ORIGINAL ARTICLE

Comparison of urban and rural non-fatal injury: the results of a statewide survey

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Objectives: This study compared the epidemiology of non-fatal injury among urban and rural residents of Colorado.
Design: A stratified probability sample with random digit dial methods was used to survey Colorado residents by telephone regarding injuries experienced in the last 12 months. Questions on the cause of the injury, the activity at the time of the injury, and the place of injury were based on the Nordic Medico Statistical Committee's (NOMESCO) classification of external causes of injuries.
Subjects: A total of 1425 urban and 1275 rural Colorado residents aged 18 and older were interviewed.
Results: Age, gender, marital status, and rural residency were found to increase the odds of self reported injury. The adjusted odds ratio for self reported injury was 1.3 (95% confidence interval (CI) 1.01 to 1.68) for rural compared with urban residents. Rural residence (odds ratio 1.02, 95% CI 0.51 to 7.01) was not a risk factor for injury among the highest risk group, those who were single and never married. No differences in injury characteristics were found by urban-rural status.
Conclusions: The increased odds of self reported injury among rural residents were not explained by differences in the causes of injury or other injury characteristics. The differences in the importance of rural residence in increased odds of injury by marital status warrants further understanding and may be important in the development of injury prevention programs. Based on comparison with a similar survey, the NOMESCO coding system appears to be a viable alternative survey tool for gathering information on injury characteristics.

Unintentional injury is the fifth leading cause of death in the United States.[1] The higher rate of injury mortality among rural residents compared with urban residents has been documented for different populations, diagnoses, and injury mechanisms.[2–5] In addition, rates of both injury hospitalizations and injury related clinic visits have been higher for rural residents than urban residents.[6 7] These differences by residence may be due to several, complex issues, such as differences in medical care; access to medical care; or susceptibility or exposure to conditions that may result in differential injury severity between rural and urban residents. To fully understand the differences in the epidemiology of injury between urban and rural residents, population based information on injuries is needed. The purpose of this study was to describe rural and urban self reported non-fatal injuries among adults in Colorado and to evaluate the association of self reported injury with selected demographic factors.

METHODS

Survey methods

A population based survey of non-institutionalized Colorado adults was conducted beginning January 1999 through October 2000. The survey design and sampling methods used followed those of the Behavioral Risk Factor Surveillance System (BRFSS).[8] The sample consisted of two strata: urban and rural. Counties with a metropolitan area of more than 100 000 people or a city with a population of at least 50 000 people were classified as urban. All other counties were classified as rural. Telephone calls were made to the urban areas from January1999 through December 1999 and to the rural areas from January 1999 through September 2000. Random digit dial telephone techniques were used to identify households within each stratum. One adult, 18 and older, was randomly chosen from each household to participate in the survey. Calling and quality control procedures followed those of the BRFSS.[8]

Questionnaire design

The main purpose of the survey was to describe disability in the state. A series of questions about injury were added which asked respondents if they had an injury in the last 12 months that required medical attention other than first aid and/or that caused restriction of usual activities for a day or more. For all those who responded positively detailed questions were asked about the most recent injury including:

1. If the injury occurred on a farm or ranch.
2. The number of missed days of work/regular activity due to the injury.
3. If the respondent was the driver or passenger of a motorized vehicle when the injury occurred.
4. The activity at the time of injury.
5. The place the injury occurred.
6. The events that caused the injury.
7. If the injury was intentional or unintentional.

Characteristics 4 through 6 were coded using the Nordic Medico Statistical Committee's (NOMESCO) classification of external causes of injuries.[9 10] This classification scheme has two levels of coding with one digit coding designed ''to enable staff without special training'' to use the codes (NOMESCO Working Group, p14).[9]

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; NOMESCO, Nordic Medico-Statistical Committee; CMSA, consolidated metropolitan statistical area; MSA, metropolitan statistical area; CI, confidence interval

Demographic questions were taken from the 1999 BRFSS.[11] An index of poverty level was determined using the United States Department of Health and Human Services 2000 poverty guidelines.[12] Respondents were categorized as living in households near or below poverty or above poverty guidelines. Poverty level is dependent on the number of household residents and the household income. Since the income categories on the BRFSS questionnaire were not the same as those found on the poverty guidelines, some respondents could not be classified as below or above poverty level. They instead could have been classified as either right below or right above these two poverty levels. These respondents were assigned as near the poverty level.

Data analysis

A weight, accounting for probability of selection and non-response bias, was developed for each respondent according to guidelines developed for weighting BRFSS survey data.[13] The data were analyzed using SAS, version 8.1 together with IVEware to account for the weighting procedure and the complex survey design.[14 15] Proportions and 95% confidence intervals were developed separately for urban and rural residents as well as the statewide population.

Design based logistic regression modeling techniques were used to identify those demographic characteristics associated with reporting at least one injury in the last 12 months.[16] It was decided *a priori* to keep all those variables with a p value of less than 0.15 in the multiple logistic regression model. All variables, including those not found to be statistically significant, were tested as potential confounders. Confounding was defined as a variable whose addition to the model changed the odds ratio of one of the other variables by 10% or more. Main effects included in the final multiple logistic regression model were those variables which continued to have a statistically significant coefficient at $p<0.15$ and/or were found to confound the effects of those variables. First order interaction terms in which the Wald test for significance of the coefficient was less than 0.05 were considered to be significant interactions.

We repeated the logistic regression analysis to investigate if the odds of reporting an injury differed by type of urban and rural county. Urban and rural counties were further subdivided into four mutually exclusive regions: Denver Metro consolidated metropolitan statistical area (CMSA), other metropolitan statistical areas (MSAs), rural non-remote, and rural remote. The rural non-remote category consisted of counties that either: (1) had a population center greater than 2500 or (2) were adjacent to either the Denver Metro CMSA or the other MSA counties. Rural remote counties included those that had a population center less than 2500 and were not adjacent to an urban county.

RESULTS

A total of 4306 Colorado households were contacted for the study: 2380 urban and 1926 rural. A total of 2713 individuals agreed to participate; 13 respondents with missing data necessary for weighting were excluded. Following the methods used by the BRFSS in calculating response rates, the response rate in the urban stratum was 57.4% compared with 63.4% in the rural stratum.[17]

Descriptive results

Table 1 provides the weighted estimates of the distribution of demographic variables for the total sample and for the urban and rural counties. The demographic characteristics were similar except that rural residents were less likely to have attended college than urban residents. While not statistically significant, rural residents were also more likely to be older and less likely to have incomes above the poverty level.

Statewide, 14.7% of adults reported having had at least one injury in the last 12 months (table 2). Those 18–24 years and never married individuals had the highest proportions of self reported injuries. The two oldest age groups had the lowest proportion of those reporting an injury. Over 17% of rural residents reported having an injury compared with over 14% among urban residents. In most subgroups rural residents more often reported being injured than urban residents. When breaking county type down further, rural remote residents had the highest proportion reporting injuries (22.6%, 95% confidence interval (CI) 15.0 to 30.1), followed by rural non-remote residents (16.6%, 95% CI 13.9 to 19.4). Urban residents outside the Denver Metro region had the lowest proportion (12.1%, 95% CI 8.7 to 15.4) with 14.9% (95% CI 12.2 to 17.6) of Denver Metro residents experiencing an injury in the last 12 months.

Table 3 summarizes the injury characteristics of the most recent injury by urban and rural status. The characteristics of the injuries to rural respondents were similar to those of urban respondents. A third of all injuries in both rural and urban areas took place in the home. More than 10% of rural respondents reported that the injury took place on a farm or ranch compared with 4% of urban respondents. Of all of the injuries on a farm/ranch, a third of them took place in a home (data not shown).

Causes of injury did not differ when comparing urban and rural residents (table 3). The most common causes of injury were overexertion and being struck or hit from a fall. These injuries accounted for greater than 50% of all injuries among rural and urban residents. Twelve percent of the injuries occurred while the respondent was a driver or passenger in a motor vehicle for urban and rural residents (table 3).

Working for income was the most frequently reported activity at the time of injury for both rural and urban residents. Rural respondents were less likely to report doing unpaid work at the time of injury compared with their urban counterparts; urban respondents were also more likely to report being involved in sporting activities at the time of injury compared with rural residents (table 3).

Thirty one percent of injuries to rural residents kept the individuals from their usual activities for six or more days while 28% of the injuries to urban residents required this restriction (table 3). Only five of the injuries were reported as intentional: four assaults and one suicide attempt (data not shown).

Multivariate results

Four variables were associated with self reported injury: residence, marital status, age group, and gender (table 4). After adjustment for age, gender, and marital status, the odds of rural residents incurring at least one non-fatal injury in the last 12 months were 30% higher compared with their urban counterparts. Residents of rural remote areas were over 60% more likely to incur a non-fatal injury compared with the residents of the Denver CMSA (odds ratio 1.64, 95% CI 0.99 to 2.73).

Based on the evaluation of interaction terms, marital status was found to have a differential effect on the other three variables. There were no respondents age 65 and older who had had an injury in the last year and who also were never married. Since the 55–64 year old age group showed no difference in odds of injury compared to the 65 and older group (table 5), the two oldest age groups were combined into one for the interaction analysis. Within the never married group, the youngest ages and males had the highest odds of self reported injury (table 5). Rural residents in this group had no higher risk than their urban counterparts. Among the formerly married respondents, those in the rural areas were over 80% more likely to report an injury than their

Table 1 Proportion and 95% confidence intervals of study respondents by selected demographic characteristics: Colorado 1999–2000

	Urban (n = 1425)	Rural (n = 1275)	Statewide (n = 2700)
Gender			
Male	49.6 (46.6 to 52.5)	52.4 (49.1 to 55.6)	50.0 (47.5 to 52.5)
Female	50.4 (47.5 to 53.3)	47.6 (44.3 to 50.9)	50.0 (47.5 to 52.5)
Age group			
18–24	13.7 (11.2 to 16.1)	12.1 (9.4 to 14.8)	13.4 (11.3 to 15.5)
25–34	21.1 (18.8 to 23.4)	18.2 (15.6 to 20.7)	20.6 (18.7 to 22.6)
35–44	23.1 (20.6 to 25.5)	22.4 (19.8 to 25.0)	23.0 (20.9 to 25.1)
45–54	19.1 (16.9 to 21.3)	20.4 (17.7 to 23.0)	19.3 (17.4 to 21.2)
55–64	10.3 (8.6 to 12.1)	12.0 (10.0 to 14.1)	10.6 (9.1 to 12.1)
65+	12.6 (10.9 to 14.3)	14.9 (12.8 to 17.0)	13.0 (11.5 to 14.5)
Ethnicity			
Hispanic	16.7 (14.5–19.0)	14.8 (12.2 to 17.4)	16.4 (14.5 to 18.4)
Non-Hispanic	83.3 (81.0 to 85.5	85.2 (82.6 to 87.8)	83.6 (81.6 to 85.5)
Poverty status			
Near or below poverty	8.8 (7.0 to 10.7)	12.2 (9.9, to 14.4)	9.4 (7.8, to 11.0)
Above poverty	91.2 (89.3 to 93.1)	87.8 (85.5 to 90.1)	90.6 (89.8 to 92.2)
Education			
Less than high school	9.6 (7.8 to 11.3)	10.3 (8.4 to 12.3)	9.7 (8.1 to 11.2)
High school graduate	29.3 (26.6 to 32.0)	35.2 (32.0 to 38.3)	30.3 (27.9 to 32.6)
Some college	61.1 (58.3 to 64.0)	54.5 (51.2 to 57.8)	60.1 (57.6 to 62.5)
Marital status			
Married/unmarried couple	64.1 (61.2 to 66.9)	67.1 (64.0 to 70.2)	64.6 (62.2 to 67.0)
Divorced/separated/widowed	17.6 (15.6 to 19.5)	17.4 (15.2,19.5)	17.6 (15.9 to 19.2)
Single, never married	18.3 (14.8 to 21.9)	15.5 (12.8 to 18.2)	17.9 (15.8 to 20.0)

urban counterparts. Married, rural residents showed close to a 30% increase in the odds of self reported injury compared with their married, urban counterparts but this increased odds was no longer statistically significant in the interaction analysis. Only young age (18–24) was a statistically significant risk factor for injury among the married group.

DISCUSSION

The odds of self reported injury were 30% higher for rural residents compared with urban residents when adjusted for age, gender, and marital status. Residents of rural remote counties had the highest odds of injury. The increase in self reported injury among rural residents is comparable to the difference in age adjusted death rates for urban and rural counties. (30% *v* 21%) (personal communication, Injury Epidemiology Program, Colorado Department of Public Health and Environment). In this study, no major differences were noted for urban and rural residents in the place, cause, or activity at the time of injury. Considering all of the above, this finding would suggest that non-fatal injuries are not different in rural and urban areas, rather that given comparable populations in age, gender, and marital status, injuries would occur more often in rural than urban areas. We found that other groups at higher risk of injury mortality and hospitalization were not at high risk of self reported injuries. As an example, in Colorado 31% of all injury deaths

Table 2 Proportion (95% confidence interval) of self reported injury by selected characteristics, by residence: Colorado 1999–2000

	Urban (n = 1425)	Rural (n = 1275)	Statewide (n = 2700)
Any injury	14.2 (12.0 to 16.3)	17.4 (14.8 to 20.0)	14.7 (12.9 to 16.5)
Gender			
Male	16.2 (12.7 to 19.7)	20.1 (16.0 to 24.3)	16.8 (13.9 to 19.8)
Female	12.2 (9.8 to 14.7)	14.4 (11.5 to 17.4)	12.6 (10.4 to 14.7)
Age group			
18–24	23.4 (14.6 to 32.1)	25.6 (14.3 to 36.8)	23.7 (16.0 to 31.4)
25–34	12.8 (8.7 to 16.8)	18.2 (12.1 to 24.3)	13.6 (10.0 to 17.1)
35–44	14.3 (10.1 to 18.5)	19.0 (13.9 to 24.1)	15.0 (11.4 to 18.7)
45–54	13.1 (8.6 to 17.5)	15.5 (10.4 to 20.6)	13.5 (9.7 to 17.3)
55–64	9.4 (4.6 to 14.2)	19.9 (12.8 to 26.9)	11.3 (7.2 to 15.5)
65+	11.9 (7.0 to 16.7)	8.2 (4.0 to 12.4)	11.2 (7.1 to 15.2)
Ethnicity			
Hispanic	14.2 (8.9 to 19.5)	17.6(9.2 to 26.0)	14.7 (10.0 to 19.3)
Non-Hispanic	14.1 (11.8 to 19.5)	17.3 (14.6 to 20.0)	14.7 (12.6 to 16.7)
Poverty status			
Near or below poverty	12.0 (5.1 to 18.8)	16.6 (9.6 to 23.6)	12.9 (7.3 to 18.4)
Above poverty	14.6 (12.2 to 17.0)	16.8 (14.0 to 19.6)	15.0 (12.9 to 17.1)
Education			
Less than high school	10.7 (4.1 to 17.4)	17.5 (9.5 to 25.5)	11.9 (6.3 to 17.6)
High school graduate	14.2 (10.4 to 18.0)	15.3 (10.8 to 19.8)	14.4 (11.2 to 17.6)
Some college	14.7 (11.9 to 17.6)	18.8 (15.3 to 22.2)	15.3 (12.9 to 17.8)
Marital status			
Married/unmarried couple	12.9 (10.4 to 15.3)	15.9 (12.9 to 18.9)	13.4 (11.3 to 15.5)
Divorced/separated/widowed	10.6 (7.1 to 14.2)	17.7 (12.8 to 22.6)	11.8 (8.7 to 14.8)
Single, never married	22.3 (15.3 to 29.2)	23.7 (14.8 to 32.5)	22.5 (16.3 to 28.6)

Table 3 Characteristics of the most recent injury by urban and rural status: Colorado 1999–2000

	Urban (n = 191)	Rural (n = 207)	Statewide (n = 398)
Place injury occurred			
Home	33.1 (25.5 to 40.7)	33.2 (25.7 to 40.6)	33.1 (26.8 to 39.4)
Sports area	16.4 (9.1 to 23.8)	9.5 (4.7 to 14.3)	15.0 (9.0 to 21.1)
Transportation area	14.8 (9.1 to 20.5)	15.5 (8.2 to 22.7)	14.9 (10.1 to 19.7)
Production/workshop area	13.9 (8.2 to 19.6)	20.4 (13.7 to 27.1)	15.2 (10.4 to 20.0)
Open areas in nature	5.5 (2.1 to 8.9)	9.1 (4.4 to 13.9)	6.2 (3.3 to 9.1)
Other	16.3 (10.3 to 22.2)	12.4 (7.5 to 17.2)	15.5 (5.6 to 25.4)
Injured on farm/ranch	4.0 (0.9 to 7.1)	10.7 (6.1 to 15.3)	5.3 (2.7 to 8.0)
Cause of injury			
Acute overexertion	31.1 (23.0 to 39.3)	27.1 (20.0 to 34.2)	30.4 (23.7 to 37.0)
Struck/hit from fall	24.7 (17.9 to 31.6)	28.0 (20.7 to 35.3)	25.4 (19.7 to 31.1)
Struck/hit from collision	13.9 (8.4 to 19.4)	18.5 (10.9 to 26.0)	14.8 (10.1 to 19.5)
Crushing, cutting, piercing	11.6 (5.9 to 17.2)	14.1 (8.4 to 19.8)	12.1 (7.4 to 16.7)
Other	18.6 (6.8 to 30.5)	12.3 (0.9 to 23.7)	17.4 (7.6 to 27.2)
Injured while in a motor vehicle	12.1 (6.8 to 17.3)	12.8 (5.9 to 19.7)	12.2 (7.8 to 16.6)
Activity at the time of injury			
Working for income	31.7 (23.7 to 39.6)	34.1 (26.4 to 41.8)	32.2 (25.6 to 38.7)
Unpaid work	29.2 (21.9 to 36.4)	18.9 (13.0 to 24.8)	27.1 (21.2 to 33.0)
Sports, athletics, exercise	23.2 (15.4 to 31.0)	19.0 (12.5 to 25.5)	22.4 (16.0 to 28.8)
Other	16.0 (4.4 to 27.6)	28.0 (16.7 to 39.2)	18.4 (8.9 to 27.9)
Number of missed days of work or regular activity			
None	35.4 (27.0 to 43.8)	39.1 (31.0 to 47.2)	36.1 (29.2 to 43.0)
1–5	36.2 (28.2 to 44.2)	29.9 (22.5 to 37.3)	35.0 (28.4 to 41.5)
⩾6	28.4 (17.9 to 38.9)	31.0 (20.5 to 41.6)	28.9 (20.3 to 37.6)

were to those 55 and older a group that comprises approximately 18% of the population.[18 19] In this study, those 55 and older had the lowest odds of self reported injury of any age group. Whereas, Hispanics have significantly higher injury death rates in Colorado than do white non-Hispanics, we did not see that differential in self reported injury.[18] This suggests that the epidemiology of non-fatal injuries is not entirely similar to that of fatal injuries.

Marital status and injury

We found marital status to be an important variable in understanding urban and rural differences in self reported injury. In the marital group with the highest odds of injury (never married), residence was not associated with self reported injury. The association was strongest in the group with the lowest odds of injury (divorced/separated/widowed). It appears that in an already ''at risk'' group, rural residence is not a salient factor for self reported injury.

The pattern between self reported injury and marital status does not mirror what is known about the association between mortality and marital status. In general, studies have shown that divorced individuals have a higher risk of mortality compared with married groups, with never married individuals falling in between.[20 21] In this study, while never married individuals had the greatest risk of self reported injury, no difference was seen between those who were currently married and those previously married (divorced/separated/widowed). Yet, the fact of living in a rural county had the biggest impact on the previously married subgroup. While small numbers of actual injuries in these subpopulations prevented us from investigating differences in injury characteristics, further investigation along these lines would help to understand if the injuries themselves differed by these marital groups.

Table 4 Crude and adjusted odds ratios* (95% confidence interval) for self reported injury: Colorado, 1999–2000

	Crude odds ratio	Adjusted odds ratios*
County type		
Rural	1.28 (0.99 to 1.65)	1.30 (1.01 to 1.68)**
Urban	Referent	Referent
Alternative county type		
Rural remote	1.66 (1.16 to 2.70)**	1.64 (0.99 to 2.73)
Rural non-remote	1.14 (0.85 to 1.52)	1.18 (0.88 to 1.58)
Non-Denver Metro	0.78 (0.53 to 1.15)	0.81 (0.55 to 1.19)
Denver Metro	Referent	Referent
Gender		
Male	1.41 (1.06 to 1.88)**	1.34 (1.00 to 1.79)**
Female	Referent	Referent
Age group		
18–24	2.47 (1.35 to 4.51)***	1.81 (0.95 to 3.46)
25–34	1.25 (0.74 to 2.10)	1.10 (0.65 to 1.87)
35–44	1.41 (0.85 to 2.34)	1.31 (0.80 to 2.19)
45–54	1.24 (0.73 to 2.11)	1.18 (0.70 to 2.03)
55–64	1.02 (0.56 to 1.84)	0.98 (0.55 to 1.79)
65+	Referent	Referent
Marital status		
Never married	1.87 (1.25 to 2.80)***	1.47 (0.96 to 2.26)
Divorced/separated/widowed	0.86 (0.61 to 1.22)	0.94 (0.66 to 1.33)
Currently married	Referent	Referent

*Adjusted for variables shown.
**p<0.05; ***p<0.01.

NOMESCO coding

To our knowledge this is the first time that the NOMESCO coding system was used for a telephone survey. This coding scheme provides a structure that is accessible because it does not require in-depth training on the coding of injuries and can be used in many different settings. In the survey by Nordstrom *et al* of respondents in a rural remote county, the activity at the time of the injury and how the injury happened were reported in narrative fashion.[22] A trained medical records professional later coded these data. Their results were similar to results in this study. In the Iowa study 25% of injuries were due to overexertion and 21% from falls compared with 26% of injuries due to overexertion and close to 28% from falls in the Colorado rural population. Home was the most frequent place of injury in both studies: 26.6% in the Iowa study compared with 33.2% in rural respondents in the current study. Five percent of injuries occurred in recreation

Table 5 Adjusted odds ratios* (95% confidence interval) for self reported injury stratified by marital status: Colorado, 1999–2000

	Never married	Divorced/separated/widowed	Currently married
Age group			
18–24	11.39 (1.52 to 107.09)***	1.49 (0.02 to 148.09)	2.27 (1.02 to 5.05)
25–34	7.64 (0.80 to 73.02)	0.39 (0.13 to 1.22)	1.23 (0.70 to 2.14)
35–44	9.22 (0.86 to 98.90)	1.01 (0.44 to 2.30)	1.42 (0.85 to 2.37)
45–54	4.80 (0.40 to 57.53)	1.23 (0.56 to 2.70)	1.29 (0.74 to 2.25)
55+	Referent	Referent	Referent
Gender			
Male	3.27 (1.52 to 7.01)***	0.65 (0.31 to 1.36)	1.16 (0.80 to 1.67)
Female	Referent	Referent	Referent
Region			
Rural	1.02 (0.51 to 7.01)	1.81 (1.06 to 3.08)**	1.29 (0.94 to1.77)
Urban	Referent	Referent	Referent

*Stratified by marital status and adjusted for variables shown.
**p<0.05; ***p<0.01.

and sport facilities compared with 9.5% of injuries to rural residents in this study.

Study limitations

Recall of injuries within the last 12 months yields the lowest injury incidence rate when compared with other shorter recall intervals.[23–25] Using a 12 month recall results in an underestimation of injury occurrences. Yet, when using shorter recall periods, larger sample sizes are needed to acquire enough injuries in the data to be able to describe differences in injury characteristics among subpopulations. Since the sample size was limited and the goal of this survey was to assess differences not only the proportion of urban and rural adults experiencing injury but also differences in injury characteristics between these two populations, a 12 month recall period was used.

While the proportion of those experiencing an injury in the last 12 months is probably underestimated by using the 12 month recall, the magnitude of the difference found in non-fatal injury between urban and rural residents would only be biased if urban or rural residents were more or less likely to report injuries in this time period. One variable not studied that could possibly influence differences in recall between these two groups is access and use of health care. One such measure of access is health insurance coverage. A larger proportion of rural than urban residents are known to be uninsured.[26–28] Would having sought medical care for an injury for which others with less access to care would not have sought such care result in more accurate recall among urban residents? Harel *et al* in their study of recall of childhood injuries found that doctor visits due to injuries could not explain the variation in recall for the various time periods.[25] More work is needed to understand how access to care and use of health services for injuries in adults influence recall in reporting injury.

One variable known to influence recall is severity of injury with severe injuries showing less recall bias than minor injuries.[23–25] Using number of days of missed regular activity as an estimate of severity, the distribution of this variable was similar for rural and urban residents (table 3). This would support the idea that recall bias did not act selectively for one group over the other. Thus, while the true estimate of injury is probably more than stated in this paper, one would not expect that the magnitude of the differences between urban and rural residents found were biased by using a 12 month recall.

Due to funding constraints, the time frame for collection of data differed between the urban and rural groups, with collection continuing for nine months more in the rural group than in the urban group. We found no differences within the rural respondents in regard to demographic characteristics and reported injury by year of interview or by month of interview. The results assessing significant risk factors for injury were similar when limiting the analysis to data only collected in 1999. In addition, the estimates of injury to rural remote residents are comparable to those reported in a population based survey of a rural remote Iowa county.[22] Thus, we believe that the difference in time frame did not affect comparisons between rural and urban residents.

More than 99% of the injuries reported were unintentional. Estimates from the Consumer Product Safety Commission's National Electronic Injury Surveillance System estimated that 6.4% of all injuries seen in emergency departments in 2000 were for violence related, intentional injuries.[29] In previous population based telephone surveys, data have been gathered on domestic violence and other types of intentional injury.[30–33] The other surveys had specific questions about specific types of intentional injuries. Our findings suggest that direct questions about intentional injuries should be included as specific, separate questions, as those reported here probably represent an under-estimate of intentional injuries.

Despite the study limitations, the results reported are consistent with other surveys. The results also provide evidence that rural residence is an independent risk factor for non-fatal injury but not for persons who have never been married. In that group, other risk factors such as being male and young age are more salient risk factors. While the risk of injury appears higher in some segments of rural populations,

Key points

- Data suggest that when adjusted for age, gender, and marital status, rural residents are more likely to experience non-fatal injury than urban residents.
- Yet, rural residence was not found to be a risk factor for injury among the never married population, but was among the divorced/separated/widowed population.
- No major differences were seen in the injury characteristics reported by rural and urban residents.
- NOMESCO coding is a viable alternative for coding of injuries for telephone surveys.

no differences were seen in the cause of injury, place of injury, and activity at the time of injury between urban and rural residents. More research is needed to understand the moderating effect of marital status on such injury risk factors as rural residence, age, and gender.

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REFERENCES

1 **Anderson RN**. Deaths: leading causes for 2000. *Natl Vital Stat Rep* 2002;**50**:1–85.
2 **Baker SP**, O'Neill B, Ginsburg MJ, *et al*. *The injury fact book*. 2nd Ed. New York: Oxford University Press, 1992:52–5.
3 **Stella J**, Sprivulis P, Cooke C. Head injury-related road crash mortality in rural Western Australia. *Aust N Z J Surg* 2001;**71**:665–8.
4 **Hwang HC**, Stallones L, Keefe TJ. Childhood injury deaths: rural and urban differences, Colorado 1980–8. *Inj Prev* 1997;**3**:35–7.
5 **Gabella BA**, Hoffman RE, Marine WW, *et al*. Urban and rural traumatic brain injuries in Colorado. *Ann Epidemiol* 1997;**7**:207–12.
6 **Hambidge SJ**, Davidson AJ, Gonzales R, *et al*. Epidemiology of pediatric injury-related primary care office visits in the United States. *Pediatrics* 2002;**109**:559–65.
7 **Reith DM**, Pitt WR, Hockey R. Childhood poisoning in Queensland: an analysis of presentation and admission rates. *J Paediatr Child Health* 2001;**37**:446–50.
8 **Centers for Disease Control and Prevention**. *Behavioral Risk Factor Surveillance System Surveillance guide*. Atlanta, GA: CDC. Available at http://ww2.cdc.gov/nccdphp/brfss2/training (accessed on 20 August 2002).
9 **NOMESCO Working Group for Classification for Accident Monitoring**. *NOMESCO classification of external causes of injuries*. 3rd Revised editions. Copenhagen: NOMESCO, 1997:28–48.
10 **Frimodt-Moller B**, Bay-Nielsen H. Classification of accidents in the arctic. A suggestion for adaptation of the Nordic classification for accident monitoring. *Arct Med Res* 1992;**51**(suppl):15–21.
11 **Centers for Disease Control and Prevention**. *Behavioral Risk Factor Surveillance System questionnaire*. Atlanta, GA: US Department of Health and Human Services, CDC, 1999.
12 **US Department of Health and Human Services**. *The 2000 HHS poverty guidelines*. Washington, DC: US Department of Health and Human Services, Available on: http://aspe.hhs.gov/poverty/00poverty.htm (accessed on 7 January 2002).
13 **Centers for Disease Control and Prevention**. *Behavioral Risk Factor Surveillance System*. Atlanta, GA: CDC, Available at: http://www.cdc.gov/brfss/ti-weighting.htm (accessed on 15 August 2001).
14 **SAS Institute Inc**. *SAS guide for personal computers, version 8.1*. Cary, NC: SAS Institute Inc, 2000.
15 **Raghunathan TE**, Solenberger PW, VanHoew J. IVEware: imputation and variance estimation software. Survey Methodology Program, Survey Research Center, Institute for Social Research, University of Michigan. Available at: http://www.isr.umich.edu/src/smp/ive (accessed on 15 July 2002).
16 **Lemeshow S**, Hosmer DW. *Applied logistic regression*. New York: Wiley, 2000:211–21.
17 **Centers for Disease Control and Prevention**. Behavioral Risk Factor Surveillance System. Atlanta, GA: CDC, Available at: http://www.cdc.gov/brfss/ti-quality.htm (accessed on 20 August 2002).
18 **Colorado Department of Public Health and Environment**. *Injury in Colorado*. Denver, CO: Colorado Department of Public Health and Environment, 2002;**139**:40–1.
19 **Colorado Department of Public Health and Environment**. *Colorado health information data set*. Denver, CO: Colorado Department of Public Health and Environment. Available at: http://www.cdphe.state.co.us/cohid/Cohids.html (accessed on 15 October 2002).
20 **Singh GK**, Siahpush M. Ethnic-immigrant differentials in health behaviors, morbidity, and cause-specific mortality in the United States: an analysis of two national databases. *Hum Biol* 2002;**74**:83–109.
21 **Tucker JS**, Friedman HS, Wingard DL, *et al*. Marital history at midlife as a predictor of longevity: alternative explanation to the protective effect of marriage. *Health Psychol* 1996;**36**:230–43.
22 **Nordstrom DL**, Zwerling C, Stromquist AM, *et al*. Epidemiology of unintentional adult injury in a rural population. *J Trauma* 2001;**51**:758–66.
23 **Mock C**, Acheampong F, Adjei S, *et al*. The effect of recall on estimation of incident rates for injury in Ghana. *Int J Epidemiol* 1999;**28**:750–5.
24 **Landen DD**, Hendricks S. Effect of recall on reporting of at-work injuries. *Public Health Rep* 1995;**110**:350–4.
25 **Harel Y**, Overpeck MD, Jones DH, *et al*. The effects of recall on estimating annual nonfatal injury rates for children and adolescents. *Am J Public Health* 1994;**84**:599–605.
26 **Frenzen PD**. Health insurance coverage in the US urban and rural areas. *J Rural Health* 1993;**9**:204–14.
27 **Hartley D**, Quam L, Lurie N. Urban and rural differences in health insurance and access to care. *J Rural Health* 1994;**10**:98–108.
28 **Duncan RP**, Seccombe K, Amey C. Changes in health insurance coverage within rural and urban environments—1977 to 1987. *J Rural Health* 1995;**11**:169–76.
29 **Office of Statistics and Programming, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention**. National estimates of nonfatal injuries treated in hospital emergency departments—United States, 2000. *MMWR Morb Mortal Wkly Rep* 2001;**50**:340–1.
30 **Buehler J**, Dixon B, Toomey K. Lifetime and annual incidence of intimate partner violence and resulting injuries, Georgia, 1995. *MMWR Morb Mortal Wkly Rep* 1998;**47**:849–53.
31 **Bensley L**, Macdonald S, Van Eenwyk J, *et al*. Prevalence of intimate partner violence and injury—Washington, 1998. *MMWR Morb Mortal Wkly Rep* 2000;**49**:589–92.
32 **Coker AL**, Odendick R, Derrick J. Intimate partner violence among men and women—South Carolina, 1998. *MMWR Morb Mortal Wkly Rep* 2000;**49**:691–4.
33 **Koziol-McLain J**, Brand D, Morgan D, *et al*. Measuring injury risk factors: question reliability in a statewide sample. *Inj Prev* 2000;**6**:148–50.