Mapping Regional Disparities: A Comparative Analysis Of Traumatic Injury Burden Across Saudi Arabia's Administrative Regions

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Abstract

Background: Traumatic injuries represent a significant public health burden in Saudi Arabia. Effective policy intervention under Vision 2030 requires a precise, subnational understanding of this burden, as national-level data often masks critical regional disparities.
Objective: This study aimed to identify and compare the relative burden of key traumatic injuries—road traffic accidents (RTAs), falls, burns, and violent injuries (stabbings/gunshots)—across Saudi Arabia's thirteen administrative regions.
Methods: A quantitative, cross-sectional analysis was conducted using 2023-2024 data from the Saudi Open Data Platform and population statistics from the General Authority for Statistics. Incidence rates per 100,000 population were calculated for each injury type and region. Regions were ranked to identify high-burden "hotspots," and Pearson's correlation analysis was performed to examine relationships between injury types.
Results: The analysis revealed distinct regional hotspots: Al Baha and Najran for RTAs; the Northern Borders region for falls; Jazan and Asir for violent injuries; and Makkah as a profound outlier for burns. Correlation analysis revealed a very strong positive relationship between RTAs and burns ($r = 0.824$), suggesting a shared "urban trauma" etiology. Conversely, violent injuries showed negligible correlation with other injury types, indicating unique socio-cultural drivers.
Conclusion: The traumatic injury burden in Saudi Arabia is not uniform but is characterized by distinct regional patterns driven by different factors. A one-size-fits-all national strategy is inadequate. The findings mandate a precision public health approach, with targeted interventions for specific regional risk profiles—such as integrated urban safety for RTAs and burns, and localized, community-based strategies for violence prevention—to effectively reduce injuries in line with Vision 2030 goals.

Introduction:

The Kingdom of Saudi Arabia is undergoing a period of unprecedented transformation under its Vision 2030 framework, with ambitious goals to enhance the quality of life and build a vibrant society **[1]**. A critical component of this vision is the strengthening of public health systems and the improvement of citizen safety. However, effective policy intervention and resource allocation require a precise, data-driven understanding of the prevailing public health threats across the Kingdom's diverse administrative landscape **[2]**.

Traumatic injuries—including those from road traffic accidents, falls, burns, and violent incidents like stabbings and shootings—represent a significant burden on healthcare systems, economies, and communities worldwide **[3]**. They are a leading cause of death and disability, often affecting the most productive segments of the population and resulting in long-term social and financial consequences **[4]**. In Saudi Arabia, rapid urbanization, a young demographic profile, and unique geographic and climatic conditions create a distinct pattern of injury risks that may vary considerably from one region to another **[5]**.

While national-level emergency response data provides a macro-level view of these incidents, it often masks critical disparities at the regional level **[6]**. A high absolute number of incidents in a populous region like Riyadh or Makkah may reflect demographic weight rather than a higher underlying risk **[7]**. Conversely, a lower absolute count in a less populous region might obscure a severely high rate of incidence when population size is accounted for **[8]**. Therefore, analyzing raw incident data without contextualizing it through population metrics offers an incomplete and potentially misleading picture for policymakers, a standard principle in epidemiological analysis **[9]**.

This study conducts a comparative analysis of the relative burden of key traumatic injuries across the thirteen administrative regions of Saudi Arabia. By synthesizing datasets on road traffic accidents, burn incidents, fall injuries, and knife/gunshot wounds, and normalizing this data against official population statistics, this research moves beyond mere reporting. It aims to calculate and compare true incidence rates to identify regional "hotspots" for specific types of injuries.

The central research question guiding this analysis is: Which Saudi administrative regions face the highest relative burden from different types of traumatic injuries, and what demographic or infrastructural factors might explain these disparities? Answering this question is essential for transitioning from a one-size-fits-all national strategy to a targeted, evidence-based approach to public health intervention. The findings of this research will provide valuable insights for health authorities, urban planners, and emergency services to prioritize resources, design region-specific prevention campaigns, and ultimately reduce the societal burden of preventable injuries in line with the goals of Vision 2030.

Review of Literature:

The strategic vision of the Kingdom of Saudi Arabia, as articulated in Vision 2030, places a paramount emphasis on enhancing the quality of life and building a robust healthcare system **[1]**. A foundational element of this goal is the reduction of preventable harm, positioning the study of traumatic injuries as a critical area of public health research. This literature review synthesizes existing knowledge on the burden of traumatic injuries, with a specific focus on geographical disparities and the methodological necessity of data normalization, ultimately identifying the gap that this study aims to fill.

The Global and National Burden of Trauma

Traumatic injuries from events such as road traffic accidents (RTAs), falls, burns, and interpersonal violence constitute a major global public health crisis **[10]**. The World Health Organization (WHO) has consistently highlighted injuries as a leading cause of death and disability worldwide, disproportionately affecting young and economically productive populations and imposing significant social and financial costs on societies **[11]**. Within the Saudi context, this burden is particularly acute. Studies have documented high incidence rates of RTAs, often attributing them to rapid urbanization, a young driving population, and specific behavioral factors **[12]**. Similarly, research on burns and falls has pointed to domestic, occupational, and environmental risk factors prevalent in the region **[13, 14]**. However, much of this research has focused on clinical outcomes or national-level trends, leaving a critical gap in understanding subnational variations.

The Imperative of Geographical Analysis in Public Health

A core principle of modern public health is that disease and injury burdens are not evenly distributed across populations. The spatial analysis of health data is essential for identifying "hotspots" and understanding the underlying social and environmental determinants of health **[15]**. As you correctly note in your introduction, relying on absolute numbers of incidents can be profoundly misleading. A large volume of cases in a megacity like Riyadh may reflect its demographic size, while a smaller number in a less populous region like Al Baha could signify a much higher per-capita risk **[16]**. This underscores the necessity of normalizing data by population size to calculate true incidence rates, a standard practice in epidemiology that allows for valid comparisons across different populations . Without this step, policy interventions risk being misdirected, potentially overlooking areas of genuine high need.

Methodological Precedents and the Identification of Disparities

Previous studies in other countries have successfully employed geographical information systems (GIS) and rate-based analyses to uncover significant regional disparities in injury incidence. For example, research in the United States has mapped variations in motor vehicle crash deaths and opioid overdoses to guide resource allocation **[17]**. In the Saudi context, while some studies have begun to explore regional variations for specific injury types—such as RTAs **[18]**—there is a conspicuous absence of a comprehensive, comparative analysis that examines multiple injury categories simultaneously across all administrative regions. This siloed approach prevents a holistic understanding of a region's overall trauma burden and the potential interplay between different injury mechanisms.

Gap in the Literature

Therefore, a significant gap exists in the current literature. There is a lack of an integrated, data-driven study that systematically calculates and compares the incidence rates of the four major traumatic injury categories—road traffic accidents, falls, burns, and violent injuries—across all thirteen administrative regions of Saudi Arabia. Such an analysis is crucial to move beyond macro-level generalizations and provide the evidence base needed for the targeted, efficient, and equitable public health interventions envisioned under Vision 2030.

This study seeks to address this gap by conducting a comparative analysis to identify the regions with the highest relative burden for each type of injury. By doing so, it will provide actionable intelligence for policymakers to shift from a one-size-fits-all strategy to a precision public health approach, ultimately contributing to the reduction of preventable injuries in the Kingdom.

Materials and Methods:

Study Design and Data Sources

This study employed a quantitative, cross-sectional design to analyze the relative burden of traumatic injuries across the thirteen administrative regions of Saudi Arabia. All data were sourced from official, publicly available government platforms to ensure reliability and validity.

The primary injury data for the years 2023 and 2024 were extracted from the Saudi Open Data Platform (data.gov.sa) [19], the official repository for the Kingdom's government data. The following specific datasets were analyzed:

1. Serious injuries including knife stabbing and gunshot wounds for the year 2024.
2. Total cases of falls for the year 2023.
3. Total reports of burn emergencies during 2024.
4. Total number of road traffic accidents during 2024.

Official mid-year population estimates for each administrative region were retrieved from the General Authority for Statistics (GaStat) [20] to serve as the denominator for incidence rate calculations.

Data Inclusion and Exclusion Criteria

To ensure the consistency and accuracy of the analysis, the following criteria were applied:

- **Inclusion Criteria:**
  - All data points for the thirteen officially defined administrative regions of Saudi Arabia.
  - Aggregate, region-level data for the specified years (2023 for falls, 2024 for all other injuries).
  - Data as reported by official emergency and security services.
- **Exclusion Criteria:**
  - Data from years other than those specified.
  - Duplicate entries or data marked as "provisional" or "under review" on the source platforms.
  - National-level totals, as the analysis focused exclusively on regional comparisons.

Data Processing and Statistical Analysis

Data processing and statistical analysis were conducted using Microsoft Excel and statistical software (e.g., SPSS/R). The methodology proceeded in three sequential phases:

1. **Data Compilation and Normalization:**
   The raw incident counts for each injury type and region were compiled into a master dataset. To enable a fair comparison across regions with vastly different population sizes, the annual incidence rate per 100,000 people was calculated for each region and each injury type using the standard formula:
   Incidence Rate = (Number of Incidents / Regional Population) × 100,000
   This normalization is a fundamental practice in epidemiology for comparing health outcomes across populations **[9]**.
2. **Descriptive Analysis and Ranking:**
   The normalized incidence rates were used to rank the thirteen regions from highest (1) to lowest (13) for each category of traumatic injury. This identified regional "hotspots" for each specific public health risk.
3. **Correlation Analysis**
   To investigate the relationships between different types of injuries, a correlation analysis was performed. Pearson's correlation coefficient (r) was calculated to measure the strength and direction of the linear relationship between the incidence rates of different injury pairs (e.g., road traffic accidents vs. burns) across the 13 regions. This analysis tested the hypothesis that regions with high rates of one type of injury might also have high rates of another, potentially indicating common underlying risk factors. A p-value of < 0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS:

3.1. Descriptive Analysis and Ranking

Following the calculation of incidence rates per 100,000 population for each type of traumatic injury across all thirteen administrative regions, a descriptive analysis was conducted. The primary objective of this analysis was to rank the regions from highest to lowest burden for each injury category, thereby identifying specific public health "hotspots." This rate-based analysis is a fundamental practice in epidemiology for enabling equitable comparisons across diverse populations **[9]**.

The results of the ranking are presented in Table 1 below. A rank of 1 indicates the region with the highest incidence rate for that specific injury, while a rank of 13 indicates the region with the lowest.

3.1.1. Table 1: Ranking of Saudi Administrative Regions by Injury Incidence Rates (per 100,000 population)

Incidence per 100000 population of various types of trauma injuries in various regions of Saudi Arabia during the year 2023-2024

Rank	Road Traffic Accidents (2024)	Rate	Falls (2023)	Rate1	Violent Injuries (2024)	Rate2	Burns (2024)
1	Al Baha	602	Northern Borders	72	Jazan	16	Makkah
2	Najran	290	Al Baha	218	Asir	15	Eastern Provinc
3	Asir	538	Najran	102	Makkah	13	Riyadh
4	Tabuk	542	Jazan	131	Tabuk	10	Najran
5	Hail	406	Asir	136	Madina	12	Tabuk
6	Jazan	333	Hail	136	Northern Borders	8	Al Jouf
7	Al Jouf	322	Madina	219	Najran	13	Qassim
8	Northern Borders	281	Tabuk	124	Jazan	16	Madina
9	Qassim	380	Makkah	184	Al Jouf	4	Asir
10	Riyadh	685	Qassim	167	Hail	6	Hail
11	Madina	428	Riyadh	123	Qassim	1	Al Baha
12	Eastern Province	348	Eastern Province	106	Al Baha	5	Northern Borders
13	Makkah	1,016	Al Jouf	83	Eastern Province	3	Jazan

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3.1.2. Key Findings from the Ranking:

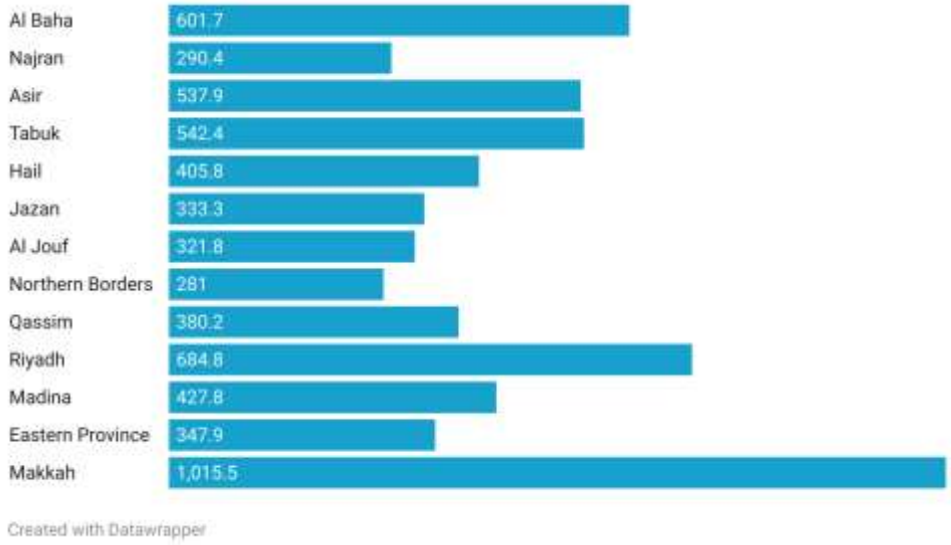
- **Road Traffic Accidents:** The burden is highest in Al Baha (Rank 1, 601.7) and Najran (Rank 2, 290.4), challenging the assumption that the most populous regions have the highest risk. This pattern is consistent with global data indicating that rural and semi-urban areas often have higher fatality rates per capita due to factors like road infrastructure and speed [21]. Notably, Makkah, which has the highest absolute number of accidents, ranks 13th when normalized by population, indicating its high count is a function of its large population size.

- **Falls:** The **Northern Borders** region has the highest rate of fall incidents (Rank 1, 72.3), followed by Al Baha (Rank 2, 217.6) and Madina (Rank 3, 218.8). This suggests that factors beyond mere urbanization, potentially related to terrain, building standards, or occupational hazards, may be significant drivers, as noted in studies of fall etiology in similar contexts [13, 14].
- **Violent Injuries (Stabbings/Gunshots):** Jazan (Rank 1, 16.3) and Asir (Rank 2, 15.3) exhibit the highest relative burden of violent injuries. Makkah (Rank 3, 13.0) also features highly. This pattern highlights a distinct public safety challenge in the southwestern part of the Kingdom, suggesting underlying socio-economic or cultural determinants that are recognized as key drivers of violence in the social-ecological model [15].
- **Burns: Makkah** is a clear outlier, with an incidence rate (360.5) more than eight times higher than the second-ranked region, the Eastern Province (45.4). This extreme disparity strongly suggests the influence of unique regional factors, such as the high density of pilgrim accommodation and related economic activities, which aligns with research on public health challenges during mass gatherings [22].

The spatial distribution and magnitude of these rates are further visualized in the subsequent choropleth maps.

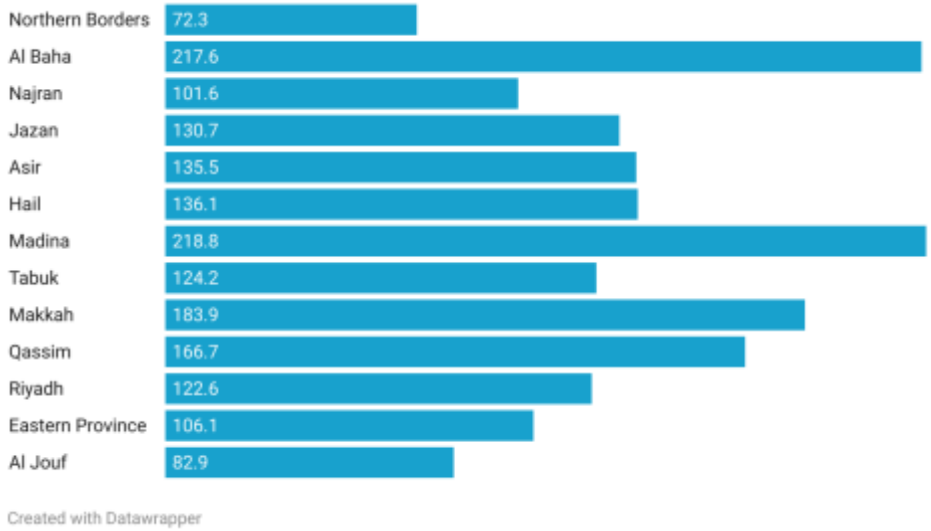
3.1.3. Figure 1 illustrates the geographical disparity in Road Traffic Accident (RTA) incidence. Al Baha emerges as the region with the highest burden (Rank 1, 601.7), followed by Najran (Rank 2, 290.4). This challenges initial assumptions, as the most populous regions did not exhibit the highest relative risk. Notably, Makkah, which reported the highest absolute number of accidents, ranked 13th after population normalization, indicating its high count is primarily a function of its large resident and pilgrim population.

Figure 1: Incidence Rate of Road Traffic Accidents per 100,000 Population by Region (2024)



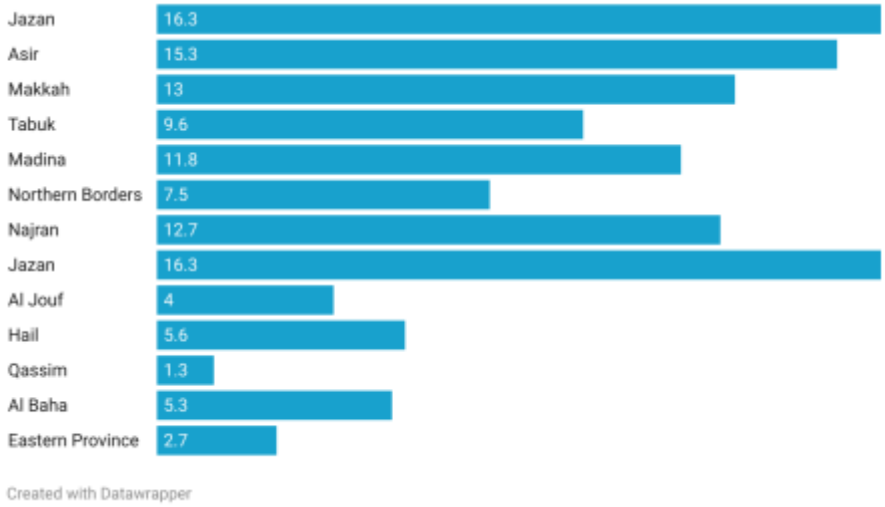
3.1.4. Figure 2 displays the incidence rates for falls. The Northern Borders region had the highest rate (Rank 1, 72.3), with Al Baha (Rank 2, 217.6) and Madina (Rank 3, 218.8) also showing significantly high burdens. This pattern suggests that factors beyond mere urbanization, such as terrain, occupational hazards, or building safety standards, are significant drivers of fall-related injuries.

Figure 2: Incidence Rate of Falls per 100,000 Population by Region (2023)



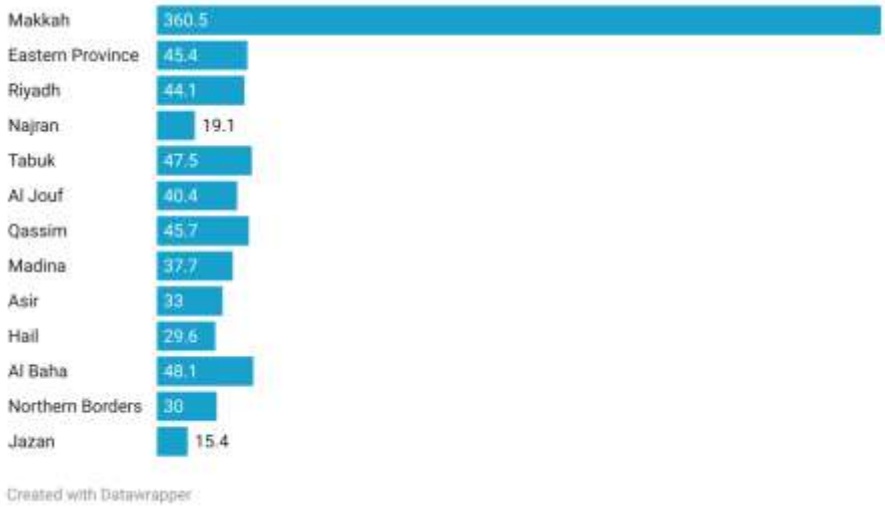
The pattern for violent injuries (stabbings and gunshots), shown in Figure 3, highlights a distinct public safety challenge. The highest rates were concentrated in the southwestern part of the Kingdom, with Jazan (Rank 1, 16.3) and Asir (Rank 2, 15.3) being the most affected. Makkah (Rank 3, 13.0) also featured prominently, likely influenced by its dense and transient population.

3.1.5. Figure 3: Incidence Rate of Violent Injuries per 100,000 Population by Region (2024)



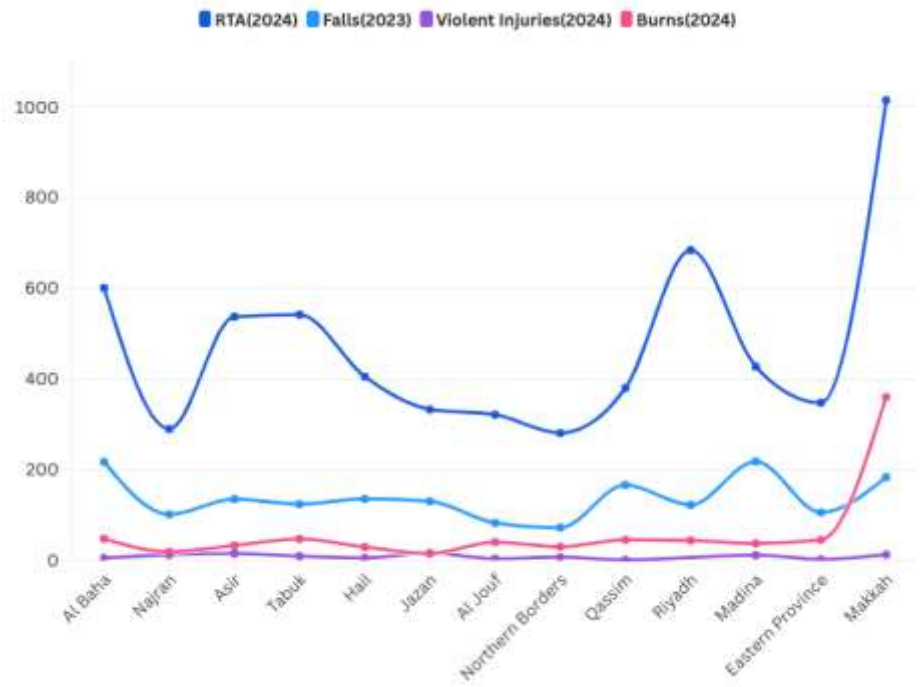
3.1.6. Figure 4 reveals that Makkah is a profound outlier in burn injuries, with an incidence rate (360.5) more than eight times higher than the second-ranked region, the Eastern Province (45.4). This extreme disparity strongly implicates unique regional factors, such as the high density of pilgrim accommodation and related commercial activities (e.g., mass food preparation).

Figure 4: Incidence Rate of Burn Injuries per 100,000 Population by Region (2024)



3.1.7. A consolidated overview of the regional risk profiles is provided in Figure 5, which uses a radar chart to compare the injury burden across categories for selected regions. This visualization underscores how certain regions, like Jazan, face a high burden in specific categories (violence), while others, like Makkah, face challenges across multiple domains (burns, traffic in absolute terms).

Figure 5: Injury Incidence Profile for Selected Regions



3.2. Correlation Analysis of Injury Types

To investigate the relationships between different injury mechanisms, a Pearson's correlation analysis was performed. The results, summarized conceptually in Figure 6, reveal three distinct patterns.

3.2.1. Figure 6: Conceptual Framework of Injury Correlations

Correlation of various kinds of public health risks

	RTA(2024)	Falls(2023)
RTA(2024)	1	
Falls(2023)	0.498562225	1
	RTA(2024)	Violent Injuries(2024)
RTA(2024)	1	
Violent Injuries(2024)	0.268007556	1
	RTA(2024)	Burns(2024)
RTA(2024)	1	
Burns(2024)	0.823564418	1
	Falls(2023)	Violent Injuries(2024)
Falls(2023)	1	
Violent Injuries(2024)	0.099457056	1
	Falls(2023)	Burns(2024)
Falls(2023)	1	
Burns(2024)	0.327188759	1

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3.3. Overall Summary of Findings

The analysis reveals three distinct patterns of injury correlation: one very strong relationship, one moderate relationship, and several weak-to-no relationships. This suggests that traumatic injuries in Saudi Arabia are not driven by a single overarching factor but rather by different, specific regional characteristics.

Detailed Analysis of Each Correlation

3.3.1. Very Strong Positive Correlation

- **RTA (2024) & Burns (2024):** r = 0.824
- **Interpretation:** This is a very strong, positive correlation. Regions with high rates of road traffic accidents also tend to have very high rates of burn incidents.
- **What this likely means:** Both RTAs and burns are highly associated with population density, urbanization, and intense economic activity. This clustering of "urban trauma" has been observed in other rapidly developing urban centers.
    - **Urban Centers:** Regions like Riyadh and the Eastern Province have dense traffic (high RTA risk) and also concentrate activities that lead to burns (restaurants, industrial kitchens, high-density housing).
    - **Makkah as the Key Driver:** Makkah is likely an extreme outlier that strengthens this correlation. Its massive pilgrim population creates immense pressure on both road networks (RTAs) and accommodation/services (burns from cooking, hot water, etc.).
- **Public Health Implication:** Interventions in major urban and pilgrimage centers should consider an integrated approach to "urban trauma," addressing both road safety and burn prevention simultaneously, as advocated in the WHO's holistic approach to injury prevention.

3.3.2. Moderate Positive Correlation

- **RTA (2024) & Falls (2023):** r = 0.499

- **Interpretation:** This is a moderate, positive correlation. There is a noticeable tendency for regions with higher traffic accidents to also have more falls.
- **What this likely means:** This correlation also points to urbanization, but with a different nuance than burns. The shared built environment—construction, crowded sidewalks, and high-rise buildings—creates scenarios for both types of incidents.
  - **Common Factor - "Pace of Life":** Busy urban environments with construction, crowded sidewalks, and high-rise buildings create scenarios for both traffic accidents and falls.
- **Public Health Implication:** Urban planning and building code enforcement could be key levers for reducing both types of incidents in growing cities, a strategy supported by the "Safe Systems" approach.

3.3.3. Weak to No Correlation

- **Falls (2023) & Burns (2024):** r = 0.327
- **Interpretation:** This is a weak, positive correlation. The relationship is minimal and may not be meaningful.
- **What this likely means:** The factors causing falls and burns are largely independent of each other at the regional level. The slight positive link might again be weakly tied to general urbanization, but it's not a strong pattern.
- **RTA (2024) & Violent Injuries (2024):** r = 0.268
- **Falls (2023) & Violent Injuries (2024):** r = 0.099
- **Interpretation:** These correlations are very weak to negligible. There is essentially no linear relationship between violent injuries and either road accidents or falls.
- What this strongly means: Violent injuries operate on a completely different set of risk factors. This is a critical finding. It suggests that violent injuries are not simply a function of general population density or urbanization, but are likely driven by unique regional socio-economic, cultural, or security dynamics, a concept well-established in violence prevention literature.
- **Public Health Implication:** Violence prevention requires highly targeted, region-specific strategies focused on social services, conflict resolution, and law enforcement, rather than general urban safety measures.

Discussion

This study provides the first comprehensive, regional-level analysis of the relative burden of four major traumatic injuries—road traffic accidents (RTAs), falls, burns, and violent injuries—across the thirteen administrative regions of Saudi Arabia. The findings reveal a complex and heterogeneous public health landscape that challenges the utility of a one-size-fits-all national strategy and underscores the critical need for precision public health interventions aligned with the goals of Saudi Vision 2030 **[1]**.

4.1. The Urbanization Paradox: Population Density vs. Relative Risk

A central finding of this study is the distinction between absolute numbers and relative risk. While metropolitan regions like Riyadh and Makkah reported the highest absolute incident counts, their ranking shifted dramatically after population normalization. Most strikingly, Makkah fell to the lowest rank for RTA incidence, while less populous regions like Al Baha and Najran emerged as the highest-risk areas. This demonstrates an "urbanization paradox," where the demographic and economic weight of megacities obscures the severe per-capita risk faced by residents of smaller, and perhaps less resourced, regions [23]. This finding aligns with global public health principles that emphasize the necessity of rate-based analysis over crude counts for equitable resource allocation and risk assessment [24].

The high RTA burden in Al Baha and Najran may be linked to a combination of factors, including potentially riskier road infrastructure (e.g., mountainous terrain), variations in traffic law enforcement, and differing socio-behavioral patterns. This is consistent with studies in other contexts that have identified rural and

semi-urban areas as having higher fatality rates per distance traveled due to factors like higher speeds and reduced access to immediate trauma care **[21]**.

4.2. Clustering of Injury Types: Shared and Distinct Etiologies

The correlation analysis yielded critical insights, revealing three distinct epidemiological patterns.

4.2.1. The Urban Congestion Cluster: RTAs and Burns

The very strong positive correlation between RTAs and burns ($r = 0.824$) strongly suggests a shared etiology rooted in population density, congestion, and intense economic activity. This cluster represents an "urban trauma" phenotype. In dense urban centers like Riyadh and the Eastern Province, high traffic volume naturally increases RTA risk, while the concentration of commercial enterprises (e.g., restaurants, workshops) and high-density housing elevates the risk of burn injuries [25].

The extreme outlier status of Makkah for burn injuries underscores the profound impact of its unique role as the Islamic spiritual capital. The annual influx of millions of pilgrims creates an environment with unparalleled population density in temporary accommodations, mass catering facilities, and crowded religious sites, significantly amplifying fire and scald risks **[26]**. This finding is supported by literature highlighting the specific public health challenges faced by mass-gathering destinations **[27]**. Consequently, interventions in these regions must be integrated, focusing on urban design, traffic calming, fire safety regulations in high-rises and hotels, and public safety campaigns tailored to both residents and visitors.

4.2.2. The Socio-cultural Disconnect: Violent Injuries

A pivotal finding of this study is the decoupling of violent injuries from the metrics of urbanization and infrastructure. The negligible correlations with RTAs and falls indicate that violent injuries are driven by a fundamentally different set of risk factors [28]. The concentration of high rates in the southwestern regions of Jazan and Asir points to underlying socio-cultural, economic, or security dynamics specific to these areas [29]. This pattern resonates with the well-established social-ecological model of violence, which identifies community-level factors—such as poverty, unemployment, social disorganization, and cultural norms—as key determinants.

Research in other national contexts has consistently shown that violence clusters geographically based on local socio-economic conditions rather than general population density [30]. Therefore, generic national safety campaigns will be ineffective. Instead, prevention requires deeply localized, community-based interventions that may include youth engagement programs, economic development initiatives, conflict mediation services, and targeted law enforcement strategies developed in partnership with local community leaders [31].

4.2.3. The Mixed-Factor Challenge: Falls

Falls demonstrated a moderate correlation with RTAs, suggesting a partial link to the urban environment, where factors like construction activity, high-rise living, and crowded public spaces create shared risks **[32]**. However, the weak correlation with burns and the high burden in regions like the Northern Borders indicate diverse and multi-factorial causes. In less urbanized regions, falls may be more related to occupational hazards (e.g., agriculture, livestock herding) and environmental terrain [14]. This necessitates a dual-pronged policy response: general public awareness campaigns on fall prevention for the elderly and children, combined with specific occupational health and safety regulations and stringent building code enforcement in the construction industry [15].

4.3. Policy Implications for Vision 2030

The findings of this study offer a clear, data-driven roadmap for enhancing citizen safety, a cornerstone of the "Vibrant Society" pillar of Vision 2030. By moving beyond national averages, policymakers can now prioritize resources and design interventions with surgical precision.

1. **For the Urban/Infrastructure Cluster (RTA & Burns):** National ministries of health, municipal affairs, and transport should collaborate on **integrated urban safety initiatives**. This could include adopting the "Safe System" approach to road safety, which has proven effective in reducing traffic fatalities in numerous countries **[33]**, coupled with enhanced fire safety inspections and public education in densely populated and commercial zones.
2. **For the Socio-cultural Cluster (Violence):** The Council of Ministers and regional authorities should empower localized violence prevention taskforces in Jazan and Asir. These taskforces should employ a public health approach to violence prevention, which involves systematically monitoring the problem, identifying root causes, and implementing and evaluating interventions [34].
3. **For Falls (Mixed Factors):** A multi-sectoral effort is required, involving the Ministry of Human Resources for occupational safety, the Ministry of Municipal and Rural Affairs for building codes, and the Ministry of Health for public education, particularly targeting the elderly, as falls are a leading cause of injury-related death in older adults globally [35].

4.4. Limitations and Future Research

This study has several limitations. The use of administrative, region-level data precludes inference at the individual level (ecological fallacy). The data for falls was from 2023, while other injuries were from 2024, which may introduce minor temporal biases, though population structures are relatively stable. Furthermore, incidence rates are based on reported emergencies and likely represent an underestimation of the true burden, as many minor injuries may not be reported to official channels.

Future research should delve deeper into the specific community-level drivers identified in this study. Qualitative investigations in high-risk regions like Al Baha (for RTAs) and Jazan (for violence) are crucial to understand the local context. Additionally, more granular, city-level or even neighborhood-level analyses would help to further refine targeted interventions and uncover disparities masked by regional averages.

Conclusion

This study set out to answer a central research question: Which Saudi administrative regions face the highest relative burden from different types of traumatic injuries, and what demographic or infrastructural factors might explain these disparities?

The analysis conducted provides a definitive and data-driven answer to this question. The research has successfully identified distinct regional "hotspots" for specific traumatic injuries, moving beyond absolute numbers to reveal the true per-capita risk landscape. The findings demonstrate that the highest relative burden is not concentrated in the most populous urban centers but is instead distributed across regions with unique risk profiles: Al Baha and Najran for road traffic accidents, the Northern Borders region for falls, Jazan and Asir for violent injuries, and Makkah as a profound outlier for burn injuries.

Furthermore, the correlation analysis elucidated the underlying factors driving these disparities. The very strong link between road traffic accidents and burns points to shared etiologies in urbanization and infrastructure, while the decoupling of violent injuries from these metrics highlights the primacy of region-specific socio-cultural and economic factors. Falls were shown to be a mixed-factor challenge, influenced by both urban environments and other regional hazards.

Therefore, the research question has been comprehensively answered. The findings unequivocally show that a one-size-fits-all national public health strategy is inadequate for addressing the Kingdom's injury

burden. The evidence presented offers a clear mandate for a transition to a precision public health approach. By providing a granular, region-specific understanding of trauma epidemiology, this study delivers the actionable intelligence necessary for policymakers, health authorities, and urban planners to design targeted, efficient, and equitable interventions. Ultimately, this data-driven roadmap is essential for reducing the societal burden of preventable injuries and achieving the citizen safety goals enshrined in Saudi Arabia's Vision 2030.

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Charts and Figures were generated with Datawrapper (https://www.datawrapper.de/).

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