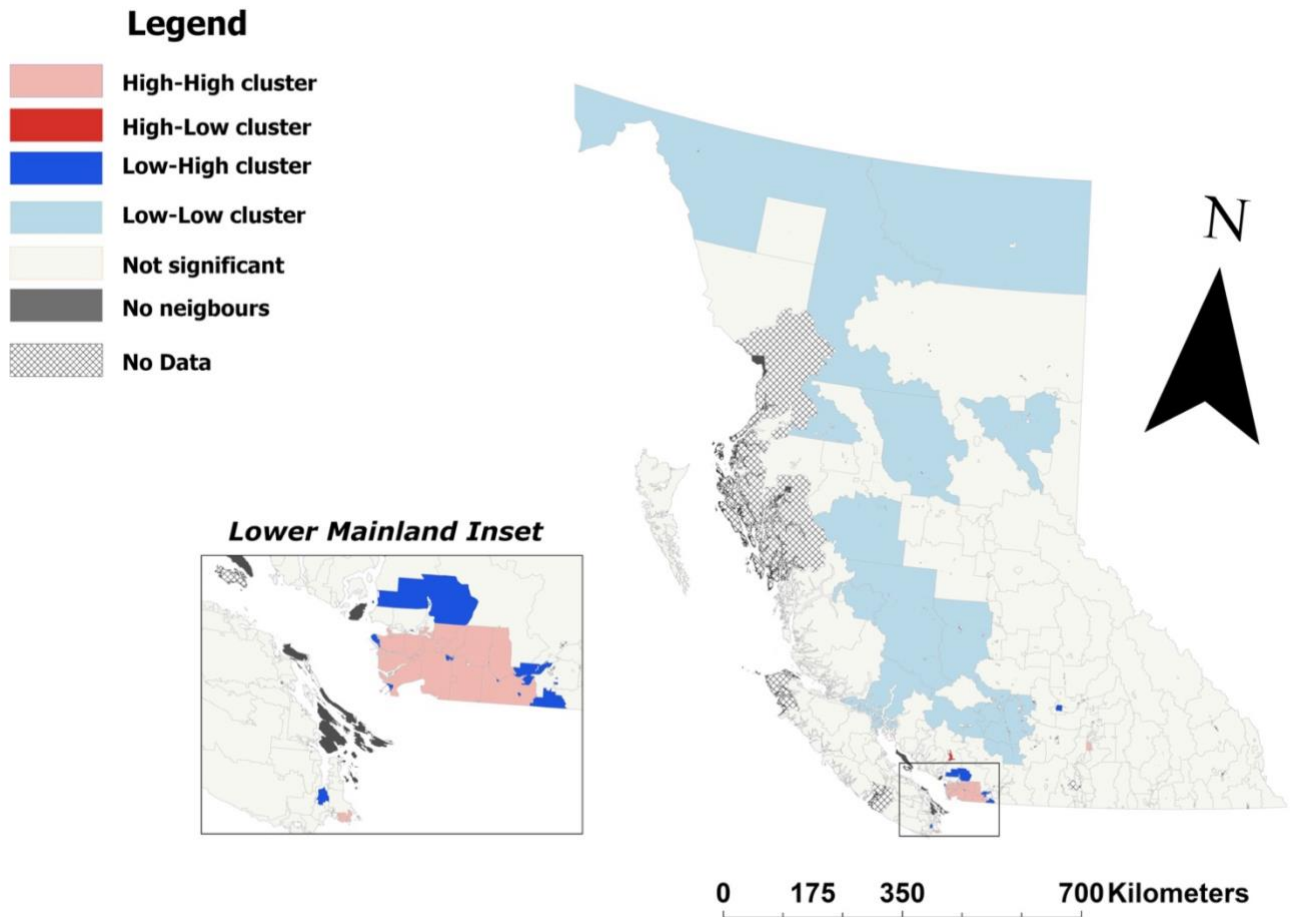
Global spatial autocorrelation analysis showed a statistically significant clustering of unintentional home injuries in B.C. (Moran's $I = 0.05$, $z = 38.53$, $p < 0.001$), indicating that high-rate areas were located near other high-rate areas. This non-random pattern justified further local exploration. Anselin local Moran's I analysis showed statistically significant local spatial autocorrelation in age-adjusted unintentional home injury hospitalization rates across CSDs in B.C. (Figure 3). High-high clusters, which are areas with elevated injury rates surrounded by

similarly high-rate neighbours, were primarily located in the Lower Mainland region. In contrast, low-low clusters, where lower injury rates were surrounded by similarly low-rate neighbours, were widespread across northern and interior regions of the B.C. Additionally, several spatial outliers were detected in the analysis. High-low clusters (areas with elevated injury rates surrounded by lower-rate neighbours) appeared in certain southern regions of B.C., whereas low-high clusters, where lower rates were bordered by higher-rate areas, were mainly concentrated within parts of Greater Vancouver.

Exploratory Regression

Five exploratory regression models were assessed to identify variables associated with age-adjusted unintentional home injury hospitalization rates across B.C. (Table 2). Although Model 1 showed the best model fit based on the lowest corrected Akaike Information Criterion ($AIC_c = 2074.71$), it also exhibited high multicollinearity ($\text{Max VIF} = 12.13$), which may affect the reliability of its coefficient estimates. Model 5, while presenting a slightly higher AIC_c (2091.22), demonstrated the most stable model with a substantially lower maximum VIF (1.19), indicating minimal multicollinearity. It included three theoretically relevant and interpretable predictors: percentage of the population with no formal education, median after-tax income, and percentage of low-rise apartment dwellings. Given its low multicollinearity and statistically significant Koenker (BP) p-value ($p < 0.001$), Model 5 was selected for further analysis using GWR to account for spatial non-stationarity in the relationships between predictors and age-standardized unintentional home injury rates.

Figure 3. Local spatial clusters and outliers of age-adjusted unintentional home injury hospitalization rates across CSDs in BC, 2015-2019



Map created using ArcGIS Pro 3.3 (Esri, Redlands, CA, USA; <https://www.esri.com/en-us/arcgis/products/arcgis-pro>).

Table 2. Exploratory regression models evaluating predictors of age-standardized injury rates across CSDs in B.C., 2015-2019

Model No.	Model Variables	AICc	Koenker (BP) p-value	Max VIF
1	Land_Area_km2 + Pct_No_Education, + Pct_Female_Pop + Median_AfterTax_Income + Pct_LowRise_Apts + Rec_Immigrant	2074.71	0.000	12.13
2	Pct_No_Education, + Pct_Female_Pop + Median_AfterTax_Income + Pct_LowRise_Apts	2077.20	0.000	12.05
3	Pct_No_Education + Pct_Male_Pop + Pct_LowRise_Apts	2078.12	0.000	12.05

Model No.	Model Variables	AICc	Koenker (BP) p-value	Max VIF
4	Pct_No_Education,+ Pct_Male_Pop + Pct_LowRise_Apts + Rec_Immigrant	2079.91	0.000	13.80
5	Pct_No_Education + Pct_LowRise_Apts + Median_AfterTax_Income	2091.22	0.000	1.19

AICc: Corrected Akaike Information Criterion; Max VIF: Maximum Variance Inflation Factor

Geographically Weighted Regression

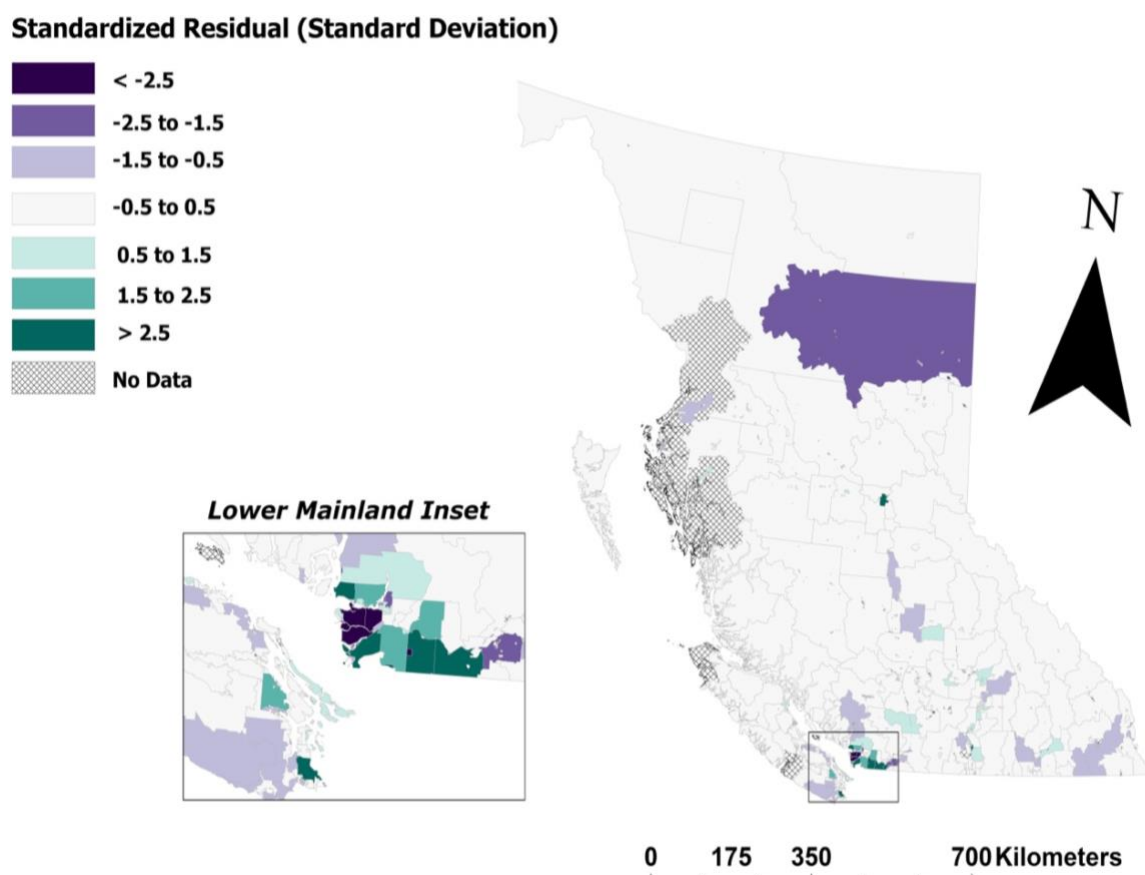
The GWR model examining age-standardized unintentional home injury hospitalization rates across 428 CSDs in B.C. demonstrated strong explanatory power, with an adjusted R^2 of 0.7758 (Table 3). This indicates that approximately 77% of the variation in unintentional home injury rates across CSDs was explained by three sociodemographic predictors. The proportion of the population aged 15-years and older without a certificate, diploma, or degree was most strongly associated with injury rates, with a rate ratio of 1.079 (95% CI: 1.074–1.085). This indicates that for every 1% increase in the population without formal education, the unintentional home injury hospitalization rate increased by approximately 7.9%, holding other variables constant. For every \$1,000 increase in median household after-tax income, the injury hospitalization rate decreases by 1.5% (rate ratio = 0.985; 95% CI: 0.978 – 0.992). Similarly, for every 100-unit increase in low-rise apartment dwellings, unintentional home injury hospitalization rates increase by 8% (rate ratio = 1.08; 95% CI: 1.02 – 1.14), indicating a positive relationship between apartment density and unintentional home injury risk. Figure 4 displays the spatial distribution of standardized residuals from the GWR model examining age-adjusted unintentional home injury hospitalization rates across census CSDs in B.C. Most areas exhibited residuals between -1.5 and +1.5 standard deviations, suggesting a reasonably good model fit across much of the province. However, some localized areas, particularly within the Lower

Mainland, central Vancouver Island, and parts of northern B.C., showed larger residuals, exceeding ± 2.5 standard deviations. These areas indicated where the model either underpredicted (positive residuals) or overpredicted (negative residuals) the observed injury rates.

Table 3. GWR model for age-standardized unintentional home injury rates by census subdivisions in BC, 2015-2019 (N=428)

Dependent Variable	Explanatory Variables	Rate Ratio (95% CI)	R²	Adjusted R²	Critical t-value
Age-standardized unintentional home injury rate	Population aged 15+ with no certificate, diploma or degree	1.079 (1.074 – 1.085)	0.7774	0.7758	2.52
	Household after-tax income (in \$1,000s)	0.985 (0.978 – 0.992)			
	Number of private dwellings in apartments <5 storeys (per 100 units)	1.08 (1.02 – 1.14)			

Fig 4. Standardized Residuals from GWR Model of Home Injury Hospitalizations (B.C., 2015–2019).



Note: Residuals represent the difference between observed and GWR-predicted rates, standardized by the local standard error.

Map created using ArcGIS Pro 3.3 (Esri, Redlands, CA, USA; <https://www.esri.com/en-us/arcgis/products/arcgis-pro>).

Discussion

This study identified significant spatial clustering of unintentional home injuries leading to hospitalizations in B.C., indicating that areas with high injury rates tend to be geographically proximal to other high-rate areas. The hotspots of unintentional home injuries were mainly located in urban areas of B.C., particularly in the Lower Mainland and the southern part of Vancouver Island. Most unintentional home injuries are strongly predicted by key sociodemographic factors, including the proportion of the population aged 15 and older without formal educational credentials, household after-tax income levels, and the prevalence of private

dwelling in low-rise apartments (fewer than five storeys). These findings highlight that urban environments may present unique risk factors for unintentional home injuries.

The concentration of unintentional home injury hotspots in B.C.'s accessible areas (Appendix E), particularly across the Metro Vancouver region and on southern Vancouver Island, reflects the complex interplay between population density and injury risk factors. Although most unintentional home injuries in our study occurred in urban areas, previous research has shown that injury rates increase along the rural-urban continuum, with higher rates in more rural areas, where frequent exposure to farming equipment and heavy machinery increases the risk of severe crush injuries, which are primarily classified as occupational rather than home injuries (Bang et al., 2019). The clustering of unintentional home injury hospitalizations in urban areas of BC aligns with Toronto findings that documented urban neighbourhood-level spatial patterns of injury (Vaz et al., 2021b). Moreover, the concentration of unintentional home injury hospitalizations in urban areas is consistent with patterns observed in residential fire data across four provinces in Canada, where overall casualty numbers were higher in urban centres than in rural areas (Beaulieu et al., 2020). Notably, urban environments in Canada may present unique hazards including complex housing structures, older housing stock, and the higher prevalence of older adults living alone, which together may elevate the risk of unintentional home injuries (Dal Bello-Haas et al., 2024; Fallon et al., 2002; McCormack et al., 2019; Pirrie et al., 2020). However, in the Nordic countries, research has showed that, with the exception of Denmark, higher population density is associated with lower mortality rates, including deaths linked to home-related injuries (Bremberg, 2020). In addition, two decades of surveillance data from Sweden showed that residential fire clusters were more often concentrated in rural communities than urban centres (Jonsson et al., 2022). Similarly, in the US, residential

fire death rates are substantially higher in rural areas than in urban ones (Peek-Asa et al., 2004). This disparity reflects both structural risk factors, such as older housing and reliance on heating sources, and systemic challenges, including lower prevalence of functional smoke detectors and longer emergency response times (Liao et al., 2024a). As such, the spatial distribution of home injury risk may vary significantly across contexts, underscoring the importance of place-based vulnerabilities.

The association between low-rise apartment dwellings and increased risk of unintentional home injuries emerged as one of the more complex and noteworthy findings of this study. Unlike single-family homes or high-rise buildings, low-rise apartments occupy a distinct space within the housing landscape. They are often subject to different regulatory standards, inhabited by diverse demographic groups, and characterized by structural features that may, in combination, contribute to higher injury risk (Andrews et al., 2024; Campani et al., 2021a; Keall et al., 2015; Shenassa et al., 2004). Our study findings are consistent with those reported in the National Health and Aging Trends Study (NHATS) of 8,077 participants, which reported a higher prevalence of falls and fear of falling among older adults living in single-storey dwellings compared to those living in multi-storey buildings (Tsai et al., 2021). Similarly, in a retrospective population-based cohort study of 112,248 residents in the Neath-Port Talbot County area of Wales, UK, individuals living in purpose-built apartment buildings experienced significantly higher rates of home injuries, with more than twice the overall injury risk and over five times the risk of poisoning compared to those in other housing types (Lyons et al., 2006). Moreover, in a sample of 102 houses in Wellington, New Zealand, each additional injury hazard identified in the home was associated with a 22% increase in the odds of an injury occurring within the home environment (Keall et al., 2008). Future research should aim to disentangle the specific

environmental, regulatory, and sociodemographic contributors to injury risk in low-rise apartments and assess the effectiveness of targeted interventions tailored to these settings.

Our findings also suggest spatial associations between socioeconomic deprivation and unintentional home injury rates that merit further investigation to understand potential causal mechanisms (Gadermann et al., 2020; Liao et al., 2024b; Zandy et al., 2019). Within the framework of social determinants of health, socioeconomic deprivation acts as a key structural determinant that shapes intermediary factors such as living conditions, psychosocial stressors, and access to health and community resources (Braveman et al., 2011). The association of lower educational attainment with higher risk of home injuries found in our study aligns with evidence showing that limited knowledge of household safety and reduced risk perception contribute to increased hazards such as burns, falls, and poisonings, particularly among children (Kendrick et al., 2012; Schilling et al., 2020). The spatial concentration of low-income areas may create compounding effects where individual financial constraints are reinforced by limited community resources and infrastructure. As such, policies aimed at improving economic conditions, housing stability, and community support systems in vulnerable neighbourhoods may have significant potential to reduce unintentional home injuries (Moore et al., 2019) and subsequent hospitalizations. Public health initiatives could focus on communities with high levels of economic dependency and residential instability, implementing injury prevention programs that address both immediate injury risks and underlying socioeconomic factors (O'Mara-Eves et al., 2015). Future injury prevention programs should adopt an intersectional approach, considering how various socioeconomic factors interact to create unique risk profiles for different population subgroups. Furthermore, our findings emphasize the importance of longitudinal studies to better

understand how changes in economic stability and housing security affect unintentional home injury rates over extended periods.

The observed associations of low-rise apartments, educational attainment, and household income with unintentional home injury hospitalizations in this study underscore the critical need to move beyond individual behaviour change and address the broader socioeconomic factors and built environment factors that shape home injury patterns, rather than relying one-size-fit-all approach (Cubbin, C., LeClere, F., & Smith, G., 2000; Sleet et al., 2011). Effective home injury prevention requires a multifaceted approach that combines policy and legal measures, environmental and engineering improvements, clinical and educational interventions, and efforts to address underlying social and economic conditions (Mack et al., 2015). Given that falls among older adults were a leading cause of unintentional home injury hospitalizations in our study, evidence shows they can be effectively prevented through structural home modifications such as installing handrails, grab bars, and improved lighting, combined with multifaceted community-based fall prevention programs (Campani et al., 2021b; Keall et al., 2015). A recent systems-based study from Singapore demonstrated that effective and sustainable implementation of community-based falls prevention programs for older adults relies on coordinated resource allocation, structured referral pathways, and strategies to enhance participant motivation and social support, highlighting the need for integrated policy frameworks and cross-sectoral collaboration to maximize program impact (Koh et al., 2025). In addition, evidence from prior reviews has highlighted that addressing structural deficiencies such as ensuring installed, functioning smoke alarms, 4-sided pool fencing, and preset safe hot water temperatures can significantly reduce home injury risks (DiGuseppi et al., 2010). However, while most countries have legislation mandating residential smoke (Diguseppi, 1999), enforcement remains

inconsistent (Harvey et al., 2013), and community-based fire safety initiatives such as *HomeSafe* in Canada have proven effective in bridging this gap (Al-Hajj et al., 2023). In addition, evidence from New Zealand shows that implementing and enforcing housing standards, such as a *Housing Warrant of Fitness*, can reduce unintentional injuries and improve health by ensuring minimum safety and maintenance standards in residential properties (Telfar-Barnard et al., 2017, 2019). As such, a multisectoral approach that integrates public health goals with urban planning policies is essential for home safety, shifting responsibility from individual to a shared societal priority embedded within the very fabric of community development.

While the GWR model in our study demonstrated strong explanatory power of the selected sociodemographic variables, these should be interpreted with caution. Although education, income, and housing type were statistically significant predictors in many areas, they may be serving as proxies for other relevant factors that could not be retained in the final model due to multicollinearity (P. Vatcheva & Lee, 2016). Several potentially important predictors, such as building age, overcrowding, and housing condition, were initially considered but were excluded during model refinement because of high VIF, indicating substantial overlap with other variables. As a result, while these dimensions were not explicitly included in the final model, their effects may still be indirectly captured by the retained predictors. For instance, the proportion of low-rise apartment dwellings may correlate with older building stock or limited safety infrastructure, while lower education levels may reflect broader challenges in health literacy or safety awareness. This highlights the complexity of modelling social and built environment determinants of injury and the methodological trade-offs involved in variable selection (Phelos et al., 2022).

Moreover, the strong fit observed in the GWR analysis may suggest an implausibly high degree of explanatory power, and we caution against interpreting it as definitive evidence of predictive certainty. Instead, this value should be understood as reflecting the localized explanatory power of sociodemographic structures in relation to unintentional home injury hospitalizations in BC. Substantially large measures of model fit are frequently observed in GWR applications, where incorporating spatial heterogeneity typically yields stronger performance than global models (Lessani & Li, 2024). Accordingly, the value of our findings lies less in the overall model fit and more in the spatial patterns it uncovers, wherein education, income, and housing type emerge as key markers of unintentional home injury risks in BC. By situating our interpretation within this broader understanding, we emphasize that the insights should be read as directional evidence of structural inequalities in the built and social environment rather than precise point estimates. In addition, The GWR analysis demonstrated little local variation in some rural and remote areas across BC. This underscores that in demographically homogenous communities, structural factors such as educational attainment or housing type may not vary enough to explain differences in injury risk. Instead, unmeasured influences such as access to health services, distance to emergency care, or local cultural practices might be more salient factors shaping health outcomes (Beck et al., 2022). Future research should explore alternative modelling strategies, such as penalized regression or structural equation modelling, to better account for interrelated factors without inflating standard errors or compromising interpretability (Jing & Ali Salman, 2025).

In spatial epidemiological analyses such as this study of census subdivision-level hotspots of unintentional home injury hospitalizations across BC, the modifiable areal unit problem (MAUP) poses significant methodological challenges by introducing sensitivity to both

the scale and the zoning of spatial units used for aggregation (Charlton, 2008). As a result, associations observed between sociodemographic characteristics and hospitalization rates may vary, if different spatial units or aggregation schemes are used. This instability reflects the broader challenge of spatial epidemiology, where patterns at the group level can mask heterogeneity within areas and should not be interpreted as individual-level risk (Briz-Redón et al., 2019). Importantly, the relationships identified between sociodemographic factors and unintentional home-injury rates are scale dependent. At finer spatial resolutions, different or additional predictors may become salient, and the strength of observed associations may shift accordingly. As such, our findings should be understood as spatial signals that highlight areas in BC where the burden of home injury is elevated and where prevention resources may be prioritized, rather than as evidence of causal pathways at the individual level.

Limitations

While this study provides valuable spatial insights related to unintentional home injury hospitalizations in B.C., several limitations should be acknowledged. A key limitation of this study is the lack of non-hospitalization data for unintentional home injuries, which may influence the observed patterns of unintentional home injury risk, particularly in rural and remote areas, and the findings of this study should be interpreted with this consideration. Injury surveillance often depends on administrative claims data created for billing purposes in hospital emergency departments and inpatient care (Crain et al., 2016). Incorporating data from multiple sources, including outpatient settings and community surveys, could provide a more complete picture of unintentional home injuries across the severity spectrum. Moreover, we used data aggregated at the CSD level, which may not accurately represent individual-level relationships between deprivation and unintentional home injuries. Consequently, the observed relationships might

reflect ecological fallacy (Shih et al., 2023). However, the use of geographic information systems and spatial analysis techniques allowed the identification of unintentional home injury geographic hotspots and their sociodemographic predictors in these hotspots. Additionally, a key limitation of spatial analyses with aggregated data is the Modifiable Areal Unit Problem (MAUP), where results can vary depending on the scale or configuration of spatial units (Buzzelli, 2020). In this study, we addressed this by using GWR, which accounts for spatial non-stationarity and provides localized estimates, helping to mitigate some effects of MAUP.

Conclusion

This geospatial analysis identified geographic clusters with significantly higher rates of unintentional home injuries in urban regions of B.C., particularly in areas characterized by higher levels of multiple deprivation. Public health initiatives could consider these spatial patterns as a starting point for deeper analysis and community-engaged research into factors contributing to home injury risks. Developing partnerships between public health, housing, social services, and community organizations is crucial for addressing the complex factors contributing to unintentional home injuries, as they may enable more integrated and effective approaches to preventing these injuries.

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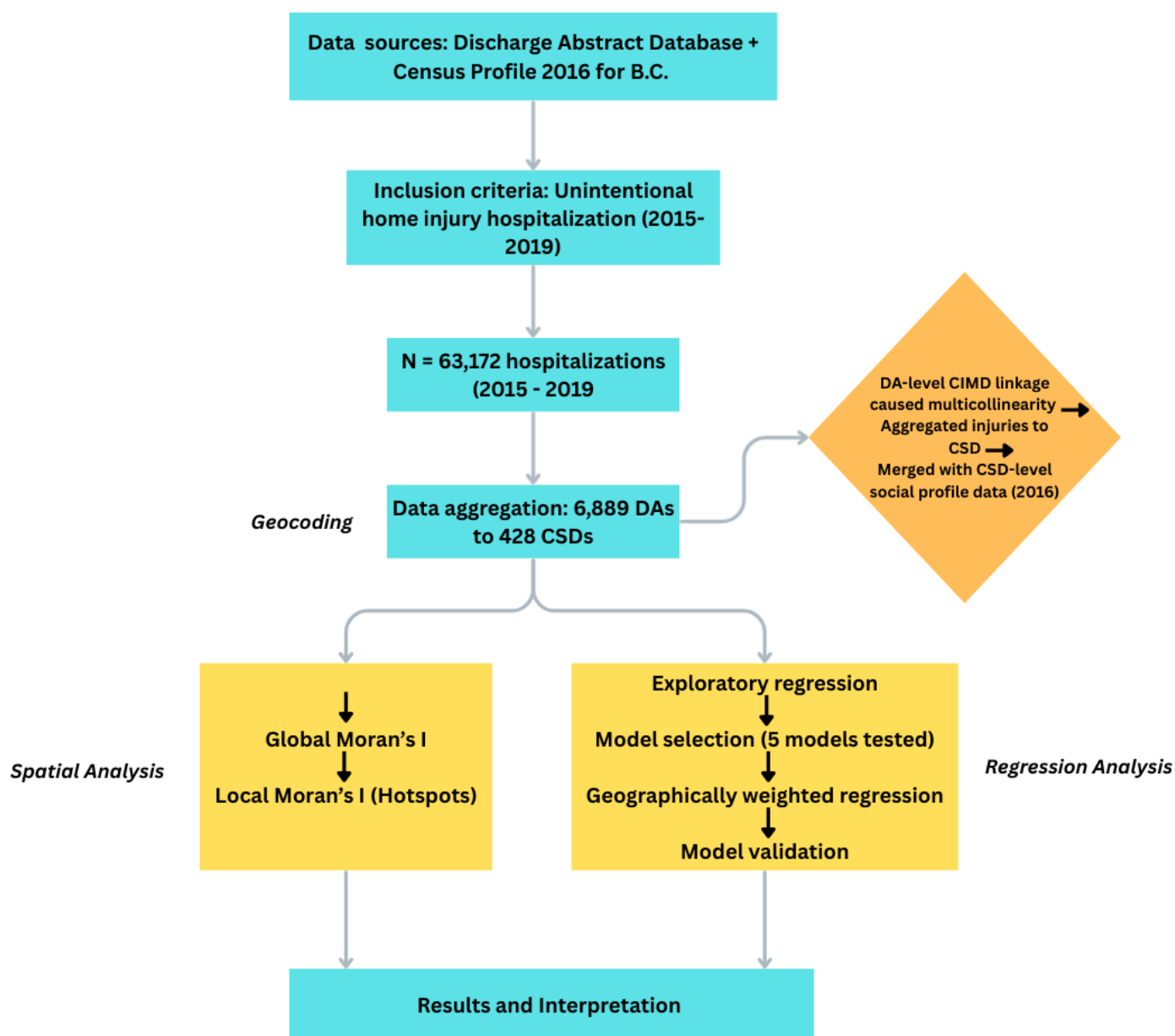
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Appendices

Appendix A: ICD-10 CA Coding for unintentional injuries

Injury Category	ICD10-CA Codes
Near-drowning/submersion	W65-W74, V92
Falls	W00-W19
Unintentional Poisoning	X40-X49
Suffocation	W75-W84
Fires/Burns	X00-X19
Overexertion	X50
Cut/pierce	W25-W29, W45-W46
Struck by or against	W20-W22, W50-W52
Caught or crushed between objects	W23
Bitten by dog or other mammal	W54, W55
Foreign body – eye or orifice	W44
Nonvenomous insect bites	W57

Appendix B: Methodological Workflow



CIMD = Canadian Index of Multiple Deprivation; DAs: Dissemination Areas; CSD: Census Subdivision

This flowchart illustrates data sources, analytical procedures, and model selection process for identifying geographic hotspots and sociodemographic predictors of unintentional home injury hospitalizations in British Columbia, 2015-2019.

Appendix C: Summary of Model Performance and Spatial Autocorrelation Tests

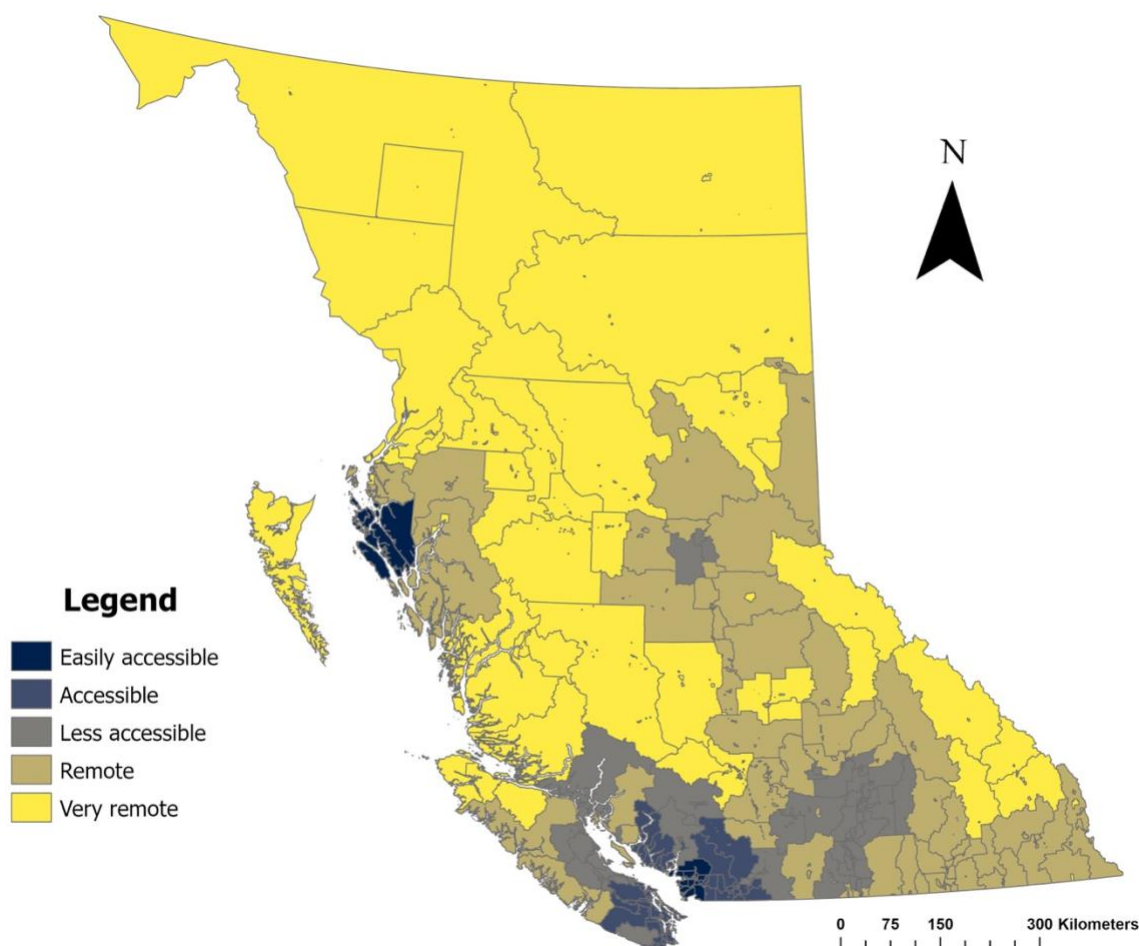
Model	Adj R ² / Pseudo R ²	AICc	Moran's I Residuals	Key Notes
OLS (global)	0.210	3269.9	Not significant (I = 0.066, p = 0.083)	Poor fit, significant Koenker BP & Jarque–Bera → evidence of spatial non-stationarity
Spatial Error Model	0.551 (Pseudo R ²)	2005.9	Residual clustering removed ($\lambda = 0.42$, p < 0.01)	Accounts for hidden spatial dependence in residuals. Improves fit versus OLS but still assumes globally constant relationships.
GWR (local)	0.775	813.1	Residual Moran's I non-significant (I = -0.0719, p = 0.093)	Provides best overall fit (lowest AICc comparable to SEM with higher Adj R ²). Shows geographic heterogeneity in determinants of injury risk, which global models mask.

OLS: Ordinary Least Square, AICc: Corrected Akaike Information Criterion, GWR: Geographically Weighted Regression

Appendix D: Local Moran's I Values for Unintentional Home Injuries by K-Nearest Neighbors (k)

k	Moran's I
2	0.413
3	0.429
4	0.416
5	0.398
6	0.382
7	0.365
8	0.349
9	0.337
10	0.331

Appendix E: Remoteness classification of British Columbia's census subdivisions



This map illustrates the classification of British Columbia's census subdivisions into five levels of remoteness based on Statistics Canada's 2021 Census data. The classification uses the Index of Remoteness (IR), a continuous measure ranging from 0 to 1, where 0 represents the least remote areas and 1 represents the most remote areas. The IR considers both the distance to population centres and the population size of these centres.

The five categories of remoteness are defined as follows:

1. Easily Accessible: $IR < 0.1500$
2. Accessible: $IR \ 0.1500 - 0.2766$
3. Less Accessible: $0.2767 - 0.4033$
4. Remote: $0.4034 - 0.5531$
5. Very Remote: $IR > 0.5532$

Map created using ArcGIS Pro 3.3 (Esri, Redlands, CA, USA; <https://www.esri.com/en-us/arcgis/products/arcgis-pro>) with data from Statistics Canada's Index of Remoteness (<https://www150.statcan.gc.ca/n1/pub/17-26-0001/172600012020001-eng.htm>).

Chapter 4

Unintentional Home Injuries: Community-Based Participatory Research among Newcomers in British Columbia, Canada

Abstract

Background: Unintentional home injuries are a major public health burden in Canada, with racialized and newcomer communities experiencing disproportionate risk. However, limited research has examined the lived experiences and structural determinants of home-injury risks within these populations. Authors in this study examined how recent Afghan immigrants and refugees in Vancouver, British Columbia, experience and navigate home-injury risks within resettlement contexts.

Methods: Using a community-based participatory research approach, we partnered with a Community Advisory Board, who were Afghan newcomers in Vancouver, to guide the research process. We conducted nine semi-structured interviews and one focus group (n=eight) with Afghan newcomers (arrived in Canada since 2019). We collected data in the Dari language and translated them into English. We analyzed the data using Braun and Clarke's reflexive thematic analysis, guided by an intersectional theory.

Results: Four themes illustrated home injury experiences as a socially negotiated process shaped by vulnerability and resilience: (1) structural vulnerability, wherein housing precarity, linguistic exclusion, and institutional mistrust compounded home injury risks; (2) gendered and intergenerational home safety burden, with women and daughters disproportionately responsible for prevention, interpretation, and caregiving; (3) cultural adaptation and embodied learning, as participants learned unfamiliar safety technologies through lived experience; and (4) community networks and resilience as protective infrastructure, functioning as trusted, language-congruent channels for home safety knowledge and support.

Conclusion: Preventing home injuries among Afghan newcomers to Vancouver requires moving beyond individual-level behaviour change toward structural, equity-driven interventions that integrate culturally safe, community-partnered education with intersectoral action across housing, settlement, health, and social services.

Unintentional injuries represent a significant global public health burden, accounting for approximately 3.16 million deaths annually and ranking among the top five causes of mortality worldwide (Halvachizadeh et al., 2025; World Health Organization, 2024). Beyond mortality, unintentional injuries lead to substantial healthcare costs, long-term disabilities, and losses in productivity (Ameratunga et al., 2024; S. Chen et al., 2019; Momenyan et al., 2025). Within the broader spectrum of unintentional injuries, home-related injuries represent a particularly prevalent yet underexamined subset. Although homes are predominantly understood, both culturally and ontologically, as spaces of safety (Harden, 2000; Mallett, 2004), they also represent complex social and material environments where everyday relations, structural conditions, and domestic practices can create injury risks for those who spend substantial time within home environments (Banerjee et al., 2022; Cho & Kim, 2025b; Gielen et al., 2015). In Canada, home injuries account for approximately 43% of all unintentional injury hospitalizations and represent the leading cause of injury-related emergency department visits for children and older adults (Public Health Agency of Canada, 2022, 2025). Falls, burns, poisonings, and other home-related injuries collectively impose over \$11 billion in direct and indirect costs on the Canadian healthcare system each year (Parachute, 2021). Contextually, unintentional home injuries in British Columbia (B.C.), particularly those resulting from falls, accounted for approximately 84% of all hospitalizations related to home injuries between 2015 and 2019 (Khudadad et al., 2024).

The risk of unintentional injuries is not uniformly distributed across populations in Canada. Among the groups disproportionately affected are recent immigrants and refugees, whose diverse backgrounds, migration histories, and settlement contexts shape their exposure to injury risks (Y. Chen et al., 2013; Kazi et al., 2019; Setia et al., 2011). In the Canadian context, a

recent immigrant refers to a person who has permanently settled in Canada within five years of the most recent census (Statistics Canada, 2019). In contrast, a *refugee* is defined as an individual who has fled their country of origin due to a well-founded fear of persecution and is unable to return safely (Canadian Council for Refugees, n.d.). Migration and displacement can act as determinants influencing disparities in injuries, posing risks to the physical, mental, and social well-being of refugees and immigrants (Castañeda et al., 2015). The experience of leaving one's home and community, often abruptly and involuntarily, can profoundly affect the overall health and well-being of individuals and communities as it exposes them to social, economic, and environmental vulnerabilities (Kalich et al., 2016; Spitzer et al., 2019). Together, these factors create conditions that shape injury risks among recent immigrants and refugees, rooted in the broader social inequities embedded within the migration and settlement process.

Despite growing recognition of immigrant and refugee health disparities, research on home injuries among recent immigrant and refugee populations remains limited, particularly in the Canadian context. Existing literature has primarily employed quantitative epidemiological approaches, documenting unintentional injury incidence rates, demographic patterns, and outcome disparities through administrative health data and population surveys (Jin et al., 2015; Saunders, Macpherson, Guan, & Guttmann, 2018; Wang et al., 2023). While these studies are valuable for identifying population-level injury patterns, they offer limited insight into the lived experiences, interpretive meanings, everyday practices, and structural conditions that shape injury risks and prevention among recent immigrant communities in Canada (Machado et al., 2022). These knowledge gaps underscore the need for qualitative research approaches through which scholars can explore the social, cultural, and structural dimensions of home injury risks (Machado et al., 2023) that shape how home safety is understood, practiced, and achieved within

domestic spaces during resettlement. Furthermore, qualitative approaches align with principles of health equity and social justice by treating immigrants and refugees as experts in their own and by producing knowledge that can inform culturally responsive and community-engaged injury prevention efforts rather than top-down behavioural change campaigns (Elshahat et al., 2025).

Among immigrant populations in Canada, Afghan immigrants represent a particularly important yet understudied group in relation to unintentional injury risks. Canada has been a primary resettlement destination for Afghan refugees and immigrants for over four decades (Public Safety Canada, n.d.). Recent political developments in Afghanistan prompted Canada to extend protection to vulnerable Afghans through its special humanitarian program. By December 2023, approximately 45,820 Afghans had been welcomed into Canada through various immigration programs, with 4,935 resettled in B.C. and 2,080 specifically in Vancouver (Immigration Refugees and Citizenship Canada, 2023). Afghan immigrants often arrive in Canada with histories of prolonged displacement, conflict-related trauma, and profound personal and collective loss, shaping health trajectories that differ markedly from those of other immigrant groups (Alemi et al., 2023; Mesa-Vieira et al., 2022). These traumatic experiences can be transmitted intergenerationally, increasing injury risks within the home environment by shaping cognitive functioning, parent–child attachment, supervision practices, coping strategies, and engagement with safety systems among Afghan immigrants and refugees.

With the substantial arrival of Afghan immigrants to Vancouver, B.C., in recent years, centring their voices and lived experiences is essential for informing equity-driven injury-prevention efforts across the province. To understand how recent Afghan immigrants experience unintentional home injuries, it is essential to account for the multiple, intersecting social, structural, and cultural factors that shape their broader health outcomes (Hossin, 2020). As such,

intersectionality theory can be employed as a useful framework to critically examine how social identities such as race, gender, and immigration status interact with structural and systemic inequalities (Crenshaw, 1991) to produce differential patterns of home injury risks among Afghan recent immigrants. Furthermore, by applying an intersectionality lens, the authors in this research prevented essentializing or homogenizing recent immigrants and refugees as a monolithic group and instead recognized the diversity and complexity of their lived realities and needs (Savaş et al., 2021). The authors in this study examined how Afghan recent immigrants and refugees in Vancouver experience and navigate unintentional home injuries, with particular attention to the structural, cultural, and community factors that shape these experiences.

Methods

After receiving ethics approval, the authors employed a community-based participatory research (CBPR) approach (Israel et al., 2005) with the Afghan Community Vancouver Foundation (ACVF) and BC Settlement Portfolio for the Afghan Community (BCSPAC). CBPR is a collaborative approach that equitably involves community members, organizational representatives, and researchers in all aspects of the research process (Wallerstein & Duran, 2006). From a positionality perspective that attends to power, privilege, and insider–outsider relationships (Collins, 1999), the authors reflected on how their social identities shaped the research process. The first author of this research, who was an Afghan refugee and is now an immigrant in Canada, leveraged his linguistic and cultural competencies to ensure that this participatory research was meaningful, respectful, and centred on the community members' self-identified needs. Author 2, a white, cisgender female of English and Welsh heritage, and Author 3, a white, cisgender male of English heritage and immigrant to Canada, occupied different social locations and levels of connection to the community. The authors recognize that their

identities are shaped by intersecting ascribed and achieved characteristics such as migration history, race, gender, professional roles, and social position, and that these dynamic and socially situated identities influenced how they related to the community and how the research was conducted and interpreted.

Community Partnership

Optimal CBPR projects are built on established relationships and ongoing community efforts (Minkler M, Hancock T., 2003). As such, we established a community advisory board (CAB), which included two members, one from the ACVF and the other from BCSPAC. CBPR approaches involving immigrants can foster community awareness, actionable change, and improved health outcomes while simultaneously enhancing problem-solving abilities, communication, teamwork, and social skills within immigrant communities (Machado et al., 2023; Vaughn et al., 2017). At the time of this research, members of the CAB were actively leading settlement and refugee services for recent immigrants and refugees from Afghanistan and providing support for integration into the local community through housing assistance, language training, skills development, and interpretation services.

Three meetings were held with the CAB throughout the study to support ongoing community input and shared decision-making, during which CAB members helped refine the research objectives to better reflect cultural relevance and community priorities. Drawing on their lived experience and concerns about re-traumatization, CAB members recommended trauma-informed training prior to data collection, which the first author completed. CAB members also advised the development of audio-visual recruitment materials to enhance accessibility for community members with limited literacy. CAB members also supported participant recruitment by connecting the first author with wider Afghan community networks in

Vancouver. To acknowledge their contributions, CAB members received a gift card worth 50 Canadian dollars for each meeting they attended.

Recruitment Strategy

The CAB members played an important role in the development of the recruitment materials. Dari and Pashto language experts (official languages of Afghanistan), independent of the CAB, reviewed the recruitment poster to ensure it was linguistically relevant and culturally appropriate. The poster included a Quick Response (QR) code to accommodate participants with limited literacy. This QR code was linked to a video that provided study information in Dari and Pashto, making it easier for participants to understand the study details in their native languages.

We employed purposive sampling to select participants who met the specific inclusion criteria for study participation, which included being recent immigrants and/or refugees from Afghanistan, aged 18 years and older, and residing in the Greater Vancouver area, Canada. For this study, recent immigrants were considered those individuals who had permanently arrived in Canada as of or after 2019, corresponding to the period of increased Afghan migration and resettlement to Canada following the escalation of the humanitarian crisis (Immigration Refugees and Citizenship Canada, 2023). Refugees included those with refugee status in Canada or those who had obtained refugee status before arriving in Canada as of or after 2019. The first author of this study recruited participants in person at events hosted by the members of the recent Afghan immigrant communities in the Greater Vancouver area of B.C. during the summer of 2025, including newcomer support workshops and Afghan community cultural gatherings. Additionally, the members of the CAB facilitated recruitment efforts by distributing digital posters and sharing social media posts in their networks.

Data Collection

In agreement with the CAB, the research team (UK, AG, and IP) used two qualitative data collection methods: individual semi-structured interviews and focus group discussions. The first author conducted nine semi-structured interviews (seven women and two men; 30-60 minutes each) with participants about their experiences of unintentional injuries at home in the Greater Vancouver area, B.C. Semi-structured interviews aligned well with our research approach, offering participants a space to express their injury experiences and the meanings they ascribed to them (Adams, 2015), and allowing follow-up questions to deepen understanding (Rubin, H. J., & Rubin, I. S., 2011). We developed a semi-structured interview guide in collaboration with members of the CAB to explore questions related to home injury experiences, challenges, and needs among recent Afghan immigrants and refugees considering migration, cultural, social, economic, and personal factors that may influence safety practices in their home environment. The first author held three in-person, four Zoom, and two WhatsApp interviews based on participant preference. These interviews were conducted in Dari and audio-recorded. After each interview, we emailed participants an electronic copy of the transcript in Dari and invited them to review and make changes to their statements if needed. No participants requested changes to their transcripts.

With members of the CAB, we developed a focus group guide that addressed various aspects of unintentional home injuries, socioeconomic factors, and challenges in preventing unintentional home injuries. The CAB member involved with the BCSPAC helped to recruit FGD participants by contacting Afghan newcomer families from their network via WhatsApp messages and invited them to participate. We included focus group discussions to create a collective, culturally familiar space in which participants could share and reflect on experiences and build on one another's accounts. The first author conducted one focus group discussion in

Dari with eight participants (five women and 3 men), which lasted 74 minutes. In addition, we gave focus group participants a demographic questionnaire to complete before they left the discussion (see Appendix). We chose not to return focus group transcripts to participants to avoid compromising the confidentiality of other group members. As compensation for their time and support, we provided participants of both semi-structured interviews and focus group discussions with a \$20 Amazon gift card.

In total, there were 17 participants in this study. The majority were women ($n = 12$), between the ages of 18 and 54 years ($n = 15$), who had lived in Canada for one to three years ($n = 13$). Most participants were permanent residents ($n = 12$), while others identified as Canadian citizens ($n = 5$) or as a refugee claimant ($n = 1$). The participants lived primarily in apartments ($n = 9$) or basement suites ($n = 3$). The majority reported annual household incomes below \$60,000 ($n = 10$). Educational attainment ranged from no formal education ($n = 2$) to graduate-level degrees ($n = 2$), with most participants having completed secondary or post-secondary education ($n = 13$).

Data Analysis

The first author led the transcription and translation of the Dari-language data into English. He verified all transcripts through line-by-line comparison with the original Dari audio recordings. Transcribing audible data into written form is an interpretive process (Bailey, 2008). As such, the first author, fluent in both Dari and English, engaged closely with the data to ensure conceptual accuracy and equivalence in transcription and translation. While the literature highlights certain limitations, such as subjective bias and loss of meaning when researchers act as translators (Squires, 2009), Temple and Young suggested that combining the roles of researcher and translator can increase awareness of cultural nuances, allowing the researcher to

engage more deeply with issues of meaning during translation and data analysis (Temple & Young, 2004).

We used NVivo version 15 to organize the data (Lumivero, 2023) and employed Braun and Clarke's reflexive thematic analysis approach (Braun & Clarke, 2019). The first author imported the translated transcripts into NVivo and read and re-read the transcripts to become familiar with their content. We invited both CAB members and research participants (co-researchers) to participate in the data analysis; however, participation in this phase was not feasible due to competing work, caregiving, and settlement commitments. The first author systematically coded interesting features of the data across the entire dataset, using a deductive approach to coding, ensuring that intersectional theory guided the process while remaining open to unexpected insights. He then collated codes into potential themes, considering how different codes might combine to form overarching themes. This process involved creating thematic networks to visualize the relationship between codes and potential themes. With the second and third authors, he refined the themes and reviewed them against the original data to ensure they meaningfully represented the voices and experiences of the recent Afghan immigrants and refugees in Vancouver, BC.

Stahl and King emphasized that qualitative researchers aim to enhance readers' confidence in the interpretability of the research findings by establishing some level of trustworthiness (Stahl & King, 2020). As such, we employed several strategies throughout our research process to ensure the trustworthiness of our findings. Prolonged engagement with the Afghan immigrant and refugee community in Greater Vancouver area, B.C., allowed us to build rapport and gain a deeper understanding of the cultural context. Olmos-Vega and colleagues recommended that qualitative researchers carefully consider their paradigmatic stance and use

reflexive practices to guide their decisions at all stages of their research (Olmos-Vega et al., 2023). As such, the first author maintained a reflexive journal to document the decision-making processes, personal reflections, and evolving interpretations. He also used reflexive memo-writing throughout the data collection and analysis to document analytic decisions, identify moments of resonance between participants' accounts and the author's lived experiences (Muhammad et al., 2015).

Results

The four themes produced through the data analysis illustrate how recent Afghan immigrants in Vancouver navigate unintentional home injuries as a socially negotiated process shaped by structurally produced risks and constraints and community resilience. These themes are as follows: (1) structural vulnerability, (2) gendered and intergenerational burden of safety, (3) cultural adaptation and embodied learning, and (4) community networks and resilience as protective infrastructure. Below, we elaborate on each theme in greater depth, drawing on participants' accounts and first author's reflexive interpretation of the data as an insider with lived experiences of displacement and systemic exclusion.

Theme 1: Structural Vulnerability

The participants' experiences showed how housing precarity, economic instability, linguistic exclusion, and institutional mistrust made them vulnerable to unintentional household injuries and shaped their home safety practices. These structural forces operated not as discrete factors but as intersecting and mutually reinforcing processes that collectively produced compounding barriers, making every-day domestic life hazardous.

The participants frequently described unsafe living conditions as inescapable features of the affordable housing available to them. Dim stairways without railings, crowded basement

suites with little ventilation, and landlords who rarely responded formed the everyday living conditions in which participants had to navigate and negotiate their safety. Parveen, who sustained a fall injury, recounted, "There was no light in the stairway... I tripped and fell." The same participant described the spatial constraints of her current living condition: "We're five people in a one-bedroom basement...Even walking around can cause someone to trip." This mirrors the conditions the first author's extended family continues to experience, residing in a household with more than 15 occupants.

Economic constraints often compelled the participants to accept substandard dwellings that exposed them to injury risks. Within these contexts, safety was not an inherent attribute of the home but rather something participants actively sought to construct through adaptive strategies. For some, this involved relying on technological workarounds to compensate for family members' limited familiarity with household appliances. Shaista described how her smoke alarm's phone notifications allowed her to monitor the home remotely and intervene when needed, noting that it "gives me peace of mind and keeps my mother safe." Similarly, she noted, "I've always had a concern about the shower in bathroom because the bathtub itself is really slippery...So, I installed a grab bar on the wall. Now my mother can hold on for support...It's better than nothing."

Although most participants had completed secondary or post-secondary education, their limited English literacy systematically excluded them from safety knowledge and systems of support. Many described feeling isolated from essential safety information available only in English, underscoring that language barriers were not merely communicative but structural in nature. As one participant, Mustafa, stated, "For me, not knowing English is very hard. I feel like I'm crippled. I feel helpless and I count on my children to help me with navigating things

around.” Similarly, Sharifa asserted, “There are warning labels on everything, but if you can’t read them ... you don’t really know what they’re telling you to avoid.” The first author’s observations of his family members’ reliance on others and reduced autonomy in accessing basic safety information and institutional resources due to language barriers further informed this interpretation.

Participants also recounted the economic necessity of continuing to work despite pain or injury, creating self-reinforcing cycles in which minor injuries escalated due to an inability to rest. The intersection of economic vulnerability and injury thus produced what participants described as a “worsening spiral,” wherein injuries precipitated financial strain that necessitated increased labour, which in turn hindered recovery and increased susceptibility to further injuries. Shaista underscored, “If my mom didn’t have to work, she’d get better... but she had to go to work, and her concussion got worse.”

Precarious employment and language barriers also produced institutional mistrust, particularly around health and social services. One participant expressed fear that seeking medical help after a child’s injury could trigger scrutiny from authorities or child protection services. Consequently, some families chose to rely on home remedies or community advice instead of formal care. Aziza observed, “I know many parents, including myself, who hesitate to take our kids for medical help because we fear child services getting involved or worry about hospital bills we can’t manage.” The first author recognized the rationality of these fears, given his prior experiences with surveillance and authority in displacement contexts, as well as the potential consequences of avoiding formal care.

Theme 2: Gendered and Intergenerational Burden of Safety

Home safety practices within recent Afghan immigrant families reflected deeply rooted gendered and intergenerational norms. Mothers and daughters assumed a disproportionate share of responsibility for preventing, responding to, and managing household injuries. This unequal distribution of home safety labour reflects broader gendered power relations which were also shaped by the specific conditions of migration and resettlement. As a man, the first author remained attentive to potential blind spots while interpreting gendered home injury experiences, which the second author, a woman, supported.

Women participants described safety within the home environment as a constant concern that required vigilance, modifications to the home surroundings, and emotional effort to maintain. Participants who are mothers also described carrying the primary responsibility of adapting household practices from Afghanistan to Canada. This adaptation involved learning new safety norms, adjusting cooking and heating methods, and reconfiguring daily routines to align with unfamiliar safety practices and living conditions. Through this ongoing process, mothers became central agents in translating prior domestic knowledge to fit the expectations and material realities of their new environments. Sharifa stated, “I’m always watching the kids and the kitchen. Even when I’m cooking, my mind is elsewhere...checking the heater, the cords, the water.” This account resonated with the first author’s observations of his mother and sisters, whose disproportionate yet often invisible responsibility for maintaining home safety shaped his understanding of gendered safety labour in displacement contexts.

For many participants, unfamiliar household technologies such as safety alarms, stoves, or heating systems introduced uncertainty and anxiety, as their operation required new forms of technical understanding. The responsibility for learning, adapting, and managing these systems

fell primarily to women, who balanced this safety work alongside employment and caregiving for children and extended family members:

In Afghanistan, we mostly cooked with gas or wood. There were risks, like open flames or smoke, but we grew up with those systems and knew how to manage them – how much gas to use, how to light it safely, and when to be careful around the fire. Here in Canada, the appliances are safer in design, with no open flames and everything looking more modern. But sometimes it actually feels more dangerous, because we don't fully understand how these systems work. – *Rabea*

The participants connected women's increased responsibility for home safety in Canada to broader shifts toward nuclear family structures, geographic dispersion, and the loss of extended kin networks. Aziza observed, "In Afghanistan, there were always neighbours or relatives nearby – everyone looked out for each other. Here in Canada, families are more isolated, and if something happened while the kids were alone, no one might even notice. That makes me very nervous."

In households with members with limited English proficiency, daughters often translated safety notices and health information, shaping how their families understood and managed home injury risks. Rooena emphasized, "If something comes from the landlord about fire alarms or hazards, I translate it to my mother. That's how she knows what she needs to do."

Theme 3: Cultural Adaptation and Embodied Learning

The participants described a profound transformation in their understanding of home safety, shifting from relational, collective, and experience-based practices in Afghanistan to more system-oriented, technological, and formalized safety protocols in Canada. They depicted safety in Afghanistan as deeply embedded within social relations, whereby family members collectively

supervised children, elders were seldom left alone, and knowledge about potential hazards was transmitted through everyday interaction and shared experience. By contrast, participants described Canadian safety systems as grounded in technological devices such as smoke alarms and carbon monoxide detectors, supported by written instructions, formal regulations, and an emphasis on individualized responsibility. Some participants emphasized the importance of safety in Afghanistan as a matter of immediate action and practical knowledge, grounded in personal and communal responsibility. In Canada, however, safety was experienced as mediated through formal housing systems and landlord authority, which limited individuals' ability to respond directly to risks. According to Sikandar,

“Back home, if something in the house seemed unsafe, like the wiring or the gas line, we fixed it ourselves. Everyone knew how to handle small problems before they became dangerous. I grew up that way, always solving things with my own hands. In Canada, it's different. You can't touch anything; it all has to go through the landlord. If you report a problem, they first check if it's your fault, and if it is, you have to pay. That makes me nervous because even small issues can turn into something unsafe while you're waiting.

Some participants described how their transition to system-based safety in Canada.”

Produced profound disorientation, particularly around technologies that were absent in Afghanistan. Home safety devices such as smoke alarms and carbon monoxide detectors, while designed to promote safety, were instead experienced as unfamiliar and disruptive, particularly for those encountering them for the first time, prompting precautionary responses. Sharifa stated, “When we would bake bread, the oven would get very hot, and the alarm would go off We would open all the doors and windows, even in the middle of winter, until it stopped.”

Several participants highlighted that technological safety depends on learning and communication through demonstration, repetition, and trust rather than simply installing devices. Without clear orientation or accessible information, they described these technologies as confusing and difficult to relate to, reflecting safety systems that assume prior knowledge and familiarity. As Khushnood remarked, “When you don’t know how these devices work, even a safe system can feel risky.”

A few participants expressed that pre-migration trauma and the ongoing cognitive demands of resettlement affected their ability to remain constantly vigilant of hazards within their home environment. They described how psychological and physical safety were deeply interconnected, highlighting that emotional distress, anxiety, and fatigue often reduced their ability to stay attentive to everyday risks. The stress of displacement, combined with the effort of navigating unfamiliar systems in a new language while managing financial insecurity, created conditions in which unintentional injuries within their home became more likely. Parwana shared, “I was so anxious and distracted that I left the oven on a high temperature without realizing it. When I noticed the smoke, I panicked ... If God forbid there had been a fire, my child could have been harmed, the neighbours too, and us as well.”

Many participants emphasized that their understanding of Canadian safety norms emerged through lived experience rather than formal instruction. They recounted learning after injuries or near-miss events, moments when their own experiences and bodily reactions became a primary way of understanding safety. This form of embodied learning, rooted in trial, error, and adaptation, underscored participants’ wish for anticipatory guidance and hands-on orientation that could prevent home injuries from occurring in the first place. As Hamida stated, “If someone had explained what the smoke alarm is for, I would have felt more prepared.”

Theme 4: Community Networks and Resilience as Protective Infrastructure

Despite pervasive structural barriers, the participants identified community centres, faith-based networks, and collective care practices as essential sources of support that helped them recognize and manage home injury risks. These networks functioned as an informal safety infrastructure that translated institutional knowledge into culturally resonant practices while offering linguistically accessible and familiar environments. The participants consistently described that information shared in these settings was easier to understand, recall, and act on than messages delivered through formal institutional channels, such as newcomer workshops delivered in English. Fakhria stated, “I think mosques are very important for raising awareness of household injury. In our community, many families go there regularly, not just to pray, but also to connect with others and hear important information. People really trust what is shared in that space.” Echoing Fakhria, Shaista observed,

“In our community gatherings, all the information is shared in our own language ... I think is a best strategy for communication because people can actually understand what’s being said. Useful resources on avoiding home injuries could also be shared within these community gatherings ... this way, our community itself becomes a bridge, making sure we stay informed and supported.”

These community spaces were not only sources of information but also provided trusted forms of support and resources for people who were injured at home and unable to seek help. As Parveen described, “After I fell and injured my arm, I didn’t know what to do or where to go for care...Volunteers at the community centre saw my arm wrapped in plastic and took me to emergency.”

In these communal spaces, participants valued opportunities to learn from others who shared similar migration and resettlement experiences, viewing these exchanges as a form of situated expertise. Participants identified learning about home safety from peers as less intimidating than receiving formal instruction from institutional authorities. Communication within these informal networks carried a protective function, enabling members of the recent immigrant Afghan communities to anticipate and respond to home safety risks collectively. Qubad argued, "If we don't talk about things like home safety or injuries, then chances are we'll be less prepared if something does happen, or we might miss out on ways to prevent them in the first place."

Despite challenges, many participants described their experiences of home safety in Canada through expressions of gratitude, often contrasting their current lives with past experiences of conflict and displacement. While these reflections conveyed relief at being free from war-related dangers, they also shaped how participants interpreted and responded to everyday household injury risks. For some, gratitude provided a framework for endurance when facing home injuries and unsafe home environments, enabling them to recognize resilience and agency even when navigating hazards they felt ill-equipped to address. Parveen shared,

"Compared to what we faced in Afghanistan and later as a refugee in Pakistan, at least we are safe here, and for that I am grateful.... We still struggle with maintaining safety within the home, but we don't complain about minor injuries that happen day to day."

Overall, the participants' accounts illustrated how Afghan newcomers' experiences of home safety and injury risks are shaped by intersection of structural constraints and relational strengths. As such, effective injury prevention efforts require partnerships with recent Afghan immigrant communities in Vancouver and culturally grounded approaches that recognize family-

based care practices while addressing the structural conditions that (re)produce home injury risks in new and complex ways.

Discussion

Unintentional home injuries among recent Afghan immigrants in Vancouver, Canada, cannot be understood apart from the broader structural, cultural, and social forces that shape how home injuries and safety are experienced, enacted, and sustained in their daily lives. Extensive research with Afghan newcomers to Canada since the early 2000s has demonstrated that years of conflict, displacement, and trauma, combined with limited English proficiency, poor health, and discrimination, create formidable barriers to settlement and everyday social participation (Kirsch et al., 2024; Pendakur, 2021; Sifat et al., 2024). These constraints map onto the structural vulnerabilities articulated by participants in this study, who described how housing precarity, financial insecurity, and linguistic exclusion shaped both exposure to home injury risks and families' capacity to mitigate them. As such, understanding these experiences through an intersectional lens is critical for centring the voices, agency, and resilience of groups that are often marginalized or rendered invisible within mainstream injury prevention research and policy narratives (Rocha-Jiménez et al., 2025). This underscores the need for home injury prevention efforts to be situated within broader settlement and equity-oriented policy interventions that address the upstream social and structural determinants of safety.

Navigating Structural Vulnerability

Living with structural vulnerability not only shaped the Afghan newcomers' exposure to hazardous home conditions but also limited their ability to understand, prevent, or respond to these risks. Importantly, these were not isolated risk factors, but interconnected dynamics that mutually reinforced one another through the participants' positionalities. For instance, the

participants' experiences as living with housing precarity shaped hazardous physical environments, and their linguistic skills restricted their access to safety and injury prevention information. These intersecting positionalities created a compounding disadvantage that traditional injury models fail to capture (Caxaj & Weiler, 2025). Checklist-based or behaviour-focused home safety models rarely account for living with structural hazards, social vulnerability, or the person-environment fit (Iwarsson et al., 2009), thereby constraining the analytic lens available to practitioners who rely on these models and limiting their ability to address the root causes of injury and the inequities that shape those risks. For instance, participants repeatedly described safety devices that did not "fit" their linguistic or experiential needs, as illustrated by Hamida's remark that she would have felt more prepared "if someone had explained what the smoke alarm is for." Her quote underscores how safety technologies that rely on English-only instructions can create confusion and potentially increase injury risk for those with limited English proficiency. This "misfit" reflects not user deficit, but safety systems designed around assumptions about English fluency, literacy levels, and familiarity with Canadian housing norms that privilege dominant groups and marginalize racialized newcomers, with resulting risks often mis-framed as individual or cultural failings rather than recognized as products of broader structural forces (Carruth et al., 2021). This pattern of misattribution reflects what Raphael described as the discursive reframing of structural failures as individual deficits, whereby social determinants of health are acknowledged while policy responses remain insufficient to address the structural conditions that produce health inequities among immigrant populations (Raphael, 2011).

Importantly, rather than being passive recipients of risk, participants' accounts reflected their engagement in complex forms of safety labour, such as modifying substandard housing to

reduce hazards, learning unfamiliar household technologies through embodied trial and error, and mobilizing intergenerational caregiving networks and community infrastructure to navigate gaps in institutional support. These findings align with Canadian studies showing that resilience among immigrants and refugees, including Afghan newcomers, is a contextual and collective process sustained through social support infrastructure, community-based practices, and both internal and external coping strategies that support navigation of resettlement demands (Kanji & Cameron, 2010; Kohistani, V., 2012; Liu et al., 2020; Oladi, 2025; Simich et al., 2005). By demonstrating how these supports translate into concrete home safety practices and adaptations, our study findings challenge deficit-oriented framings that pathologize immigrant practices as risky behaviours. Such framings overlook how intersecting systems of power including racialized housing discrimination (Rana et al., 2025), economic marginalization (Statistics Canada, 2024), linguistic exclusion (Díaz-Millón & Olvera-Lobo, 2025), gendered home safety expectations (Cho & Kim, 2025a), and uncertain immigration status (Nizamuddin, 2023) shaped by xenophobia (Bhalla et al., 2025) converge to produce the mutually reinforcing conditions that increase home injury risks. As such, the vulnerability to home injuries experienced by participants in this study did not stem from any single factor, but from the compounding effects of their intersectional social locations within overlapping structures of marginalization. At the same time, participants demonstrated culturally grounded problem-solving within these structurally constrained conditions, reflecting the framework of community cultural wealth (Yosso *, 2005), which recognizes the navigational skills and resourcefulness that members of marginalized communities deploy to navigate institutions and environments not designed with their needs in mind. For example, participants in our study identified community centres and mosques as trusted spaces for injury-prevention knowledge. As such, understanding household

injuries through the lens of structural vulnerability reframes Afghan immigrants not as inherently vulnerable but as diversely positioned resilient actors whose experiences of home safety and injury risks are shaped by their social identities at the nexus of immigration status, racialization, gender, language, and length of residence in Canada, as they navigate and mitigate structurally produced risks in their everyday home environments.

Gendered Patterns in Home Injury Prevention

Our analysis of participants' accounts indicated that the prevention of unintentional home injuries was disproportionately carried out by women and daughters in the households of recent Afghan immigrants in Vancouver. This pattern reflects how participants' roles as Afghan women, daughters, and caregivers were shaped by migration-related disruptions and household power relations within a resettlement context (Iqbal, 2025). Among the 17 study participants, 12 were women aged 18–54 years, most of whom were recent arrivals managing home safety responsibilities while navigating limited English proficiency and unemployment or precarious low-wage work. Normative gender expectations, combined with financial constraints, migration precarity, racialization, and Islamophobia, confine Afghan women to intensified unpaid safety labor in hazardous housing (Khattab et al., 2019). Scholars in Canada and globally have consistently shown that women perform most unpaid domestic and caregiving labour (Ervin et al., 2022; Marani & Peckham, 2023), and it is particularly pronounced among immigrant and Muslim women compared to their non-immigrant and non-Muslim counterparts (Alghamdi et al., 2022). Notably, hegemonic injury prevention discourses position mothers as the primary agents responsible for child safety and direct education and behaviour-change interventions toward them (Morrongiello, 2004). Within immigrant communities, this dynamic is reinforced by settlement agencies and health education materials that frequently direct safety and child injury

prevention messages primarily to mothers (Khan & DeYoung, 2019). Recognizing and valuing the unpaid care work predominantly performed by women within immigrant communities is therefore essential, not only to address gender inequities but also to ensure that programs and policies are implemented that provide caregivers with the resources and stability needed to maintain safer home environments and reduce injury risks.

Reconstructing Home Safety through Cultural Adaptation and Embodied Learning

Participants described developing new ways of understanding and managing home safety through everyday practice, trial, and adjustment within unfamiliar Canadian housing contexts. This cultural adaptation responds to the broader physical, psychological, and structural disruptions of a community's cultural resources (Subica & Link, 2022). The loss or disruption of cultural modes of communication and social organization (language, norms, values), institutions (family structures, faith systems, education, legal and health systems), and land produces chronic stress, stigma, and resource depletion that undermine the well-being of the recent Afghan immigrants in Canada (Ahmad et al., 2020; Alemi et al., 2014; Gokani et al., 2023). However, in this study, participants' accounts demonstrated profound cultural adaptation and embodied learning as they navigated unfamiliar risks within Canadian home environments. Importantly, cultural adaptation and embodied safety learning varied across participants, as intersecting dimensions of their social identities, such as length of time in Canada, English language proficiency, and type of housing shaped their access to resources, exposure to stress, and the forms of safety practices they enacted within their home environments. As such, the Afghan newcomers in our study illustrated that while disruption in cultural knowledge shapes health risks, resilience actively reshapes pathways to home safety and overall well-being. Leveraging

these capacities among Afghan newcomers creates opportunities to develop injury-prevention strategies that enhance household safety and contribute to improved health outcomes.

Individuals construct their understanding of risk through socially, culturally, and politically situated lenses, and these interpretations are profoundly shaped by the degree of trust they place in the institutions and people delivering safety information (Alaszewski, 2005). This aligns with participants' reluctance to bring children to the hospital after minor injuries, a hesitation driven by fears that routine questioning could escalate into accusations of neglect. Such concerns reflect the central role trust plays in how people interpret and respond to risk; once trust is compromised, it becomes difficult to rebuild (Hawthorne et al., 2025). For Afghan families who endured state surveillance, conflict, or precarious immigration pathways, this mistrust represented a rational response to the institutional power imbalances that influence whose knowledge is valued and who controls the safety information (Foucault, 2001). Participants' fear that injuries would be judged through culturally biased standards aligns with some Canadian research demonstrating that racialized and immigrant families face disproportionate surveillance and child-protection involvement for unintentional injuries (Boatswain-Kyte et al., 2020; King et al., 2017; Mohamud et al., 2021). As such, effective home-injury prevention among newcomers requires bottom-up approaches that cultivate trust by drawing on community knowledge, lived experience, and culturally meaningful forms of engagement (Guillot-Wright et al., 2022).

Community Networks as Protective Infrastructure for Home Injury Prevention

The participants in this study described relying on faith-based spaces, community centres, and peer networks to understand, manage, and respond to home safety risks in ways that formal settlement and health systems often failed to support. By prioritizing peer-to-peer knowledge

sharing, these networks counteract the "misfit" of home safety technologies designed for dominant English-speaking groups and those familiar with Canadian technologies. These findings align with evidence from injury-prevention researchers demonstrating that culturally grounded, community-embedded approaches are more effective for migrant and racialized populations than individually focused or institution-led interventions (Williams & Thompson, 2011). For newcomers with limited English proficiency and disrupted social networks, as was the case for the participants in this study, close connections within their own communities become essential for navigating unfamiliar risks (Hanson-Easey et al., 2018). As demonstrated in *SafeCare* research, community ties can directly reduce household hazards by providing emotional, instrumental, and informational support (Slemaker et al., 2017). Moreover, programs such as *Stop the Bleed*, implemented with refugee communities in Clarkston, Georgia, USA, showed that culturally adapted, interpreter-delivered training, supported by translated materials and hands-on instruction, substantially improved participants' knowledge, confidence, and ability to apply injury-prevention techniques [108]. The success of such programs underscores that true health equity cannot be achieved through an 'add and stir' approach of simple translation (Kabir et al., 2021); instead, it requires a transformative shift that positions community networks as foundational delivery systems for home injury prevention interventions.

Limitations

This study had several limitations that should be acknowledged. Although the participants provided rich insights, they were predominantly female. This likely reflects the gendered expectations within Afghan households wherein women often assume primary responsibility for caregiving and household safety. In addition, recruiting participants through community organizations and networks may have excluded more isolated families or those

without community connections. However, partnering with Afghan immigrant communities in Vancouver supported trust and relationship-building, enabling participation from families who might otherwise be hesitant to engage in research (Salma & Giri, 2021). Moreover, the cultural and linguistic concordance between the first author, who conducted the interviews and focus groups, and the participants, while facilitating trust and depth, may have also shaped what participants felt comfortable discussing (Irvine et al., 2008). Nonetheless, having a shared language and cultural background builds rapport, reduces miscommunication, and creates a supportive environment in which participants can speak more openly about sensitive issues related to home safety, lived experiences, and resettlement challenges.

Conclusion

Unintentional home injuries experienced by recent Afghan immigrants in the greater Vancouver area, B.C., are shaped by individuals' social locations as newly arrived, low-income, racialized, gendered and Muslim households, and by their limited relational power within housing, health, and policy systems that structure exposure to injury risks. Our study's findings challenge dominant injury prevention paradigms (Shield, 2007) that individualize responsibility and pathologize cultural difference. Instead, they indicate that home safety for marginalized immigrant populations cannot be achieved through information dissemination or behavioural change interventions that ignore the broader conditions shaping risk. Notably, as Giles and colleagues argued, effective injury prevention requires integrating equity into injury-prevention models by prioritizing culturally safe and inclusive interventions that meaningfully reduce disparities in injury risk (Giles et al., 2020). In the future, injury prevention scholars may draw on participatory action research partnering with Afghan communities to co-design and evaluate

injury prevention interventions, generating evidence regarding what approaches effectively reduce injuries while being acceptable and feasible within community contexts.

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Appendices

Appendix A: Semi-structured Interview Guide

Date of the interview:

Start time:

End time:

Location:

Purpose of the interview: to learn more about the home injury experiences of refugees and immigrants from Afghanistan who have arrived in Canada since 2019 in order to inform and strengthen culturally safe approaches to injury prevention programs and services.

Preamble prompt for interviewer:

- If there are any questions that you do not feel comfortable answering, you can ask to skip the question
- Are there any questions/concerns you have before we start the interview?

Sociodemographic information of the participant:

Name:	Age:
Gender identity:	Any disability:
Ethnicity:	Length of residence in Canada:
Type of housing:	Level of education:
Household income (annual):	Are you employed? If yes, specify:
Residency status in Canada:	

Interview Questions

1. Can you please tell me a bit about your experiences as a recent immigrant or refugee from Afghanistan living in Vancouver?
2. Can you share any experiences related to injuries or safety concerns you or a family member has faced at home in Canada?
3. How do you feel about your current home environment in terms of safety? Are there any things that you think could potentially cause injuries at home?
4. Have you come across any difficulties when it comes to practicing safety within home to prevent injuries? If so, could you elaborate a bit more on that?
5. Could you share your thoughts on how safety practices might be different in Canada compared to Afghanistan or other places where you lived as a refugee before moving to Canada?
6. What worries you the most when it comes to home safety? And in what ways these concerns related to home safety may differ among your family members.

7. Do you have kids and elderly family member living with you at home? If yes, can you describe how safety practices at home might be influenced by the presence kids and elderly family member?
8. In what ways do you think your social circle (the people you know and interact with, including your friends, family, and neighbors etc.) or community support (childcare, financial assistance, and informational resources) might play a role in preventing unintentional injuries at home?
9. From your observations, do you think the level of income in household may influence the likelihood of unintentional injuries occurring at home? If so, how?
10. Could you discuss any strategies you have thought to be useful in integrating safety practices from Afghanistan with those in Vancouver?
11. In what ways do you think knowing the English language may impact your understanding of home safety practices or finding useful information regarding home injury prevention?
12. What are your thoughts on how someone's level of education might influence their access to resources and opportunities for enhancing safety within their home to prevent injuries?
13. How has your disability impacted your access to resources and opportunities for making your home safer? (Applicable to those who self-identified as disabled)
14. As a disabled person, how do you manage safety concerns at home? (Applicable to those who self-identified as disabled)
15. How do you ensure to remain safe and free from sustaining unintentional injuries at home given any physical limitations?
16. What things do you think could make communication regarding home safety easier for immigrants and refugees?
17. In what ways do you think community organizations and agencies can better support recent immigrants and refugees in maintaining/promoting home safety?
18. Are there any additional resources or support you feel would be beneficial in promoting home safety for immigrants and refugees from Afghanistan?
19. Do you have any final thoughts on how we can make homes safer for immigrant communities to prevent unintentional injuries within the home?

Thank you for your time and participation in this interview.

Interviewer wrap-up prompt: You will receive the interview transcript via email soon. You'll have two weeks from when you get it to make any changes or corrections.

Appendix B: Focus Group Discussion Guide

Date of the focus group:

Start time:

End time:

Location:

Purpose of the discussion: to learn more about the home injury experiences of refugees and immigrants from Afghanistan who have arrived in Canada since 2019 in order to inform and strengthen culturally safe approaches to injury prevention programs and services.

Preamble prompt for the discussion facilitator:

Confidentiality: [READ ALOUD] - Before we begin our discussion, I want to spend a few moments talking about confidentiality and to go over some basic ground rules for our focus group discussion today:

- Everyone's views are welcomed and important.
- The information which we will collect today will be attributable (connected or associated) to you as a group.
- We will not identify quotes or ideas with any one person of this group. Because of the nature of small communities or groups, it is possible that people could link participants in this room to quotes in the report. This is why we need to talk about confidentiality.
- We are assuming that when we learn about one another's views, they remain confidential. In a small community (group) like this, people are identifiable to some degree by their views and opinions.
- Having said this, and having made these requests, you know that we cannot guarantee that the request will be honoured by everyone in the room.
- If you want to stop being in the focus group you can leave or stay and simply stop talking, but it will not be possible for you to pull out your data from the flow of the conversation because of the interconnected nature of the group discussion where one person's comments can stimulate the sharing of comments made by others in the group.
- Anything heard in the room should stay in the room.
- All voices are to be heard, so I will step in if too many people are speaking at once or to make sure that everyone has a chance to speak.
- I may also step in if I feel the conversation is straying off topic.
- You can expect this discussion group to last about 90-120 minutes.

Use of Voice Recorder:

- This focus group discussion will be recorded to increase accuracy and to reduce the chance of misinterpreting what anyone says.
- All recordings and transcripts will be stored in password-protected computers held by the research team.

- Names will be removed from transcripts. Participants will have coded numbers attached to their name which only I will know.
- Only I, my thesis supervisor, and co-researchers will have access to transcripts (with your names removed) of this focus group.
- I'll also ask that when using abbreviations or acronyms, you say the full name at least once to aid transcription.
- I will also take some notes during the discussion.

Focus Group Questions:

1. Can you please tell me a bit about your experiences as a recent immigrant or refugee from Afghanistan living in Vancouver?
2. Can you share any experiences related to injuries or safety concerns you or a family member has faced at home in Canada?
3. How do you feel about your current home environment in terms of safety? Are there any things that you think could potentially cause injuries at home?
4. Could you share your thoughts on how safety practices might be different in Canada compared to Afghanistan or other places where you lived as a refugee before moving to Canada?
5. What specific safety concerns do you have for children or elderly family members in your household?
6. In what ways do you think your social circle (the people you know and interact with, including your friends, family, and neighbors etc.) or community support (childcare, financial assistance, and informational resources) might play a role in preventing unintentional injuries at home?
7. Could you discuss any strategies you have thought to be useful in integrating safety practices from Afghanistan with those in Vancouver?
8. In what ways do you think knowing the English language may impact your understanding of home safety practices or finding useful information regarding home injury prevention?
9. What are your thoughts on how someone's level of education might influence their access to resources and opportunities for enhancing the safety within their home to prevent injuries?
10. What things do you think could make communication regarding home safety easier for immigrants and refugees?
11. In what ways do you think community organizations and agencies can better support recent immigrants and refugees in maintaining/promoting home safety?
12. Are there any additional resources or support you feel would be beneficial in promoting home safety for immigrants and refugees from Afghanistan?
13. Do you have any final thoughts on how we can make homes safer for immigrant communities to prevent unintentional injuries within home?

Thank you for your time and participation in this focus group discussion.

Wrap-up prompt: WHAT IS SAID IN THE ROOM SHOULD STAY IN THE ROOM.

Appendix C: Focus Group Demographic Questions

DO NOT Put your name on this sheet.

INSTRUCTIONS: Please fill in this form. Your answers will provide us with some basic background information about you.

1. How would describe your gender? _____ (Please fill in or leave blank)
2. What is your age? _____ years
3. What is your ethnicity? _____
4. Do you have any disability? If yes, please specify: _____
5. How long you have been residing in Canada? _____ years
6. What is your residency status in Canada? _____
7. What is the type of housing you are living in? _____
8. What is your level of education? _____
9. Are you employed? If yes, please specify: _____

Please turn over this brief information sheet and leave it on the table when you leave. Thanks.

Chapter 5

Conclusion

When I started my doctoral training in Human Kinetics, I initially felt out of place. My background was firmly rooted in injury epidemiology and nursing, and I questioned whether I belonged in this disciplinary space. I remember being in class trying to understand how concepts about social relations, culture, and power could relate to injury epidemiology. It did not immediately make sense to me. During that period of ambiguity, one of my supervisors, Audrey, reassured me that the pieces would eventually come together. Over time, they did. As I moved forward in my doctoral training and research, I began to see how sociocultural theories from my coursework helped me move beyond viewing injuries as purely biomedical events and instead to understand them as shaped by social context, inequality, and lived experience. What earlier felt abstract gradually became vital to how I framed and interpreted my doctoral research.

Throughout my doctoral research, I developed a multidimensional understanding of unintentional home injuries in British Columbia (BC) across three interrelated studies. Beginning with population-level hospitalization data, I examined the distribution of home injury patterns across BC. I then extended this work through GIS-based spatial analysis to identify geographically patterned risk. Finally, I drew on community-engaged qualitative inquiry to contextualize these findings within the lived experiences of Afghan newcomer communities. In this chapter, I summarize the three publishable papers that collectively constitute this dissertation. I then examine how the findings from these three studies deepen equity-focused, spatially informed understandings of unintentional home injuries and the structural conditions that shape their distribution across BC. Next, I discuss the methodological and conceptual limitations of this research and offer recommendations for future work. Finally, I conclude with reflections on the insights I gained throughout my doctoral studies.

Summary of Papers

Paper One

In the first paper, I established the foundational epidemiological landscape of unintentional home injury hospitalizations in BC between 2015 and 2019 by examining how these injuries varied across four dimensions of the Canadian Index of Multiple Deprivation for BC (Khudadad et al., 2024). I observed a clear deprivation gradient, with significantly higher unintentional home injury hospitalization rates in neighbourhoods characterized by greater situational vulnerability, economic dependency, and residential instability compared to their less deprived counterparts. However, I found that neighbourhoods with larger immigrant and visible minority populations had lower unintentional home injury hospitalization rates than less diverse areas. This protective pattern highlights opportunities to design culturally informed injury prevention interventions and to draw lessons from practices within multicultural communities. I concluded that unintentional home injury hospitalizations are not randomly distributed but are instead influenced by social determinants of health. Furthermore, the counterintuitive finding regarding ethnocultural diversity raised important questions about immigrant health trajectories, cultural practices, and healthcare utilization patterns, warranting further investigation.

Paper Two

In the second paper, I used geospatial methods to identify hotspots of unintentional home-injury hospitalizations across BC (Khudadad et al., 2026). I also investigated specific neighbourhood characteristics associated with high-risk clusters. I observed that, after adjusting for age, home injury hospitalizations were mainly concentrated in urban areas such as the Lower Mainland and southern Vancouver Island. Moreover, I found that living in low-rise apartments, lacking formal education, and having low household income are key environmental and social factors contributing to the high rate of unintentional home injuries in these urban centres. I also

identified that home injury risks were not only spatially clustered, but that their determinants were spatially non-stationary, meaning that the same socioeconomic factors did not exert uniform effects across different geographic areas. I concluded that home injury prevention efforts should focus on high-risk urban communities identified through spatial analysis. Linking health data with physical and social environments generated a spatial signal indicating where the home injury burden was greatest, thereby laying the groundwork for more in-depth, community-engaged research into the factors driving these injury risks.

Paper Three

In the third paper (Khudadad et al., under review), I employed community-based participatory research (CBPR; Israel et al., 2005) guided by intersectional theory (Crenshaw, 1991) to examine how Afghan newcomers in the Greater Vancouver Area experience and navigate home-injury risks within resettlement contexts. This involved conducting nine semi-structured interviews and one focus group discussion followed by a reflexive thematic analysis (Braun & Clarke, 2019). The findings illustrated that Afghan newcomers' experiences of unintentional home injuries are shaped by their social positions as newly arrived, low-income, racialized, gendered, Muslims individuals, as well as by their limited power within housing, health, and policy systems that determine exposure to injury risks. I concluded that Afghan newcomers' vulnerability to home injuries was not primarily a function of cultural deficits or lack of knowledge but rather stemmed from structural inequities.

Research Implications

Together, my three papers deepen scholarly understanding of unintentional home injury risk as a phenomenon shaped by social structures and geographic factors. Across these three papers, I demonstrated how deprivation, place, and social positions influence injury exposure

and prevention efforts. In doing so, my doctoral research enhances injury prevention scholarship by combining epidemiological, spatial, and community-engaged approaches to offer a more nuanced and equity-focused understanding of unintentional household injury risks.

Methodological Contributions

Conducting my research in BC transformed my understanding of what rigorous injury scholarship requires. Access to comprehensive, population-level hospitalization data from the BC Injury Research and Prevention Unit, which was led by Ian, my co-supervisor, until his recent retirement, enabled me to conduct province-wide quantitative and geospatial analyses with precision and consistency. In this process, I recognized that the scope and extent of my analyses were made possible by a well-established data infrastructure, conditions that would not have been available had I attempted the same study in my previous homes in Pakistan or Afghanistan. At the same time, my community-based qualitative work underscored the limits of administrative data. Listening to participants' descriptions made it clear that relying solely on statistical patterns does not adequately capture the realities of people's lived experiences. Bringing together administrative health data, spatial epidemiology, and community-based discussions strengthened the coherence of my research. It elucidated that robust injury scholarship requires not only reliable data systems but also ongoing, meaningful engagement with the communities whose experiences are reflected in those data.

Measuring socioeconomic context in injury epidemiology has been limited by unidimensional methods that mask the intricate structure of neighbourhood disadvantage. Previous studies in BC and across Canada have mainly used unidimensional or material deprivation measures, such as income quintiles or composite wealth indices, to explore the relationship between socioeconomic status and injury hospitalizations (Burrows et al., 2016;

Rajabali et al., 2019; Zandy et al., 2019). Although these approaches offer useful insights, they reduce the complexity of disadvantage to a single measure, obscuring how multiple forms of social marginalization can simultaneously impact injury risk (Catalan, 2017). As such, in my first paper, I extended previous research by employing the Canadian Index of Multiple Deprivation (CIMD), a multidimensional framework that considers ethno-cultural composition, situational vulnerability, economic dependency, and residential instability as separate yet interconnected aspects of neighbourhood disadvantage (Statistics Canada, 2019). This approach is important; rather than simplifying socioeconomic context into a single score, researchers can use CIMD to analyze specific dimensions of deprivation and determine which are most strongly associated with inequitable health outcomes. For example, my finding that ethno-cultural diversity was inversely related to injury rates, whereas the other dimensions were positively associated, would not have been discernible through a single-measure index. This demonstrates the analytical power of a multidimensional method.

Although geospatial methods have long been recognized as powerful tools in broader public health surveillance (Hovenden & Liu, 2020; Kureshi et al., 2024; Lawson et al., 2015), injury epidemiology has traditionally relied heavily on descriptive mapping approaches that display crude rates or standardized mortality ratios without addressing spatial dependence, variance instability, or small-area population heterogeneity. As Forst and colleagues (2015) observed, such approaches can produce misleading interpretations, especially in sparsely populated areas where small case counts can inflate perceived risk. Consequently, simple choropleth mapping, while visually intuitive, may overstate spatial variation or conceal statistically significant clustering. GIS methods remain underutilized in injury research due to geocoding challenges, methodological traditions favouring conventional statistics, and a lack of

spatial analysis training among injury scholars (Bell & Schuurman, 2010; Cusimano et al., 2007; Singh et al., 2016). In my own work, the process of learning GIS required sustained effort, and it was frustrating at times. There were instances when model diagnostics did not perform as expected, when spatial autocorrelation results required further troubleshooting, and when I needed to revisit foundational concepts to interpret the outputs accurately. Gradually, through self-paced coursework, self-directed learning, and guidance from colleagues, the techniques became clearer. As I progressed through the analyses, I recognized how mapping injury hospitalization rates alongside measures of deprivation added depth to the findings.

Despite its potential, the adoption of advanced GIS techniques remains limited in injury epidemiology, with most studies continuing to rely on conventional mapping approaches rather than more sophisticated spatial modelling methods. My home injury spatial analysis work advanced this methodological landscape in two important ways. First, instead of relying solely on visual inspection of mapped rates, I used geospatial statistical analysis to determine whether observed clustering exceeded what would be expected by chance. This approach goes beyond simple visualization to offer statistically sound inferences about spatial patterns. Second, the analysis included regression diagnostics and geographically weighted regression to address spatial non-stationarity, acknowledging that the link between deprivation indicators and home injury hospitalization rates may change across space. Traditional global regression models assume consistent relationships across areas; in contrast, this approach allowed me to see how the relationships between neighbourhood deprivation and home injury risks vary across places, uncovering context-specific structural dynamics that simple maps cannot capture. Instead of just showing where injuries happen, through the geospatial modelling framework used in this dissertation, I identified statistically significant clusters, measured the strength of the relationship

between multidimensional deprivation and home injury hospitalizations, and highlighted spatial differences in these relationships.

As immigrant populations continue to grow and they face persistent barriers to accessing healthcare in Canada, research that meaningfully engages members of these communities is essential to addressing health disparities. Community-engaged research involves equitably partnering with communities throughout all phases of the research process, grounding the work in lived experience, building mutual capacity for culturally relevant and rigorous inquiry, and generating findings that translate into tangible improvements in community wellbeing (Israel et al., 2005; Wallerstein et al., 2018). In Canada, much of the existing community-based participatory research with newcomer populations has concentrated on mental health (Charles-Rodriguez et al., 2023), trauma (Naqvi et al., 2025), and psychosocial integration (Elshahat et al., 2025), with comparatively limited attention to unintentional injuries as a domain of health inequity. Although scholars have broadly acknowledged that community engagement enhances research rigor (Israel et al., 2005; Wallerstein & Duran, 2010), there remains a need to more clearly articulate how community participation strengthens the inquiry process in ways that produce meaningful and positive impacts for the communities involved.

My CBPR with Afghan newcomers in the Greater Vancouver Area offers a practical example for meaningfully engaging members of newcomer communities as equitable partners in injury research. Although I had linguistic and cultural alignment with participants, there were oversights that community partners helped me identify. For example, members of the community advisory board noted that potential participants might view the study as a safe space to disclose home injuries related to domestic violence. Recognizing the ethical responsibility to respond appropriately and the risk of re-traumatization, I pursued additional training in trauma-informed

practice and referral protocols. This training not only prepared me to manage potential disclosures ethically but also reshaped my broader engagement with the community by deepening my understanding of how forced migration, resettlement stressors, and pre-migration trauma could influence participants' accounts of trust in research and comfort in discussing injury experiences. I would strongly recommend that scholars engaging immigrant and refugee communities in research undertake similar trauma-informed preparation.

While a core principle of CBPR is recognizing the community as a shared unit of identity (Wallerstein et al., 2018), I applied an intersectional theoretical lens to ensure the community was not treated as homogeneous. This was important because Afghan newcomers include diverse subgroups, differing in ethnicity, language, religious and cultural practices, and sociopolitical views towards modernization. Applying an intersectional lens to my qualitative work allowed me, as a researcher, to promote more equitable engagement by intentionally involving CAB members from ethnically diverse Afghan subgroups and drawing on their input throughout the research process. This included working with CAB members to adapt recruitment strategies, refine interview and focus group guides, and ensure that questions were responsive to different lived experiences related to home injury risks and safety practices. I also remained attentive during data collection to how factors such as language, gender, and migration experiences shaped participation and responses, and adjusted my approach accordingly.

Complementary Insights Across the Studies

The three papers comprising this dissertation are not simply standalone contributions; rather, they collectively and progressively deepen understanding of home injury inequities in BC. Each paper built upon and critically refined the findings of the previous one, generating a layered

and nuanced understanding of how place-based disadvantage, spatial dynamics, and immigrant experiences intersect to shape home injury risk.

While in Paper one, I demonstrated socioeconomic gradients in home injury rates across geographic areas, the analytic approach treated areas as independent units and did not test whether observed differences reflected meaningful spatial clustering or broader spatial processes. In Paper two, I addressed this limitation by explicitly modelling spatial relationships and demonstrating that home injury rates in one area were statistically associated with rates in neighbouring areas. This shift from non-spatial to spatial modelling aligns with established geospatial epidemiological approaches that have been used to emphasize the importance of accounting for spatial dependence in area-level health research (Singh et al., 2016). Notably, when I conducted hotspot analysis at the dissemination area (DA) level, it was inconclusive due to the relatively low counts of home injury hospitalizations within individual DAs, which is inherent to micro-geographic units. To address this limitation, I conducted geospatial analysis at the census subdivision level, where larger population denominators improved stability and enabled clearer identification of spatial clustering.

The qualitative findings from Paper 3 not only provided mechanism-based explanations for the deprivation gradients observed in Paper 2 but also helped contextualize the seemingly protective link between ethnocultural composition and home injury hospitalization rates identified in Paper 1. While the ecological analyses indicated that areas with higher ethnocultural diversity had lower home injury hospitalization rates, this pattern could not be interpreted with certainty from administrative data alone. This pattern may have been a reflection of underreporting driven by institutional mistrust (Lin, 2024), as participants in Paper 3 described hesitating to seek acute care for injuries due to concern that doing so might trigger scrutiny by

child protection services. In addition, while the hotspot analysis identified neighbourhoods with increased injury rates, accounts of participants in Paper 3 illustrated that even within these high-risk areas, Afghan newcomers were not homogeneously vulnerable to home injury risks. For example, when low income and limited English proficiency co-occurred, vulnerability to home injury intensified because language barriers limited access to safety information and the ability to navigate healthcare services, while financial precarity restricted families' capacity to make safety modifications within their homes. As such, the findings from Paper 3 underscore that population-level patterns observed in administrative data must be interpreted cautiously and contextually, as they may mask important within-group variations and barriers to healthcare and social services.

Implications for Injury Prevention Efforts in Canada

Unintentional home injuries among newcomers are shaped by housing and settlement conditions, requiring systemic reform of the conditions that produce injury risk, rather than as an individual knowledge deficit to be rectified through education alone. While education has value in preventing unintentional injuries (Pike et al., 2015), my doctoral research demonstrated that it is not enough when newcomer families live in structurally unsafe housing and lack the economic resources to implement safety recommendations. Moreover, while BC has several injury prevention initiatives, such as fire safety programs (Al-Hajj et al., 2023), social marketing campaigns (Smith et al., 2018), and community-based fall prevention programs (Health Link BC, 2025), significant inequities remain in access to these services. Addressing injury hazards within the home can prevent health losses, especially for populations disproportionately exposed to unsafe housing conditions, including low-income households, children, older adults, people with disabilities, and other structurally vulnerable groups. Importantly, the evidence suggests that such interventions are economically justified; the reductions in injury-related hospitalizations

and associated health care costs tend to exceed the investments required to improve home safety, resulting in overall net societal benefits (Keall et al., 2017; Liu et al., 2012).

While rental housing regulation exists in Canada, it is largely not regulated through a coherent, proactive injury-prevention framework, but rather through fragmented, reactive systems that often fail to protect those most at risk. Rental housing safety in Canada is regulated through a mix of provincial tenancy law (e.g., BC's *Residential Tenancy Branch* or Ontario's *Residential Tenancies Act*), municipal property standards, fire and building codes, and landlord repair obligations (Murray, 2020). However, these protections are fragmented across jurisdictions, mainly activated through tenant complaints, and weakly tied to public health mandates (RentSafe, 2025). As a result, preventable home hazards often persist in low-income rental housing where tenants have limited power to demand change without risking displacement. Moreover, weak rent regulation can indirectly worsen injury risk because unaffordable housing pushes tenants into poorer-quality housing or unstable tenancies (Chisholm et al., 2018). According to the Canadian Centre for Housing Rights (2023), rent regulation across Canada is patchy, with some provinces lacking rent controls altogether and others providing only limited protection against steep rent increase and displacement. Notably, the UK offers a useful model; its Housing Health and Safety Rating System uses an injury-focused framework that requires local authorities to assess dwellings against specified home safety hazards and to treat serious "Category 1" hazards as triggering a legal duty to take enforcement action (Donald, 2022). For effective regulation of rental housing, it is important to implement comprehensive safety standards and enforcement mechanisms, supported by collaboration among public health, housing, and community stakeholders.

While home safety checklists and inspection protocols have been developed to identify household hazards systematically, these tools must be intentionally adapted and made accessible to newcomer communities in Canada through culturally appropriate, linguistically relevant, and community-based delivery approaches. For example, in a population-based study of older Chinese women in Chicago, researchers partnered with 20 Chinese community organizations and engaged 3,159 older women using culturally and linguistically appropriate recruitment strategies (Chang et al., 2016). These strategies included outreach delivered in participants' preferred Chinese dialects, collaboration with trusted community centers, senior housing, faith-based groups, and social clubs, and in-home interviews conducted by culturally matched staff. This collaborative approach helped identify and address key health concerns, including home-related injuries such as falls. In a related context, from 2012 to 2019, nearly 4,000 families in Cincinnati, United States, received home safety education and equipment through community-based partnerships, resulting in a 28.4% reduction in injury rates in intervention communities compared to those without the program (Pulliam et al., 2023). The success of these initiatives was grounded in culturally and linguistically tailored approaches, transparent data sharing, sustained community engagement, continuous evaluation of program outcomes, and iterative adjustments based on community feedback. As such, home injury prevention for Afghan immigrant and refugee communities should be co-designed with community members, delivered through trusted settlement and cultural networks, and paired with material supports to ensure that safety recommendations are both culturally relevant and practically feasible.

Effective home injury prevention strategies should also be geographically targeted, with particular attention to socioeconomically disadvantaged neighbourhoods, as findings from this dissertation demonstrated that the risk of home injury-related hospitalization varies across

geographic areas in BC. As such, place-based home injury prevention approaches can be effective because they are designed to address the physical and social conditions of high-risk neighbourhoods (Dankwa-Mullan & Pérez-Stable, 2016; McGowan et al., 2021). For example, from 2012 to 2014, a place-based home injury prevention initiative implemented in a high-injury urban community in the United States involved trained community volunteers conducting in-home safety visits to 207 households (Falcone et al., 2016). During these visits, volunteers installed a bundle of safety devices, including stair gates, window locks, cabinet latches, and smoke alarms, and provided tailored safety education to caregivers. Overall, observed injuries were 59% lower than expected in intervention households, compared with a 6% increase among households that did not receive the intervention. This intervention was effective because it targeted a community vulnerable to home injury risks, was delivered directly in the home, and combined the free installation of evidence-based safety devices with tailored safety education. Moreover, for place-based interventions to achieve broader and more equitable impact, they need to be implemented at a scale that aligns with the neighbourhood-level distribution of socioeconomic disadvantage (McGowan et al., 2021). Place-based home injury prevention efforts are most effective when they are built on cross-sector collaboration and actively engage communities to leverage local resources and address shared safety concerns at scale (Boyce, 2013).

Integrating home injury prevention into settlement policy and programming for newcomers is more effective when it is embedded across policies, sectors, and routine practices, not added as a standalone project (Ma et al., 2021). While immigrants arrive in Canada with better health than their Canadian-born counterparts (Lu & Ng, 2019), the early years of resettlement present a critical window of opportunity to sustain these protective effects, as

newcomers are most consistently engaged with settlement services during this period. An equity-oriented approach is therefore essential, given the diversity of newcomer experiences and household contexts that shape exposure to home injury risks and access to prevention resources. This underscores the importance of integrating principles of equity, diversity, and inclusion into home injury prevention efforts to address inequities in risk, enhance accessibility, and ensure prevention strategies are responsive to diverse living conditions (Lennon et al., 2022).

Incorporating an intersectional understanding of the factors shaping newcomers' home environments enables injury prevention initiatives to better address inequities in risk and to design prevention strategies that are inclusive, culturally responsive, and accessible to diverse populations (Miles et al., 2022). Moreover, ensuring equitable access to the social determinants of health through supportive programs and policies strengthens the effectiveness of home injury prevention strategies by creating conditions in which individuals are better able to engage with preventive interventions once their fundamental needs are met (Braveman & Gottlieb, 2014).

Although knowledge mobilization has been relatively underdeveloped in injury research (Bugeja et al., 2011; Hanson et al., 2012; MacKay & Vincenten, 2009), it is essential for ensuring that evidence meaningfully informs injury prevention policy, programs, and practice. To prevent home injuries and reduce associated harms among newcomers in BC, home injury prevention education should be integrated into routine settlement services, including orientation sessions, language training, and housing navigation supports. Aligning prevention efforts with trusted settlement services accessed during early resettlement can enhance engagement and improve the uptake and impact of home injury prevention initiatives. An example of this approach is the *Safe Work Toolkit for Newcomers* in Ontario, which is designed for delivery through settlement agencies as part of regular newcomer orientation and language programs to

build awareness of occupational health and safety rights, workplace hazards, and appropriate responses to work-related injuries (Kosny et al., 2014). Specifically for Afghan newcomer communities, home safety materials should be linguistically accessible and co-created with community members to ensure cultural relevance and usability. As such, I am working with my MITACS partner, Pacific Public Health Foundation to design a tailored home safety checklist and fall prevention infographic. Both resources will be developed in Dari and Pashto, using intuitive visuals to support low-literacy users, and will be refined through iterative feedback from the members of CAB. These materials will be strategically distributed through settlement service agencies across Greater Vancouver and integrated into newcomer orientation packets to provide Afghan newcomer families with practical tools for creating safer home environments.

Public health agencies can further strengthen equity-oriented prevention by routinely integrating area-based deprivation measures, such as the CIMD, into injury surveillance and reporting systems. Currently, injury researchers often rely on ad hoc deprivation linkages to contextualize their analyses of injury data (Khudadad et al., 2024, 2026; Rajabali et al., 2019; Zandy et al., 2019). While the Canadian Hospitals Injury Reporting and Prevention Program is a well-established sentinel system for capturing proximal causes of injury events (Crain et al., 2016), it remains largely event-focused rather than equity-informed in the absence of integrated deprivation measures that identify upstream structural injury risks. Moreover, the pan-Canadian *Health Inequalities Data Tool* supports deprivation analysis (Public Health Agency of Canada, n.d.), but injury reporting remains fragmented across provinces and territories in Canada, which limits national comparability. An example of how a deprivation-integrated injury surveillance system could be established is the Canadian Chronic Disease Surveillance System (CCDSS; Lix et al., 2018)). In the CCDSS, administrative data from physician billing records, hospitalizations,

and disease registries are deterministically linked to census-derived deprivation indices across provinces and territories, enabling the production of standardized, equity-stratified prevalence and mortality reports.

Limitations

My research had several limitations. First, my secondary data analysis of administrative health data included only home injuries severe enough to require acute inpatient care. Second, the dataset did not capture post-2020 (COVID-19 pandemic) trends, thereby omitting critical shifts in injury patterns driven by public health measures. Third, in my CBPR work, 12/17 participants identified as women, which underrepresented other genders' perspectives on home injury risks and safety practices.

While in my dissertation, I leveraged available administrative data to offer meaningful insights into severe home injuries requiring hospitalization (Khudadad et al., 2024, 2026), it did not capture home-related injuries managed in emergency departments or primary care settings, nor those that were underreported. This inherent data constraint limited my ability to capture the full spectrum of home injury risk. The structural limitations of inpatient administrative data are well documented in the methodological literature (Boncyk et al., 2020; Crain et al., 2016). Electronic medical records (EMRs) in primary care settings offer an emerging and valuable opportunity to capture timely, longitudinal information on injury-related conditions that are often absent from traditional administrative databases (Bang et al., 2020). Importantly, linking primary care EMR data with hospital and emergency department records has considerable potential to strengthen injury surveillance by providing a more comprehensive picture of injury occurrence, severity, patterns of care, and longer-term outcomes across the continuum of care.

A key limitation of this dissertation is that the administrative data accessible at the time of analysis were available only up to 2019, which constrained my ability to explore changes in injury patterns during and following the COVID-19 pandemic. Emerging evidence suggests that lockdowns and mobility restrictions altered both the volume and context of unintentional injuries, with reductions observed in injuries occurring in public spaces (e.g., road traffic collisions, workplace, and sport-related injuries), alongside increases in home-based injuries, including those related to domestic activities, recreational equipment, and do-it-yourself projects (Karmali et al., 2024). Similarly, hospital-based evidence indicates an overall decline in trauma volume during lockdown periods, alongside an increased proportion of injuries occurring in residential settings, reflecting changes in daily activity patterns and exposure environments (Jaber et al., 2021). Such findings underscore that the COVID-19 pandemic functioned as a natural experiment that reshaped risk environments, social behaviours, and healthcare utilization in ways that are not captured in pre-2020 datasets. As a result, the patterns identified in this dissertation, while robust for the pre-pandemic period, may not fully reflect the dynamic and evolving nature of home injury risk in the context of large-scale societal disruptions.

While women's perspectives were essential, the experiences of gender-diverse Afghan newcomers related to home injury risk and prevention remain underrepresented. People from LGBTQIA+ communities, particularly within immigrant and refugee populations, may experience unique home injury risks shaped by unstable living arrangements and limited access to safe, affirming spaces (Ghabrial et al., 2024; Gottvall et al., 2025). In injury research, LGBTQIA+ communities remain underrepresented due to limited collection of sexual orientation and gender identity data (Ghorbanian et al., 2022), and barriers to participation driven by mistrust and concerns about safety and disclosure (Koch et al., 2023). While gender expression

within Afghan communities is shaped by patriarchal norms (Nourpanah, 2014), which may shift as individuals adapt to Canadian contexts, I made efforts to engage Afghan networks in the Greater Vancouver Area to identify LGBTQIA+ participants. These efforts were limited, as LGBTQIA+ Afghan individuals may not be connected to mainstream community networks and may instead rely on more specialized, queer-serving organizations. This highlighted a limitation of standard CBPR approaches in reaching this population without more intentional, trauma-informed, and targeted strategies (Ricks et al., 2022). In the future, injury scholars could address this by partnering directly with LGBTQIA+ organizations to support more inclusive and ethically grounded participation in injury-related research.

Future Research

While in this dissertation I demonstrated the value of applying intersectionality in qualitative analyses of home injury experiences among Afghan newcomers in the Greater Vancouver Area, there is a need for future research to prioritize the integration of intersectional approaches within quantitative injury research. Although the quantitative phases of this dissertation provided valuable insights into deprivation gradients linked to home injury hospitalization rates (Khudadad et al., 2024, 2026), these analyses relied on traditional stratification by single demographic factors that mask subgroup disparities. Intersectionality can be operationalized in quantitative injury research through what McCall (2005) described as an “inter-categorical” analytical approach (p. 1773). Methodologically, inter-categorical analysis employs multiple categorical measures, often referred to as “categories of difference,” to investigate the experiences of groups delineated along various axes of identity (McCall, 2005, p. 1784).

Future research should move beyond descriptive analyses of home injury risk to examine exposure–response relationships that more precisely link environmental conditions with injury outcomes. Specifically, studies are needed to assess how the number and type of hazards within the home interact with the amount of time individuals spend in that environment to influence both the frequency and severity of injuries. For example, Keall and colleagues (2008) examined the relationship between home hazards and injuries requiring medical or related services among household members. They found that each additional hazard was associated with a 22% increase in the odds of injury occurrence. Such work would help clarify causal pathways and inform prioritization of prevention efforts, particularly for populations who spend disproportionate amounts of time in the home due to caregiving roles, unemployment, disability, or housing precarity.

While my CBPR helped illuminate the home injury experiences of Afghan newcomers, future injury research would benefit from sustained collaboration with members of Afghan communities to co-create home injury prevention programs that are responsive to their lived experiences, needs, and priorities. Injury prevention programs that are community-led and co-designed have been shown to produce positive outcomes for communities experiencing marginalization (Guillot-Wright et al., 2022; Pollard-Wharton et al., 2025). Co-designing requires the meaningful engagement of end users throughout the research and intervention development process (Slattery et al., 2020), and it is particularly well-suited to injury prevention efforts with Afghan newcomer communities (Meigs et al., 2025). Engaging individuals who are marginalized by systemic barriers in the design process ensures that their perspectives, lived experiences, and needs inform intervention development, leading to more relevant, acceptable, and effective outcomes (Ross et al., 2025).

Conclusion

Throughout my dissertation, I engaged with three distinct methodological approaches to present a multi-layered understanding of unintentional home injuries in BC, Canada. The quantitative analyses of neighbourhood deprivation and geospatial clustering highlighted the role of socioeconomic gradients and place-based patterns in home injury risk, while the community-based participatory research with Afghan newcomers contextualized these findings by illustrating how home injury risks are experienced, negotiated, and mitigated within households during the resettlement process. Through this work, I realized that no single method can fully capture the complexity of home injury risks; instead, I developed a more nuanced understanding when I examined home injuries through these approaches in relation to one another. Notably, the application of intersectional theory in my CBPR work prompted me to reflect on how social positions and intersecting processes of oppression, privilege, policy, and institutional structures shape both home injury risks and prevention efforts. As an injury scholar, I will carry this intersectional perspective forward in my work. Importantly, this dissertation reshaped how I see my role as an injury researcher, reinforcing the value of reflexivity, partnership, and humility, and strengthening my commitment to producing research that not only documents inequities but also supports meaningful, community-informed change. I am grateful to all those who rode along with me on this journey and have become part of a growing community committed to making meaningful change through equity-oriented scholarship.

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Appendix A: University of Ottawa Ethics

08/07/2025

Université d'Ottawa

Bureau d'éthique et d'intégrité de la recherche

University of Ottawa

Office of Research Ethics and Integrity

CERTIFICAT D'APPROBATION ÉTHIQUE | CERTIFICATE OF ETHICS APPROVAL

Numéro du dossier / Ethics File Number

H-07-24-10239

Titre du projet / Project Title

 Understanding unintentional
home injuries among recent
Afghan immigrants and refugees
in Vancouver, BC: A
community-based participatory
research approach

Type de projet / Project Type
Thèse de doctorat / Doctoral
thesis
Statut du projet / Project Status

Renouvelé / Renewed

Date d'approbation (jj/mm/aaaa) / Approval Date (dd/mm/yyyy)

15/07/2024

Date d'expiration (jj/mm/aaaa) / Expiry Date (dd/mm/yyyy)

14/07/2026

Équipe de recherche / Research Team

**Chercheur /
Researcher**
Affiliation
Role

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KineticsChercheur Principal / Principal
Investigator

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École des sciences de l'activité physique / School of Human
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Superviseur / Supervisor

Ian PIKE

UBC

Co-superviseur / Co-supervisor

Conditions spéciales ou commentaires / Special conditions or comments

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