# Intentional and Unintentional Injuries Across Health Regions in Alberta, Canada: An Implication for Policy

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**Abstract:** The growing practice of including intentional injuries (suicide and interpersonal violence) under the injury control umbrella has produced some controversy. The present study was designed to determine whether or not there might be an empirical basis for this initiative from an ecological point of view by examining the associations among unintentional and intentional injuries across 17 geographically defined health regions. The study was set in the Province of Alberta, Canada, where health services were delivered to a population of 2.96 million persons in 1999 through 17 regional health authorities. The results of a principal components analysis showed that nearly all causes of injury-hospitalization loaded on a single factor. It was not possible to produce separate factors for intentional and unintentional injuries. The strong intercorrelation among all measures suggests that there is an empirical basis for the view that intentional and unintentional injuries belong under the same conceptual umbrella, at least at the ecological level.

**Keywords:** Intentional injury, unintentional injury, policy, ecological, suicide, assault.

Although the definition of "injury" varies across agencies whose mandate covers injury control and/or prevention, most include suicide and homicide along with the more standard topics such as motor vehicle collisions (MVCs), falls, and unintentional poisonings. However, the question of whether intentional injuries, such as suicidal behavior and serious assault, belong under the same conceptual roof as unintentional injuries has been raised (Fisher, 1999). Although both classes of injury deal with physical trauma, they seem to have such obviously different contexts and causes that there seems no reason to have them studied or dealt with within the same agency. On the other hand, Pless (1999) has pointed out that whatever the form, in the end an injury is a health problem, and Overpeck and McLoughlin (1999) have noted that the evidence on shared risk factors among intentional and unintentional infant deaths warrants "convergence" of effort rather than the compartmentalization engendered by separation.

The suicide prevention community does not seem to be bothered by this issue, and indeed, many suicide prevention programs are operated by injury control agencies, at least in North America. In the United States, for example, the National Center for Injury Prevention and Control is responsible for many suicide prevention activities (DeMartino et al., 2003) and research initiatives (Hammond, 2001). Having said that, there is little evident acceptance of the view that suicide has any commonality with other forms of injury, since suicide is characterized by separate reports and initiatives, with little connection to unintentional injuries (although the association between suicide and other intentional injuries, such as homicide and assault, is well-established; reviewed by Plutchik, 2000). However, recent studies have shown that some form of connection appears to exist. Individuals that have survived self-inflicted injuries have shown a higher risk for later mortality due to unintentional injuries, interpersonal violence, and natural causes such as circulatory and respiratory system disorders (Hall et al., 1998; Harris & Barraclough, 1998; Hawton & Fagg, 1988). In addition, similar parental factors have been found for a variety of infant injury deaths, regardless of intent (Brenner et al., 1999; Cummings, Theis, Mueller, & Rivara, 1994; Overpeck et al., 1998). Hunt et al. (1992) demonstrated a relationship between injury-proneness (falls), suicidal behavior, and disease, and Neeleman and colleagues (Neeleman, Wessely, & Wadsworth 1998; Neeleman 2001) found an overlap among predictors of

*Crisis* 2004; Volume 25 (4): 156–160
DOI: 10.1027/0227-5910.25.4.156

death by suicide, accidents, and natural causes. Finally, a follow-up study of emergency room (ER) patients in Alberta noted a much higher rate of return visits to the ER for unintentional injuries by suicide attempters in comparison with all other patients (Colman et al., 2004).

Although the studies listed above have used a variety of methodologies, they all have suggested that intentional and unintentional injuries cluster together. The present study was designed to see whether this might hold true within the context of an ecological analysis. More specifically, we aimed to determine the association between selected injury conditions across the geographically defined health regions of Alberta, Canada. The ecological approach may be of value because it lends a perspective to the issue that has not been examined, and, perhaps more importantly, because the ecological units used here correspond to the jurisdictional authorities that are responsible for delivering health and injury prevention services.

# Method

## Study Variables

Injuries classified as either intentional or unintentional were studied. While there is no consistent international format for grouping of injury causes, the Alberta Center for Injury Control & Research has developed standard injury groupings in partnership with Alberta Health & Wellness for use within Alberta. These 25 injury groupings were based on the *International Classification of Diseases, Version 9, Clinical Modification*, external causes of injury (E-Codes) codes. "Injury" was operationalized as hospitalization due to injury during the 1999 calendar year. Morbidity data were used in preference to mortality figures because deaths due to injury occur at a much lower rate and would thus provide less reliable regional estimates of specific types of injuries.

## Alberta's Health Regions

At the time of the collection of the data used in this study, the delivery of health services in Alberta was organized around 17 health regions (in 2003 this was reduced to 9). Each regional authority is responsible for the delivery of health services, while the Province of Alberta retains responsibility for overall health policy and allocation of resources. Health data collected by Statistics Canada were made available by health region.

## Analysis

The prevalence of each type of injury was expressed as a rate per 100,000 for each health region to allow comparisons across conditions. Regional rates were adjusted to Provincial values for gender and age. The basic form of analysis was the calculation of the degree of association (correlation) between variables across health regions. These individual correlations were then subjected to a principal components analysis to determine whether the intentional and unintentional injuries sorted into separate factors or into one common factor.

# Results

Table 1 contains the hospitalization rate per 100,000 population for each of the 25 injury categories. The range is very large with "adverse effects" (medical misadventures and drug effects), falls, MVCs, and suicide making up 78% of all injury admissions.

Since the measure of injury used here was based on hospitalizations, it could be thought to be biased by a number of service delivery variables (e.g., distance from hospital, admission policies) that do not reflect injury. To test this, we correlated the hospital rate with the mortality rate across regions and found a healthy correlation of 0.79, indicating that the two are measuring more or less the same construct, and that the existence of any "extraneous factors" has not caused the hospitalization-based rates to depart from mortality rates to any great extent. When specific injuries were considered, however, the agreement dropped, suggesting that the mortality rates were indeed less reliable measures of overall injury. For example, agreement level for falls was 0.02; MVCs, 0.68; suicide, –0.04; fire/scalding, 0.39; and poisonings, –0.09. In the case of suicide, the low level of association may support the view of many researchers that suicide attempters and suicide completers represent two separate populations (e.g., Linehan, 1986; Stengel, 1964).

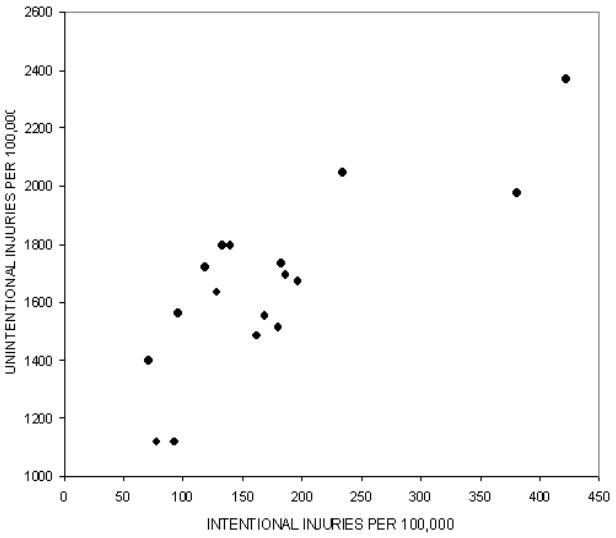


*Figure 1.* Scatterplot of the association between unintentional and intentional injuries across the 17 health regions.

*Table 1.* Injury hospitalization rate per 100,000 population according to the cause of admission.

| | | Rate/100,000 | |
|---|---|---|---|
| **Retained Groupings** | 1. Adverse Effects–Medical Misadventures | 520.5 | 33.0% |
| | 2. Falls | 366.8 | 23.2% |
| | 3. Adverse Effects–Drug Effects | 193.0 | 12.2% |
| | 4. Motor Vehicle Crashes | 78.4 | 5.0% |
| | 5. Suicide Attempts | 76.7 | 4.9% |
| | 6. Assault | 38.7 | 2.5% |
| | 7. Overexertion/Strain | 31.5 | 2.0% |
| | 8. Poisonings | 26.0 | 1.7% |
| | 9. Struck Object or Person | 25.6 | 1.6% |
| | 10. Natural /Environmental Causes | 20.6 | 1.3% |
| | 11. Sports Related | 18.3 | 1.2% |
| | 12. Cutting/Piercing | 15.1 | 1.0% |
| | 13. Suffocation by Foreign Body | 13.4 | 0.9% |
| | 14. Machinery | 12.0 | 0.8% |
| | 15. Fire/Scalding | 11.6 | 0.7% |
| **Removed Groupings** | 16. Bicycle–Nontraffic | 9.4 | 0.6% |
| | 17. Undetermined Intent | 8.0 | 0.5% |
| | 18. Pedestrian–Nontraffic | 1.8 | 0.1% |
| | 19. Drowning | 0.9 | 0.1% |
| | 20. Firearm (Unintentional) | 0.8 | 0.1% |
| | 21. Legal Intervention | 0.4 | <0.1% |
| | 22. Other Transportation Related | 40.4 | 2.6% |
| | 23. Late Injury Effects | 30.5 | 1.9% |
| | 24. Unspecified Cause of Injury | 25.7 | 1.6% |
| | 25. Other Injury | 12.6 | 0.8% |
| | All Injuries | 1578.8 | 100% |

Ten of the groupings were removed from consideration for further analysis. Six because their low rates (< 10 per 100,000 population) would likely be unstable in the smaller regions, three because they represented nonspecific categories (i.e., "other injuries," "other transportation," and "unspecified intent"), and one ("late injury effects") because it represented treatment of earlier injuries that were unspecified. Although this resulted in the loss of 40% of the groupings, those removed made up only 8.3% of all injury hospitalizations.

Intercorrelations among the retained injury groupings are shown in Table 2. Of particular interest are the correlations between the groupings representing intentional injury (suicide, assault) and the major unintentional injuries (falls, MVCs, and unintentional poisonings). These are all positive and of meaningful magnitude. In fact, nearly all of the associations in the Table are positive, indicating that these injuries have a great deal in common. This suggests that, statistically, a significant proportion of the variance can be accounted for by reducing the 15 variables to a lower number of common factors. One approach to this is to compare the rates of the categories in question (i.e., unintentional and intentional injuries) across regions. A scatter plot of this relationship is shown in Figure 1. Clearly, regions that are high on one type of injury tend to be high on the other ($r = 0.81$).

This compelling finding, however, still leaves us dealing with the two types of injury as if they were separable, but related. In this ecological context, however, this might not be correct. As a consequence, a principle components factor

 

*Table 2.* Intercorrelations of retained injury groupings.

| | Suic | MVCs | Falls | Poison | Asslt | Suffoc | Fire | Nat/Env | Adv-Eff Medical | Adv-Eff Drugs | Mach | Struck | Cut | Sport |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Motor Vehicle | 0.70 | | | | | | | | | | | | | |
| Falls | 0.69 | 0.42 | | | | | | | | | | | | |
| Poison | 0.54 | 0.51 | 0.57 | | | | | | | | | | | |
| Assault | 0.80 | 0.47 | 0.85 | 0.29 | | | | | | | | | | |
| Suffocation/Foreign Body | 0.53 | 0.09 | 0.35 | 0.22 | 0.36 | | | | | | | | | |
| Fire/Scalding | 0.52 | 0.57 | 0.29 | 0.67 | 0.19 | 0.04 | | | | | | | | |
| Natural/Environmental | 0.66 | 0.49 | 0.78 | 0.78 | 0.61 | 0.36 | 0.53 | | | | | | | |
| Adverse Effect–Medical | 0.46 | 0.15 | 0.65 | 0.41 | 0.53 | 0.20 | 0.08 | 0.30 | | | | | | |
| Adverse Effect–Drugs | 0.32 | 0.15 | 0.49 | 0.33 | 0.39 | 0.28 | –0.03 | 0.64 | 0.18 | | | | | |
| Machinery | 0.60 | 0.60 | 0.59 | 0.47 | 0.49 | 0.43 | 0.49 | 0.57 | 0.30 | 0.09 | | | | |
| Struck Object/Person | 0.60 | 0.37 | 0.78 | 0.52 | 0.70 | 0.52 | 0.42 | 0.79 | 0.30 | 0.42 | 0.71 | | | |
| Cutting/Piercing | 0.54 | 0.37 | 0.55 | 0.10 | 0.49 | 0.38 | –0.03 | 0.19 | 0.50 | 0.14 | 0.55 | 0.29 | | |
| Sports Related | 0.23 | 0.33 | 0.08 | 0.81 | –0.17 | 0.12 | 0.66 | 0.47 | 0.06 | 0.00 | 0.36 | 0.20 | –0.19 | |
| Overexertion/Strain | 0.15 | 0.34 | 0.33 | 0.61 | –0.02 | 0.02 | 0.45 | 0.59 | –0.10 | 0.44 | 0.24 | 0.36 | 0.12 | 0.52 |

*Table 3.* Principle components analysis of the retained injury variables.

| | Factor | | |
|---|---|---|---|
| | **1** | **2** | **3** |
| Eigenvalue | 6.9 | 2.6 | 1.4 |
| Variance | 45.8% | 17.2% | 9.6% |
| Suicide | .85 | –.20 | –.24 |
| Motor Vehicle | .67 | .16 | –.39 |
| Falls | .87 | –.31 | .16 |
| Poison | .77 | .49 | .04 |
| Assault | .74 | –.53 | .00 |
| Suffocation/Foreign Body | .48 | –.30 | .06 |
| Fire/Scalding | .59 | .59 | –.34 |
| Natural/Environmental | .89 | .19 | .33 |
| Adverse Effects–Medical | .51 | –.40 | –.11 |
| Adverse Effects–Drugs | .48 | –.10 | .77 |
| Machinery | .76 | .03 | –.37 |
| Struck Object/Person | .83 | –.09 | .17 |
| Cutting/Piercing | .50 | –.55 | –.25 |
| Sports Related | .42 | .79 | –.14 |
| Overexertion/Strain | .48 | .57 | .37 |

analysis was applied to the retained injury groupings to test for both the similarity and separability of the two notions of injury. The analysis produced a three-factor solution, but our interest was only with the first in this case, since the principle components analysis identifies the maximum amount of commonality that can appear in the primary factor. By using an arbitrary, but conventional, factor-loading cutoff of 0.50, it becomes clear that nearly all of the variables load on the first factor (Table 3). Furthermore, the remaining loadings on this factor do not approach zero, the lowest being 0.40. Thus, there appears to be a strong general injury factor that accounts for a very large proportion of the variance (46%). In this context, it is important to note that it is not possible to discriminate the unintentional injuries from the intentional injuries on the basis of scores on the principal factor. All of the coefficients are positive and relatively high. To test for the possibility that the data nonetheless contained a factor comprising intentional injuries only, orthogonal (Varimax) and oblique (correlated) rotations of the three derived factors were conducted. These analyses did not produce a separate, intentional-injury factor. In fact, the second and third factors were not readily interpretable.

It is important to note when interpreting these findings that factor analyses are ordinarily conducted on individual level data. Here, although they were based on human activity, regional level data were used. Thus, conclusions that may be drawn from the data need to be understood in ecological terms.

## Discussion

The results of this study add to the growing literature that suggests a functional link between unintentional and intentional injuries. The nature of that link remains unclear, but the associations across geopolitical regions reported here suggest the possibility that there is something about these regions that predisposes its members to a broad range of injuries—so broad that it covers nearly all events that appear on the lists of those who study either unintentional or intentional injuries. The root explanation(s) may reflect regional differences in demography, social climate, geopolitics, and so on, but it is beyond the scope of this paper to speculate on the causal factors that may be in play. This is, however, an important focus for further research.

It may be useful to remember that the associations reported here do not mean that unintentional and intentional injuries should be amalgamated at all levels or without thoughtful planning. A campaign to restrict access to firearms will likely not have much in common with a program to prevent falls in the elderly—at least when planning interventions that are specific and proximal to the event. On the other hand, global programs that are closer to the primary prevention end of the intervention spectrum could be expected to prevent a diverse array of injuries. Whatever the case, future studies of the factors underlying the commonality found here could serve as the unifying force in the inclusion of some aspects of unintentional and intentional injuries under one conceptual roof. Furthermore, regional data on injury commonalities might be used to inform those with regional intervention responsibilities about the potential for preventing both unintentional and intentional injuries with a common intervention program.

### Acknowledgments

We wish to thank Morag MacKay of the Children's Hospital of Eastern Ontario, and Brent Hagel of the Alberta Center for Injury Control and Research, for their helpful comments on the manuscript.

Portions of this paper were presented at the 2003 Canadian Injury Prevention and Safety Promotion conference, "Evidence to Action: Injury, Violence, and Suicide Prevention"; Ottawa, Canada; November 23–25, 2003.

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