Childhood Injury Rates in Manitoba

Socioeconomic Influences

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ABSTRACT

Background: Injury is the leading cause of death among Canadian children between 1 and 19 years, and accounts for one sixth of all hospitalizations of children between 0 and 19 years. We examined the causes of injury in Manitoba children, and the relationship between injury rates and region of residence, premature mortality rate (PMR), and income.

Methods: Regional differences in injury death and hospitalization rates, and causes of injury were derived from the Population Health Research Data Repository. The relationship between injury rates and area income levels was assessed and correlations between regional premature mortality rates (PMR) and injury rates were calculated.

Results: Motor vehicle crashes were the leading cause of injury mortality. Falls were the leading cause of injury hospitalization. Regional differences were substantial. Rural-urban differences in injury rates were pronounced; northern Manitoba's rates were very high compared to the rest of the province. Regional PMR values correlated significantly with injury mortality and hospitalization rates. Both types of injury rates correlated significantly with income; higher injury rates were associated with lower income levels.

Conclusion: Injuries are not random events, but are related to social factors.

La traduction du résumé se trouve à la fin de l'article.

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Injuries are the leading cause of death among Canadian children between the ages of 1 and 19. In 1995, over 30% of the deaths to Canadian children under 20 years were the result of injuries, compared to 5% for cancer and 1.8% for infectious diseases.¹ Injuries are also the leading cause of death in all developed nations, accounting for close to 40% of deaths among children between 1 and 14 years.² In Manitoba, injuries account for over half of all deaths to children between 1 and 9 years of age, and about three quarters of all deaths between 10 and 19 years of age (see Martens, this issue).³ Most of these injury-related deaths are preventable: 59 of the 60 child and adolescent injury deaths in Manitoba in 1997 were deemed preventable by the standards committee of the College of Physicians and Surgeons charged with reviewing all child deaths in the province.⁴

Mortality represents only part of the story of injuries. Recent estimates suggest that for every injury-related death, there are 40 hospitalizations and an estimated 670 emergency room visits for treatment of injuries for Canadian children.⁵ Injuries are responsible for about one sixth of all hospitalizations for Canadian children between 0 and 19 years.¹ Injuries exact a heavy price in health: every day Canadians are killed and disabled by injuries. Beyond the health burden, the economic burden of injuries is staggering; preventable injuries cost Canadians \$8.7 billion in 1995, or \$300 for every citizen in this country.¹

Referring to injuries as "accidents" implies that these incidents are random and beyond our control. An examination of the geographic and socioeconomic patterns of childhood injuries demonstrates that they are not indiscriminate, but strongly influenced by such factors as age, sex, urban or rural residence, socioeconomic status, and the interaction between these factors. For instance, both injury mortality and hospitalization rates differ across income levels. One study reported that Canadian children living in the poorest urban neighbourhoods had a 39% higher death rate and a 25% higher hospitalization rate due to injuries compared to those from the wealthiest urban neighbourhoods.⁶

In this paper, we explore injury rates for Manitoba children. Injury rates are broken down by region of residence and income,

TABLE I
Injury Rates by Age and Sex, Manitoba Children 0-19 Years

Mortality per 100,000 (1994-1997)						
	age <1	1-4	5-9	10-14	15-19	0-19
Males	21.65	20.23	10.84	22.78	69.25	30.36
Females	29.20	21.90	8.95	9.92	19.75	15.41
Overall	25.33	21.05	9.92	16.54	45.10	23.41

Hospitalization per 10,000 (1994/95-1998/99)						
	age <1	1-4	5-9	10-14	15-19	0-19
Males	51.19	74.23	59.82	81.60	138.10	86.79
Females	50.68	52.30	35.85	59.45	103.47	62.16
Overall	50.94	63.51	48.11	70.85	121.22	72.88

in an attempt to explore the patterns of childhood injury. In addition, we look at the relationship between premature mortality rates (PMR) and injury rates, as well as the relationship between injury rates and the socioeconomic factor index (SEFI). PMR is considered an indicator of the healthiness of a population, with higher PMR generally associated with both poorer health and lower socioeconomic status. SEFI is an indicator of the socioeconomic conditions within regions, with higher SEFIs associated with socioeconomic conditions that are less favourable for population health (see Martens et al., this issue, for a more detailed discussion of PMR and SEFI).⁷

METHODS

Administrative data from the Population Health Research Data Repository were used to derive injury mortality and hospitalization rates for Manitoba children, aged 0 to 19 years. These data are anonymized, encounter-based records of Manitobans' interactions with the health care system. Injuries resulting from misadventures during surgical or medical care, and adverse drug reactions were excluded from analyses. Mortality rates were derived from Manitoba Vital Statistics data for calendar years 1994 to 1997, and hospitalization rates were derived from hospital separation abstract files for fiscal years 1994/95 to 1998/99 (see Brownell et al., this issue, for a more complete description of data sets).⁸ Hospitalization rates were based on total separations rather than individuals. All rates were age- and sex-adjusted using the direct method of standardisation. For both mortality and hospitalization, injuries were broken down into 14 categories, based on the external cause of the injury. The ICD-9-CM codes and labels that fall into each of

the 14 categories can be found in Table G.5 at http://www.umanitoba.ca/centres/mchp/reports/pdfs/childpdfs/child_glossary.pdf. Regional differences in the rates at which these 14 types of injury occur were examined. Regions were defined using Manitoba's 12 Regional Health Authorities (RHAs). Manitoba's largest city, Winnipeg (population approximately 650,000), which is itself an RHA, was divided into 12 subregions called Winnipeg Community Areas (Winnipeg CAs). Summary rates are given for: 1) the total Manitoba child population; 2) Winnipeg; 3) Non-Winnipeg (all children residing outside of Winnipeg); 4) Rural South (children residing in rural regions below the 53rd parallel); and 5) North (children residing in regions above the 53rd parallel). Comparisons of rates across regions used t-test methodology.⁹ To adjust for multiple comparisons between each RHA or Winnipeg CA and an overall provincial or Winnipeg rate, 99% confidence intervals were used. Rates were suppressed where cell counts were less than 5. Because regions are ordered according to PMR (from lowest to highest) in each graph, visual inspection of the regional graphs provides insight into the relationship between the healthiness of the population within a region (PMR) and the injury variables. To further assess the association between injuries and PMR as well as the socioeconomic conditions in the region, injury mortality and hospitalization rates for the regions were correlated with the regions' PMRs and SEFIs, using Spearman's rank correlation.

To determine differences in income levels, rural and urban neighbourhoods were each divided into five different income levels referred to as quintiles, based on 1996 Census information available through Statistics Canada (see Brownell et al., this

issue, for a complete description of the construction of income quintiles).⁸ Cochran-Armitage trend tests were used to assess the significance of the relationships between injury variables and area income level.

RESULTS

Age and sex differences in injury rates

Injury mortality rates by age for Manitoba children form a j-shaped curve, with rates decreasing after the first year of life and then increasing again after age 14 years (Table I). The highest rate of injury deaths is found in the oldest (15-19 years) age category, with the second highest death rates in the youngest (less than 1 year) age category, and the lowest mortality rate for those in the 5-9 year old category.

The injury mortality rate for Manitoba males 0 to 19 years is almost twice as high as that for females. Due to the small number of deaths, and because it is contrary to national trends, the higher mortality rate for females in the first year of life shown in Table I is most likely due to random fluctuations that could differ should different years of data be examined. Sex differences are minimal between 1 and 9 years of age, and begin to reappear at 10 to 14 years of age, with males having higher injury mortality rates than females. The greatest sex differences occur at 15 to 19 years of age, with males having an injury mortality rate over three and a half times higher than females.

Hospitalization rates for Manitoba children increase slightly after the first year of life, then drop after the 1-4 year old category and increase after the 5-9 year old category, with the most dramatic increase in the 15-19 year old category (Table I). As was found with mortality rates, males have a higher rate of injury hospitalization than females, with the differences starting younger (at 1 to 4 years) than was seen with mortality rates, but being much less dramatic.

Regional differences in injury rates

Figure 1 shows the four-year injury mortality rates across RHAs, and Figure 2 shows these rates across Winnipeg CAs. There was a tendency for higher overall injury mortality rates in regions with higher PMRs (i.e., where the populations are

found to be generally less healthy), with a moderately high correlation between the two variables ($r=0.68$, $p=0.0005$). The correlation with SEFI was less pronounced but still significant ($r=0.59$, $p=0.0039$), suggesting that areas with less favourable socioeconomic conditions had higher injury mortality rates.

Children residing in the north, where the highest PMR values are found, had a significantly higher injury mortality rate than those residing in the rural south, who in turn had a significantly higher rate than those children residing in Winnipeg. There was an almost five-fold variation in injury mortality rates across the province, ranging from a low of 14.6/100,000 (Winnipeg) to a high of 72.7/100,000 (Burntwood) (Figure 1). Within Winnipeg the variation was seven-fold, ranging from 6.0/100,000 (Fort Garry) to 42.2/100,000 (Downtown) (Figure 2).

Figure 3 shows the five-year injury hospitalization rates by RHA, and Figure 4 shows these rates for the Winnipeg CAs. Regional variation is evident in both figures. As with mortality, there was a significant correlation between injury hospitalization rates and PMR, with higher injury rates in areas with less healthy populations ($r=0.71$, $p=0.0001$). Injury hospitalization rates also correlated with SEFI, with higher injury rates in areas with less favourable socioeconomic conditions ($r=0.58$, $p=0.004$). Both the north and rural south injury hospitalization rate totals were significantly higher than the Manitoba rate, which is driven largely by the substantially lower injury hospitalization rate for Winnipeg children.

Causes of injuries

Motor vehicle crashes (MVCs) were the leading cause of injury death in Manitoba children, accounting for about 34% of all injury deaths over a four-year period (7.7/100,000). Other major causes of childhood injury deaths included violence to self (4.2/100,000), drowning (2.6/100,000), suffocation and choking (2.4/100,000), and violence by others (1.6/100,000).

The mortality rates by cause of death were too low for detailed comparisons across RHAs and Winnipeg community areas, although Winnipeg/non-Winnipeg comparisons were made for some cate-

Figure 1. Injury mortality rates for children aged 0-19 years by RHA, 1994-97

Figure 2. Injury mortality rates for children aged 0-19 years by Winnipeg CA, 1994-97

gories. For MVCs, violence to self, and drowning, the rates for non-Winnipeg children were significantly higher than those for Winnipeg children: over 2 times higher for MVCs, 2 times higher for violence to self, and over 4 times higher for drowning. For both violence to self and drowning, the rates for children from regions with the highest PMRs (north) were significantly higher than the provincial average: over 2.5 times higher for violence to self, and 4 times higher for drowning. Figures 3 and 4 show injury hospitalization rates by caus-

es of injury, with many of the 14 categories of injury combined in the "other" category due to small numbers. Accounting for approximately 22% of all injury hospitalizations (16.1/10,000), falls were the leading overall cause of injury hospitalization for Manitoba children. Other leading causes of injury hospitalization included MVCs (12%) and violence to self (11%). For all 14 categories of injury cause, the hospitalization rates for those children residing in the regions with the highest PMRs (northern Manitoba) were significantly higher

Statistical Significance:

* - Rate significantly different from Manitoba mean at $p < 0.05$

N - Rate significantly different from mean for Northern Manitoba at $p < 0.05$

S - Rate significantly different from mean for Rural South Manitoba at $p < 0.05$

Figure 3. Injury hospitalization rates for children aged 0-19 years by cause of injury, RHAs, 1994/95-1998/99

Statistical Significance (For Totals Only):

* - Rate significantly different from Manitoba mean at $p < 0.05$

W - Rate significantly different from Winnipeg mean at $p < 0.05$

Figure 4. Injury hospitalization rates for children aged 0-19 years by cause of injury, Winnipeg CAs, 1994/95-1998/99

than both the provincial average and the rural south average. The injury hospitalization rate due to violence to self for children from the north (43.3/10,000) was over 7 times as high as that for children from the rural south (5.9/10,000). Injury hospitalization rates due to violence from others

were over 4 times higher, hospitalizations due to drowning were over 5 times higher, hospitalizations due to poisoning were almost 4 times higher, and hospitalizations due to falls were over 2 times higher for children from the north compared to the rural south.

Children living in Winnipeg had significantly lower injury hospitalization rates for all 14 causes of injury than were found in the rest of the province. Within Winnipeg, children living in the two community areas with the highest PMRs (Downtown and Point Douglas) had significantly higher overall rates of injury hospitalizations. For MVCs, violence to self and by others, falls, poisoning, and "other" causes of injury hospitalizations, the rates for children from these two areas were significantly higher than those found for other Winnipeg children.

For a more detailed breakdown of injury rates by cause, please see http://www.umanitoba.ca/centres/mchp/reports/pdfs/child-pdfs/child06_injury.pdf.

Injury and income

Injury *mortality* rates for children from the lowest income neighbourhoods in rural areas were almost 2.5 times higher than those from the highest income neighbourhoods (Figure 5). For urban areas, children from the lowest income neighbourhoods had injury mortality rates 4.5 times higher than those from the highest income areas (Figure 5). Trend tests confirmed highly significant differences ($p < 0.0001$) across income quintiles for both rural and urban areas.

For injury *hospitalizations* among children from rural areas, those from the lowest income areas had rates almost 3 times higher than those from the highest income areas (Figure 6). For children from urban areas, those from the lowest income areas had injury hospitalization rates 2.5 times higher than those from the highest income areas (Figure 6). Once again, trend tests confirmed highly significant trends ($p < 0.0001$) of increasing injury hospitalization rates with decreasing income quintile.

DISCUSSION

This paper examined rates of death and hospitalization from injury in Manitoba children, as well as the causes of injuries. We found correlations between injury rates (both mortality and hospitalization) and PMR value, SEFI, region, and income.

National data indicate that the leading causes of death in Canadian children are also the leading causes of death in Manitoban children. Manitoba's principal

difference with Canada is its very high injury mortality rate. At 23.4 deaths per 100,000 children 0 to 19 years, Manitoba's injury mortality rate for 1994-1997 was almost 50% higher than the national rate in 1996 of 16 deaths per 100,000.⁵ The injury mortality rate for Manitoba males is 41% higher and for females 51% higher than their national counterparts. The data presented in this paper do not permit us to state with any confidence why Manitoba's rate is so high, but they do suggest several possible explanations.

Regional differences within Manitoba are substantial, and appear to be related to the overall healthiness of the populations within the regions and the socioeconomic conditions within the regions. We found significant, positive correlations between both injury mortality and hospitalization rates and PMR, which suggest that as PMR increases (indicating a less healthy population), injuries also increase. We also found significant positive correlations between both types of injury rates and SEFI, suggesting that as the socioeconomic factors that are associated with poor health increase, so too do injury rates. The extremely high injury rates in the northern part of Manitoba are of particular concern. This part of the province is sparsely populated, accounting for only about 6% of the total population. It is home to over one third of Manitoba's First Nations communities and over 40% of the province's First Nations population 0 to 19 years.¹⁰ Data from Health Canada and Statistics Canada indicate that injury mortality rates are much higher among First Nations children with Treaty Status, compared to the total population of Canadian children.⁶ During infancy (under 1 year), the rate of death from injuries for First Nations children is almost 4 times greater than the general population; for preschoolers, the rate is over 6 times greater; for children 5-9 years the rate is 3 times greater; and for 10-14 year olds, the rate is over 1.5 times greater.⁶ First Nations teenagers aged 15-19 years are 3.5 times more likely to die due to injuries than the total population of 15-19 year olds in Canada.⁶ The Manitoba Paediatric Death Review Committee⁴ reported that the injury mortality rate for First Nations children aged 29 days to 14 years was over 9 times higher than that for non-First Nations children in Manitoba.

R represents rural income quintiles, with R1 being the lowest and R5 being the highest income quintile; U represents urban income quintiles, with U1 being the lowest and U5 being the highest income quintile. Statistically significant trends in both rural and urban ($p < 0.0001$), using two-tailed Cochran-Armitage trend test.

Figure 5. Injury mortality rates for children aged 0-19 years by rural and urban income quintile, 1994-97

R represents rural income quintiles, with R1 being the lowest and R5 being the highest income quintile; U represents urban income quintiles, with U1 being the lowest and U5 being the highest income quintile. Statistically significant trends in both rural and urban ($p < 0.0001$), using two-tailed Cochran-Armitage trend test.

Figure 6. Injury hospitalization rates for children aged 0-19 years by rural and urban income quintile, 1994/95 - 1998/99

Also substantial is the difference in injury rates between rural and urban areas, notably Winnipeg. Non-Winnipeg children die from injuries more than 2 times as frequently as Winnipeg children and are hospitalized almost 2.5 times as frequently. While it could be argued that the substantially higher injury *hospitalization* rates in rural regions may in part reflect admission

practices (see Brownell, et al., this issue),¹¹ judging from the higher injury *mortality* rates in rural areas, injuries are a more significant problem in rural than in urban areas, particularly more serious injuries. Studies in the U.S. have also found higher injury rates in rural compared to urban areas.¹²⁻¹⁵ The rural-urban differences in injury could be due to exposure to haz-

ardous environments and products,¹⁴ differences in response rate and transportation-time to trauma centres,^{14,15} and differences in the use of prevention strategies.^{13,16} An observational study of Winnipeg and nearby rural communities reported significantly higher helmet use for urban children compared to rural children. The overall urban/rural difference (including adults) was highly significant with the prevalence of helmet use for urban cyclists at 22.9% compared to 8.9% for rural cyclists.¹⁶

The causes of injuries are also influenced by many of the factors discussed above. Motor vehicle crashes (MVCs) are the leading cause of injury death in all Manitoba children, findings that are replicated both nationally and internationally.^{5,17} Nationally, MVC injuries and deaths for children 0 to 14 are lower than any other age group (including adults), whereas rates for those 15 to 19 years are about double the population as a whole, suggesting that the factor underlying the sudden and dramatic increase in MVCs at this age is strongly related to the acquisition of a driver's licence,⁵ as well as exposure to motor vehicles. Preliminary evidence from Ontario's Graduated Licensing System suggests graduated licensing may be an effective means of reducing MVCs for new drivers. This system requires new drivers to go through several stages of increasing responsibility and decreasing restrictions over a specified period of time before they qualify for a full driver's licence. The collision rate for novice drivers was 31% lower in 1995, after the introduction of graduated licensing than in 1993, prior to its implementation, whereas the general driving population experienced only a 4% drop during the same time period.¹⁸

Suicide is the second leading cause of injury mortality for Manitoba children, a finding that mirrors national statistics.⁵ Whereas unintentional injury has decreased nationally over the past several years, suicide rates have increased slightly.⁵ The rate of suicide deaths in the northern part of Manitoba is almost three times higher than the provincial average, whereas the rate of hospitalization for suicide attempts is over seven times higher in the north than in the rest of the province.

Accounting for close to a quarter of all injury hospitalizations, falls were the lead-

ing overall cause of injury hospitalization for Manitoba children, a finding that is also consistent at the national level.¹⁹ Injuries from childhood falls cost \$630 million each year in Canada.¹

In addition to PMR, SEFI and region, injury mortality and injury hospitalization rates for Manitoba children correlate with neighbourhood income level, meaning that the lower the income level, the higher the injury rate. Other studies have found not only this association between decreasing SES and increasing injury rates,²⁰ but also that children from lower SES families tend to experience more severe and more often fatal injuries.²¹ Why do we find higher injury rates for children from lower income families? Morrongiello¹⁹ suggests that these children are more likely to live and play in more hazardous environments and their parents may have limited knowledge about parenting and child development and abilities, leading to poor parental judgement. All these factors are associated with greater risk for injury.¹⁹ An observational study of Manitoba cyclists found that helmet use was strongly related to income level: 30.5% of the cyclists in the highest income neighbourhoods were observed wearing helmets compared to only 7.8% in the lowest income neighbourhoods.¹⁶ Manitoba data from the NLSCY showed that 40.6% of children from low-income families (less than \$20,000 per year) seldom or never wore seatbelts while driving in a motor vehicle, compared to 14.5% of children from families with higher incomes.

National data from Statistics Canada confirm that both injury mortality and injury hospitalization rates differ across urban income quintiles, and also show that the income gap narrows as children get older, and income differences are greater for some types of injury than others.⁶ Whereas income was not significantly associated with deaths due to MVCs, poisonings or suicide, children in the lowest income group were 1.5 times more likely to die from drowning, twice as likely to die from falls, over 4 times more likely to die from homicide, and over 18 times more likely to die from fires.⁶ For injury hospitalizations, there was no clear effect of income on motor vehicle collisions or falls. Hospitalization rates for children from the poorest neighbourhoods were almost 1.5 times higher for choking and suffocation, over 1.5 times higher for sui-

cide attempts, 2 times higher for poisonings, over 2 times higher for fires and burns, and almost 3 times higher for violence by others.⁶

Clearly, injuries are not random events but are related to social factors, including income level, and the overall healthiness and socioeconomic well-being of the population. Given the significance of injuries to child health, it is imperative to use existing information on the impact of social and demographic factors when designing and implementing programs and policies for injury prevention. Perhaps the most effective means of reducing the burden of childhood injury would be to reduce the social inequalities that contribute to inequalities in both child and adult health.

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RÉSUMÉ

Contexte : Les blessures sont la principale cause de mortalité chez les enfants canadiens de 1 à 19 ans et entraînent le sixième de toutes les hospitalisations de la naissance à 19 ans. On examine ici les causes de blessures chez les enfants manitobains et le lien entre les taux d'accident avec blessures et la région de résidence, le TMP et le revenu.

Méthode : Les écarts régionaux dans les taux de décès et d'hospitalisation résultant de blessures et dans les causes de blessures ont été dérivés du Population Health Research Data Repository. On a examiné le lien entre les taux d'accident avec blessures et les niveaux de revenu par sous-région et calculé les corrélations entre les TMP et les taux d'accident avec blessures des sous-régions.

Résultats : Les accidents de la route étaient la principale cause de décès résultant de blessures, et les chutes, la principale cause d'hospitalisation résultant de blessures. Les écarts régionaux étaient considérables. Les écarts entre les zones urbaines et rurales dans les taux d'accident avec blessures étaient marqués; les taux dans le Nord du Manitoba étaient très élevés par rapport au reste de la province. Les valeurs régionales du TMP présentaient des corrélations significatives avec les taux de décès et d'hospitalisation résultant de blessures. Ces deux types de taux d'accident avec blessures présentaient des liens significatifs avec le revenu (les taux étant plus élevés au bas de l'échelle des revenus).

Conclusion : Les blessures ne sont pas le fait du hasard, mais sont liées à des facteurs sociaux.