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### Descriptive Characteristics Of Injury Recidivism Among Adults In The Us: Population-Based Study

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# **Descriptive Characteristics of Injury Recidivism Among Adults in the US: Population-Based Study**

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Submitted in partial fulfillment of the requirements for the Degree of Master of Public Health

Chronic Disease Epidemiology

Yale School of Public Health

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## **Abstract**

**Introduction:** In the United States (US), injury-related morbidity and mortality is a public health burden in terms of lives lost, healthcare costs, and lost productivity. In 2020, according to the Centers for Disease Control and Prevention (CDC), unintentional injuries were the fourth leading cause of death (200,955) behind heart disease, cancer, and COVID-19. Many of the studies of injury recidivism were limited to demographic data and often focus on a specific type of injury, such as motor vehicle crashes, interpersonal violence, or falls. The aim of this study is to present the descriptive characteristics of injury recidivism among adults in the United States, using a population-based dataset.

**Method:** Using the Medical Expenditure Panel Survey (MEPS), an annual cross-sectional survey of non-institutionalized U.S. households, 13,284 adults (2012-2018) with injuries were followed up for two years. Injuries captured in the study were those associated with healthcare utilization, disability days or any effects on self-reported health. Descriptive characteristics were performed using SAS version 9.4.

**Results:** Recurrent injuries were reported by 2885 which is representing over nine million individuals in the U.S. over a 2-year follow-up. These statistics imply that 21.72% of those injured experienced recidivism after accounting for sampling weights, clusters, and strata. Persons with repeat injuries were more likely to be Caucasian, unmarried, and have private insurance. Although they were more likely than persons reporting single occurrences of injuries to report diabetes (13.0 vs. 11.4%,  $p = 0.04$ ), asthma (17.3 vs. 13.2%,  $p < 0.01$ ), stroke (7.2 vs 4.8%,  $p < 0.01$ ), and smoking (21.4 vs. 17.%,  $p < 0.01$ ), there was no difference in the prevalence of cardiovascular illnesses or emphysema. Persons with repeat injuries were also significantly more likely than persons with single injury occurrences to have a positive depression (15.3 vs 9.6%  $p < 0.01$ ).

**Conclusions and Implications:** We identified a range of characteristics associated with higher recidivism rate among injured individuals. It is critical to identify evidence-based risk factors, preventative measures, and the role of many stakeholders in reducing the burden of injuries on population health. It is as important to also include policy makers in the evaluation and implementation of effective injury prevention strategies.

**Keywords:** Injury burden, Recidivism, Repeated injuries, MEPS, Chronic Disease Epidemiology

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**Introduction:**

In the United States (US), injury-related morbidity and mortality is a public health burden in terms of lives lost, healthcare costs, and lost productivity. In 2020, according to the Centers for Disease Control and Prevention (CDC), unintentional injuries were the fourth leading cause of death (200,955) behind heart disease, cancer, and COVID-19.<sup>1</sup> Traumatic injuries have far-reaching consequences in the United States health care spending. There are about 30 million non-fatal injuries visits to the emergency departments (EDs) each year.<sup>2</sup> In 2020, the number was estimated to be lower (22,887,137)<sup>2</sup>, which could be attributed to the hesitation to go to the EDs for fear of getting infected of by COVID19. CDC estimated the economic cost of injuries by attributing the cost of medical care, value of statistical life, work loss, and quality of life losses to the injury records reports from the Web-based injury statistic query and reporting system (WISQARS).<sup>3</sup> In 2019, the largest costs were related to the value of statistical life and quality of life losses at \$3.8 trillion.<sup>3</sup> Other cost included \$327 billion in medical costs, \$69 billion in lost wages. Overall, injuries cost the economy about \$4.2 trillion, and the working-aged adults (25-64 years) accounted for more than half of the total cost.<sup>3</sup> Additionally, injuries contributes to a further decline in health and quality of life, which may yield additional annual health care expenses.<sup>4</sup>

Injuries are also a substantial contributor to excess years of life lost, which are more accurate measures for assessing the impact of diseases and injuries. When compared to other diseases such as cancer and heart disease, injuries disproportionately affect younger people, and it is more prominently noted when measured using the Years of Potential Life Lost. According to the National Healthcare Quality and Disparities Report 2021, unintentional injury is the leading cause of years of potential life lost (YPLL).<sup>5</sup> While the deaths from heart disease and cancer, the top two leading cause of death, are declining, death rates from unintentional injury have risen.<sup>5</sup>

Injury recidivism is defined as patients who survive serious injuries but return to the emergency departments with repeated injuries. By increasing our ability to predict individuals at risk of recidivism, prevention strategies can be developed to reduce the incidence of recidivism. Several studies have identified demographic characteristics linked to injury recidivism, such as substance abuse, male gender, advancing age, and mental illness.<sup>6,7,8</sup> Many of these studies, however, are limited to demographic data and often focus on a specific type of injury, such as motor vehicle crashes, interpersonal violence, or falls.<sup>9,10</sup>

Alghnam et al, did a similar study using eight panels (9-16) and found that persons with repeated injuries were more likely to report diabetes, asthma, and to have more depressive symptoms than persons reporting single occurrences of injuries. The aim of this study is to present the descriptive characteristics of injury recidivism among adults in the United States, and to see whether the finding from Alghnam et al longitudinal study could be replicated using different panels (17-23) from the same population-based dataset.

**Method:**

**Dataset**

Data from the Medical Expenditure Panel Survey (MEPS) were used in this longitudinal study. The MEPS is a widely used nationally representative survey conducted by the Agency for Healthcare Research and Quality (AHRQ) that collects data of households through an overlapping panel design. Each year, a new panel of sample households is selected, and for each panel the data are collected for two calendar years. Each panel's two years of data are gathered in five rounds of interviews spread out over a two-and-a-half-year period.<sup>11</sup>

The MEPS collects detailed information on health status, health care utilization, health insurance, as well as a range of social and demographic characteristics. To meet the objective of this study, the MEPS characteristics and the medical conditions files were used. For the purpose of the analysis, panels 17-23 that started between 2012 to 2018, were pooled. Each panel will remain in the survey for two full calendar years as shown in figure (1). In any given calendar year, two panels will take part in the survey. As the figure illustrates, panel 17 enters the survey in 2012, and completes their first relative year of data collection. They remain in the survey for a second year, 2013, for their second year of data collection.

Figure 1

	Calendar year 2012			Calendar year 2013			Calendar year 2014			Calendar year 2015		
Panel 17	R1	R2		R3	R4	R5						
Panel 18				R1	R2		R3	R4	R5			
Panel 19							R1	R2		R3	R4	R5

## **Study Population**

Enrollment criteria for the study include: age 18 years old or older and experiencing at least one injury during the study period. When a respondent reports an injury the interviewer additionally inquires about the date of the injury. Since the focus of this study is on short-term recidivism, the sample were limited to injuries that occurred within a year of recruiting or during the study follow-up period.

## **Outcome Measures**

The main dependent outcome variable of this study is a binary variable indicating injury recidivism during the follow-up period. The MEPS captured the injury condition of a respondent in several ways. (1) Most directly, the injury is reported by a household respondent for a particular medical event (hospital stay, outpatient visit, emergency room visit, home health episode, prescribed medication purchase, or medical provider visit). (2) An injury may have been reported as the reason for one or more episodes of disability days. (3) An injury may have been reported by the household “bothering” the person during the reference period.

## **Characteristics of Interests**

The characteristics of interest were considered on the basis of previous literature.<sup>12,13,14,15</sup> The following characteristics were used for the analysis: gender (male or female), income status [poor (<100 % of poverty level), near poor (100– <125 % of poverty level), low income (125– <200 % of poverty level), middle (200– <400 % of poverty level), and high income ( $\geq$ 400 % of poverty level)]; age (categorized as 18–25, 26–45, 46–64 and  $\geq$ 65 years); education level (high school or below, some college, college graduate, and graduate studies); census region (Northwest, Midwest, South, West); and race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or non-Hispanic other). The ‘non-Hispanic other’ race category refers to Asians, American Indians, native Hawaiian, and those who reported two or more racial/ethnic groups. Binary variables include marital status as a binary indicator of being married or unmarried and an indicator for being a current smoker.

Depression could be another risk factor for injury and recidivism.<sup>16,17,18</sup> MEPS asks respondents to report their depressed mood and decreased interest in usual activities by using the Adult Self-Administered Questionnaire (SAQ). A Patient Health Questionnaire (PHQ-2) score was used as a screening tool for depression.<sup>19</sup> A score of three or higher from a possible



score of 0-6 is considered a positive screening of depressive symptoms. The PHQ-2 was measured twice during the follow-up, a categorical variable for the depression was created as follows: negative depressive symptoms in both years or positive depressive symptoms in both years.

The following health conditions that are known to affect health status were considered: diabetes, coronary heart disease, asthma, stroke, emphysema, and hypertension. Those are specified by the Agency for Healthcare Research and Quality (AHRQ), because of their prevalence, expense, and generally accepted standards for appropriate clinical care have been developed for them.<sup>20</sup>

## **Statistical Analysis**

All analyses were conducted using SAS version 9.4. The MEPS survey has a complex survey design, considering survey weights, strata and clustering of participants for providing nationally representative results of U.S. non-institutionalized populations. This study, including standard errors, adjusted for the design and its survey procedures.<sup>21</sup> Recidivism status was used to derive descriptive characteristics and Chi-2 tests were used to assess bivariate associations. A p-value of  $p < 0.05$  was considered statistically significant.

## **Result**

### **Descriptive characteristics: an injury**

Over the course of the study, 106,762 people were recruited as MEPS participants in panels 17-23. A total of 13,284 (12.4%) people met the study's inclusion criteria and were included in the analysis. Recurrent injuries were reported by 2885 of these 13,284 people during the study period. These statistics imply that 21.72% of those injured had more than one injury incident during the study period after accounting for sampling weights, clusters, and strata. This represents over thirty-one million adults in the United States experiencing injury recidivism over the period of the follow-up (Table 1). This is higher than what Alghnam et al found, as they identified over nine million adults experienced injury recidivism accounting for 17.9% of the adult population.

Similar to the finding from Alghnam et al, persons experiencing injury recidivism were more likely to be Caucasian, unmarried, and have private insurance. Although person

experiencing single injury events were more likely than persons experiencing injury recidivism to report diabetes (13.0 vs. 11.4%,  $p = 0.04$ ), asthma (17.3 vs. 13.2%,  $p < 0.01$ ), stroke (7.2 vs 4.8%,  $p < 0.01$ ), and smoking (21.4 vs. 17.%,  $p < 0.01$ ), there was no difference in the prevalence of cardiovascular illnesses or emphysema. Persons experiencing injury recidivism were also more likely than persons experiencing single injury events to have a positive depression symptoms as measured by the PHQ-2 ( $p < 0.01$ ).

## Discussion

Many studies have examined predictors of injury recidivism using samples that are not nationally representative. To the best of our knowledge, Alghnam et al, is the only study that has used population-based dataset to evaluate injury recidivism in the U.S. This study's finding that over 31 million injured individuals had experienced re-injury, indicates the importance of further studies to develop and implement injury prevention and intervention programs and policies.

**Table 1** Descriptive characteristics of the injured population by re-injury status

Variable	Total	Repeated Injury Weighted	Single Injury Weighted	<i>p</i> -value
N (un-weighted)	146,649,214 (13,284)	31,852,209 (2885)	114,797,005 (10,399)	
Age Category (%)				0.14
18 – 24	10.5	10.7	9.6	
25 – 45	31.7	32.1	30.2	
46 – 64	35.2	34.7	36.9	
>=65	22.7	22.5	23.2	
Male (%) <sup>a</sup>	49.7	49.4	51.0	0.20
Income (%) <sup>ab</sup>				<0.01
Poor	12.6	12.1	14.5	
Near poor	4.5	4.2	5.5	
Low	13.4	13.2	14.2	
Middle	27.9	28.3	26.4	
High	41.6	42.2	39.4	
Race\Ethnicity (%) <sup>a</sup>				0.03
Non-Hispanic white	72.2	71.6	74.3	
Non-Hispanic black	10.0	10.1	9.6	
Hispanic	11.4	11.8	9.9	
Non-Hispanic other/ multiple races	6.4	6.5	6.2	
Highest degree (%) <sup>a</sup>				<0.01
High school or below	57.5	56.3	61.8	
Some college	14.3	14.8	12.4	
College	12.6	12.6	12.8	
Graduate	15.6	16.3	12.9	

Insurance status (%) <sup>a</sup>				<0.01
Private	68.4	69.0	66.2	
Public	23.6	22.8	26.5	
Uninsured	8.1	8.3	7.3	
Region (%)				<0.01
Northeast	16.3	16.2	16.7	
Midwest	24.1	23.7	25.6	
South	34.9	36.0	30.8	
West	24.7	24.1	26.9	
Married (%) <sup>a</sup>	47.6	48.9	42.9	<0.01
Diabetes (%) <sup>a</sup>	11.7	11.4	13.0	0.04
Coronary heart disease (%) <sup>a</sup>	6.5	6.2	7.3	0.07
Asthma (%) <sup>a</sup>	14.1	13.2	17.3	<0.01
Stroke (%) <sup>a</sup>	5.3	4.8	7.2	<0.01
Emphysema (%) <sup>a</sup>	3.2	3.04	3.8	0.08
Hypertension (%) <sup>a</sup>	38.4	37.4	41.9	<0.01
Depression (%)				<0.01
Neither years	89.2	90.4	84.7	
Both year <sup>a</sup>	10.9	9.6	15.3	
Smoke (%) <sup>a</sup>	18.7	17.9	21.4	<0.01

a Age-adjusted (2000 U.S. population)

b Percentage of poverty line

The descriptive characteristics of depressive symptoms of the current study and Alghnam et al, were similar. Alghnam found that compared to those who only had one injury, persons with injury recidivism were more likely to report depressive symptoms in both years (4.8 vs 7.1 %,  $p < 0.01$ ). In this study, compared to persons without recidivism, persons with injury recidivism were also more likely to have depressive symptoms in both years (9.6 vs 15.3 %,  $p < 0.01$ ). Although the logistic regression models were not used to estimate odds ratios, it is likely that the result would be similar to what Alghnam et al found. Nevertheless, the problem of deliberate self-harm is also a particular concern within this group as depression is known risk factor for both self-harm and suicidal behavior.<sup>22,23</sup> A study that looked into patients who died by suicide found that half of those who died had previously been admitted to a trauma center.<sup>24</sup> Studies in the future should investigate the injury patterns amongst persons with injury recidivism and depression to help design prevention strategies and policies that could reduce the risk of injury.

Correspondingly, the descriptive characteristics of this study showed that younger generations were more likely to have injury recidivism, in consistent with the descriptive characteristics of the Alghnam, et al study. Many studies have shown that young men are more likely than young women to sustain repeated injuries.<sup>13,25,26</sup> The gender differences could be explained by gender patterns of risk-taking behaviors. As it is suggested by many studies, men are more likely to engage in risky behaviors than women.<sup>27,28</sup>

The recidivism rate of 21.72% found in this study is higher than what is reported in Alghnam et al and other studies.<sup>13,29</sup> This discordance could be attributed to some clear discrepancies in methodology in the other studies. Additionally, previous studies relied only on hospital admission data which might have resulted in lower recidivism rates. However, Alghnam et al used the same methodology, and also found a lower recidivism rate of 17.9%. This difference could be ascribed to the different time frame of the two studies.

Asthma, stroke, and diabetes were more prevalent in recidivists, based on the descriptive characteristics. Diabetes is considered a major risk factor for future falls<sup>30</sup>, and it could also cause a delay in bone fracture healing, resulting in a prolonged recovery period for individuals with diabetes. Similarly, impairments in cognitive and physical aspects due to stroke are known to cause an increased risk of injuries.<sup>31</sup> After a stroke, patients are at an increased risk of falling<sup>32</sup>, which can result in activity limitations, increased reliance on assistance, and impaired mobility. Therefore, assessing the risk of falling is critical in developing preventive programs for such patients. Additionally, many studies have found asthma symptoms to be associated with an increased risk of injuries.<sup>33</sup>

With advancement in the prevention of infectious diseases and the progress of reducing the chronic disease burden, epidemiological trends have shifted, with injuries accounting for 9% of global mortality.<sup>33</sup> Data show that the global burden of injuries is rising, with the potential to continue increasing unless public-health efforts are taken to prevent injuries.<sup>34</sup>

Research documenting the effectiveness of unintentional injury prevention is limited, particularly in the Low- and Middle-Income Countries; however, some countries have taken initiatives to prevent injuries in the form of legislation, product and environment improvements, safety equipment, and education.<sup>35</sup> Many studies have found that traditional health education in the school classroom can be effective to promote students' mental health as well as decrease their health risk behaviors which include unintentional injury behaviors.<sup>36</sup> Additionally, home safety practices like hazards removal, the use of safety equipment, as well as regular proactive children's education about safety could reduce children injuries.<sup>37</sup> Home modification is another effective preventive program that could help reduce fall injuries among older populations.<sup>38</sup>

It is critical to identify evidence-based risk factors, preventative measures, and the role of many stakeholders in reducing the burden of injuries on population health. It is as

important to also include policy makers in the evaluation and implementation of effective injury prevention strategies. Understanding people's attitudes and views about injury causation, as well as learning how to change behavior, is critical for public involvement and intervention success.

### **Strengths and limitations**

One major limitation of the study is the fact that only descriptive characteristics were reported. Another limitation regarding the data is that MEPS is based on self-report survey data, which may be prone to error or bias as a result of subject recall or other issues related to self-reporting of health conditions. Institutionalized individuals are also not included in the sampling frame. Strengths of the MEPS include that the data is national, a relatively large number of individuals participated each year and detailed demographic and clinical information is available.

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