Trauma is the greatest cause of morbidity and mortality in the United States for people younger than 45 years. More than 180,000 deaths are attributed to injury every year, and the cost of health care and lost productivity as a result of violence and injury is more than $500 billion each year. The common occurrence of patients returning with a new injury calls for further examination of characteristics associated with recidivism and the financial burden that these injuries place on the health care system. Several studies showed that certain behaviors are risk factors for injury. Alcohol use has been a compounding factor in motor vehicle collisions, falls, and other nonlethal injuries. A 2007 study found that 71.8% of those treated as inpatients for trauma were lifetime alcohol users and 45.3% were recreational drug users. Mean hospital charges for intoxicated patients are estimated to be $1833 more than those for nonintoxicated patients, showing the profound financial impact of intoxication on medical costs. Recidivism rates at trauma centers vary greatly and can be as high as 44%. The authors are from the Department of Orthopaedic Surgery, Case Western Reserve University, and the Department of Orthopaedic Surgery, MetroHealth Medical Center, Cleveland, Ohio. The authors have no relevant financial relationships to disclose. Correspondence should be addressed to: Heather A. Vallier, MD, Department of Orthopaedic Surgery, MetroHealth Medical Center, 2500 MetroHealth Dr, Cleveland, OH 44109 (hvallier@metrohealth.org). Received: November 16, 2015; Accepted: April 20, 2016. doi: 10.3928/01477447-20160623-05
Social and demographic characteristics as well as risky behaviors have been analyzed to better explain the likelihood of repeat injury. The goals of this study were to determine the recidivism rate for a population of patients who were treated surgically for orthopedic trauma and to identify risk factors for repeat trauma and potential areas for intervention. It was hypothesized that substance abuse and underlying mental illness would be associated with higher rates of recidivism.

**Materials and Methods**

The study population consisted of skeletally mature patients who were treated at an urban level 1 trauma center between 2007 and 2011 for high-energy operative fractures of the spine, pelvis, acetabulum, and/or femur. Social and demographic factors that were evaluated included age, sex, mechanism of injury, insurance coverage, employment status, education history, substance use (including tobacco, alcohol, and recreational drugs), and psychiatric history. Hospital length of stay also was determined.

Recidivists were defined as patients who returned to the emergency department for an unrelated injury before January 1, 2013. Recurrent recidivists were defined as patients who returned for 2 or more subsequent new, unrelated trauma events. Emergency department follow-up visits related to a previous injury were not included. Insurance coverage was categorized as commercial, managed care, Medicaid, Medicare, Bureau of Worker’s Compensation, or uninsured. Employment status at the time of injury was classified as employed, unemployed, disabled, retired, or student. Employment demand was grouped according to the following categories: heavy (standing/walking throughout the day, with frequent heavy lifting and/or other manual activity), moderate (standing/walking throughout the day, with occasional lifting and/or other manual activity), mild (standing and walking intermittently throughout the day), and sedentary (may include occasional standing and walking). The highest level of education was documented. History of alcohol, tobacco, and recreational drug use was recorded as well as the use of alcohol or drugs on the day of initial injury. Serum ethanol tests were used to determine the presence of alcohol, intoxication (>80 mg/dL), and heavy alcohol use (>300 mg/dL). Toxicologic findings indicated the types of recreational drug use.

The population was divided into recidivists and nonrecidivists. Age was analyzed both as a continuous variable and as an ordinal variable, with subgroups split at 18, 40, and 65 years of age. Independent-samples t tests were used to compare means of continuous and ordinal variables. For variables with Levene’s test for equality of variances greater than 0.05, equal variance was not assumed. Pearson’s chi-square test was performed, and P<.05 was considered to represent a significant difference in categorical variables between repeat and nonrepeat patients. Multivariate regression techniques were used to control for age, mechanism of injury, substance abuse, and insurance status. Analysis was performed with SPSS version 21.0 software (IBM Corp, Armonk, New York).

**Results**

A total of 879 patients were included in the study. Mean age was 40±17.1 years, 74.7% of patients were men, and 68.9% were single. The most frequent mechanism of injury was motor vehicle collision.
Injury as a result of motor vehicle collisions was less common in recidivists than in nonrecidivists (38.4% vs 51.2%, respectively; \( P<.003 \)); however, gunshot wounds and assaults were more frequent in recidivists than in nonrecidivists (14.0% vs 5.17%, respectively; \( P=.003 \)). In addition, other assaults occurred in 1.22% of recidivists vs 0.14% of nonrecidivists (\( P=.32 \)). Although the rate of motor vehicle collisions was lower in recidivists, patients who were injured in motor vehicle collisions and were intoxicated at the time of injury were more likely to be repeat patients (\( P<.001 \)).

Several types of substance abuse occurred more often in recidivists (Table 2). Self-reported alcohol use was common among all patients, occurring in 68% overall and in 72.5% of recidivists. Although the difference between recidivists and nonrecidivists was not significant (72.5% vs 66.6%), recidivists were more likely to have used alcohol (47.2%, \( P=.007 \)) or to be intoxicated (32.4%, \( P=.005 \)) on presentation. Self-reported drug use was frequent, occurring in 46.6% of all patients with traumatic injury, and 12.2% of all patients had used both alcohol and recreational drugs at the time of presentation. Repeat patients were more likely than nonrepeat patients to use tobacco (66.2% vs 50.2%, respectively; \( P=.0003 \)) or recreational drugs (59.1% vs 43.2%, respectively; \( P=.0004 \)). Subgroup analyses of male and female recidivists compared with their nonrepeat counterparts showed that recidivist men were more likely than nonrecidivist men to have used alcohol or recreational drugs on the day of injury. Similarly, female recidivists were more likely than female nonrecidivists to have used alcohol or recreational drugs. (Data not shown.)

A diagnosis of mental illness was more common among recidivist patients, occurring in 28.1% vs 20.0% of nonrecidivists (\( P=.032 \)). Depression, bipolar disorder, and a history of suicidal ideation were more common in patients who had more than 1 injury during the study period (Table 2). A diagnosis of posttraumatic stress disorder was infrequent among all patients (0.9%), with no differences found between recidivist and nonrecidivist patients.

Only 12% of all patients had more than a high school education. Although highest level of education was not associated with recidivism, 31% of recidivists had less than a high school education (66.2% vs 50.2%, respectively; \( P=.003 \)). In addition, other assaults occurred in 1.22% of recidivists vs 0.14% of nonrecidivists (\( P=.32 \)). Although the rate of motor vehicle collisions was lower in recidivists, patients who were injured in motor vehicle collisions and were intoxicated at the time of injury were more likely to be repeat patients (\( P<.001 \)).
have health insurance (83.4% vs 62.3%, respectively). Recidivists were more likely than nonrecidivists to be uninsured (33.5% vs 17.8%, respectively; \( P < .0001 \)) or to have Medicaid coverage (33.5% vs 23.2%, respectively; \( P < .0001 \)).

Table 4 shows rates of recidivism in various cohorts. Multivariable regression analysis was performed to evaluate factors potentially associated with recidivism. Type of health insurance or lack of health insurance had the highest association with recidivism. Notably, 67% of all recidivists had no insurance or Medicaid coverage. Of the patients with Medicaid coverage, 42% acquired it after their injury. After uninsured patients and those with Medicaid coverage were grouped together (defined as underinsured), underinsurance was the greatest risk factor for recidivism. After the authors controlled for age, drug use, and mechanism of injury, underinsured patients were 2.37 times more likely than insured patients to return with a new injury (\( P < .001 \)). Mechanism of injury was the second strongest risk factor for recidivism. Patients who were injured by gunshot or other assault were 1.98 times more likely to become recidivists (\( P = .019 \)). Recreational drug use also was associated with recidivism, and those with this risk factor were 1.57 times more likely to become repeat patients (\( P = .017 \)).

During the study period, 72 patients were seen in the emergency department with 2 or more different episodes of trauma. This accounted for 8.18% of all patients and 44.4% of recidivists. Further analysis of recurrent recidivists showed that only 16 (22.2%) were employed, a significantly lower percentage than was reported for the other recidivists (\( P < .0001 \)). Only 5.56% of recurrent recidivists had more than a high school education, and only 18.1% were married (both \( P < .0001 \) vs other recidivists). The frequency of mental illness in recurrent recidivists was 30.6%. In addition, 61% reported recreational drug use and 74% reported tobacco use.

### Discussion

This study was conducted to determine the recidivism rate for patients who were treated surgically for traumatic injury at an urban level 1 trauma center and to identify the demographic and social factors associated with recidivism, including the incidence and potential role of substance use. The calculated recidivism rate was 18.7%, and of these repeat patients, 23.8% were admitted to the hospital a second time for traumatic injury. In other words, almost 1 in 5 trauma patients will return with another injury, and approximately 1 in 4 of them will be admitted to the hospital. The results supported the initial hypothesis, which predicted that repeat patients more often use tobacco and illegal substances and are more likely to be intoxicated at the time of injury. In addition, repeat patients more frequently have a diagnosis of mental illness. Recidivists also are more likely to be single, and in this study, they were more likely to be male.

Employment correlated with insurance coverage, with repeat patients more likely to be unemployed and underinsured. In contrast, nonrepeat patients were more likely to be employed and to have commercial or managed care insurance plans. Because most employees obtain health insurance through their employer, it is not surprising that unemployed patients are more likely to be uninsured.

A limitation of the current study was that it did not determine potential causes of unemployment, although it did separate people who were classified as dis-

### Table 3

<table>
<thead>
<tr>
<th>Social Factor</th>
<th>Recidivist Patients (n=164)</th>
<th>Nonrecidivist Patients (n=715)</th>
<th>All Patients (n=879)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest education level</td>
<td>30.9%</td>
<td>24.4%</td>
<td>25.8%</td>
<td>.74</td>
</tr>
<tr>
<td>Did not complete high school</td>
<td>58.8%</td>
<td>62.3%</td>
<td>62.3%</td>
<td>.006</td>
</tr>
<tr>
<td>High school/GED</td>
<td>8.82%</td>
<td>10.3%</td>
<td>10.0%</td>
<td>.36</td>
</tr>
<tr>
<td>College/technical school</td>
<td>1.47%</td>
<td>2.07%</td>
<td>1.94%</td>
<td>.82</td>
</tr>
<tr>
<td>Graduate school</td>
<td>9.15%</td>
<td>15.4%</td>
<td>14.2%</td>
<td>.004</td>
</tr>
<tr>
<td>Insurance coverage</td>
<td>14.0%</td>
<td>32.3%</td>
<td>28.9%</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Managed care</td>
<td>33.5%</td>
<td>23.2%</td>
<td>25.1%</td>
<td>.006</td>
</tr>
<tr>
<td>Medicaid</td>
<td>4.88%</td>
<td>6.85%</td>
<td>6.48%</td>
<td>.36</td>
</tr>
<tr>
<td>Bureau of Worker’s Compensation</td>
<td>4.88%</td>
<td>4.47%</td>
<td>4.55%</td>
<td>.82</td>
</tr>
<tr>
<td>uninsured</td>
<td>33.5%</td>
<td>17.8%</td>
<td>20.7%</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Employment status</td>
<td>43.8%</td>
<td>60.2%</td>
<td>57.2%</td>
<td>.003</td>
</tr>
<tr>
<td>Employed</td>
<td>40.8%</td>
<td>19.6%</td>
<td>23.5%</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Unemployed</td>
<td>7.53%</td>
<td>12.3%</td>
<td>11.4%</td>
<td>.12</td>
</tr>
<tr>
<td>Retired</td>
<td>2.05%</td>
<td>1.09%</td>
<td>1.27%</td>
<td>.34</td>
</tr>
<tr>
<td>Disabled</td>
<td>6.16%</td>
<td>6.71%</td>
<td>6.60%</td>
<td>.81</td>
</tr>
</tbody>
</table>

Abbreviation: GED, General Educational Development.
The study also did not investigate potential reasons for lack of health insurance. Notably, many uninsured patients who present to the hospital are eligible for Medicaid and obtain Medicaid coverage subsequently. Nevertheless, these findings underscore the economic pressures on trauma centers that treat large numbers of underinsured patients as well as the potential financial impact of trauma prevention programs.

Although self-reported alcohol consumption was not higher in the recidivist population, alcohol use was extremely prevalent, occurring in 68% of all patients, with 35% presenting with alcohol in their system at the time of injury. The authors likely underestimated the magnitude and frequency of alcohol and drug use on presentation to their facility because of the time elapsed since the injury and because 44% of the study patients were transferred from other hospitals. However, recidivist trauma patients were more likely to have alcohol in their system or to be intoxicated at the time of injury.

Patients who presented with alcohol intoxication were further studied when they had an ethanol level greater than 300 mg/dL, which is considered an extremely high concentration. Recidivism was significantly more likely in patients with an alcohol level greater than 300 mg/dL compared with lower levels of intoxication. Alcohol may be involved in the cause of injury, and it appears to be associated with recidivism. Some trauma centers have implemented screening and intervention programs for heavy alcohol use,\textsuperscript{16-20} and initial successes have been demonstrated.\textsuperscript{16,18-22}

The finding that patients with repeat trauma were more likely to use tobacco and recreational drugs and were more likely to use drugs on the day of injury calls into question the responsibility these patients have in managing their health and behavior. Further, in addition to the patients identified in the current study, it is important to consider potential injury to others (eg, bystanders). In addition to alcohol use, the use and abuse of recreational substances has been associated with trauma recidivism in other studies.\textsuperscript{4,9,14,15}

Earlier reports showed that mental illness at baseline is prevalent in patients with new trauma.\textsuperscript{22-25} The current study supports these results, with a finding of known mental illness in more than 20% of patients and a significantly higher
incidence among recidivists. Another limitation of the study is the likelihood of underestimating the actual frequency of mental illness in the study patients because data were obtained retrospectively. Information on mental health may not have been obtained, reported, or documented consistently. Earlier studies showed that trauma is associated with high rates of subsequent depression and posttraumatic stress disorder, which could contribute further to recidivism and poor outcomes. This study did not obtain data on the subsequent mental health status of the patients.

Certain mechanisms of injury were more common in recidivists, in particular, gunshot wounds and assaults. The use of alcohol or recreational drugs was common in these patients, adding to the risk profile for recidivism. Again, this finding shows a potential link between risky behavior and trauma recurrence. Musculoskeletal disease accounts for more than $1 trillion annually in health care and related indirect expenses in the United States. Injury accounts for more than half of these costs. The personal and financial effects of injury on modern society are staggering. The current study highlights prevalent contributing factors in a large group of patients with repeat traumatic injury. In addition to a large sample that was representative of an urban trauma population, other strengths of the study include the incorporation of social, mental, and economic factors. Limitations include retrospective data collection and potential recall and reporting bias, which are likely to underestimate the frequency of various factors, including alcohol, drug, and tobacco use and mental illness. In addition, the study did not determine whether patients were treated for unrelated injuries at other hospitals.

Despite these limitations, this study addressed several important issues. Trauma recidivism is common, occurring in 18.7% of patients at a mean of 2.9 years. Personal injury, loss of productivity, and increased health care expenses occur as a result of these repeat injuries, making this issue a major public health concern. Opportunities for intervention include counseling, support groups, educational services, and treatment for mental illness. It appears worthwhile to determine the cost-effectiveness of these strategies as well as their effect on personal well-being. Factors associated with recidivism included age younger than 40 years, unmarried status, unemployment, and substance use. Medicaid insurance or no insurance and history of assault or gunshot were the greatest risk factors.

REFERENCES


