The Association of Injury With Substance Use Disorder Among Women of Reproductive Age: An Opportunity to Address a Major Contributor to Recurrent Preventable Emergency Department Visits?

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Abstract

Objectives—Substance use disorder (SUD) among women of reproductive age is a complex public health problem affecting a diverse spectrum of women and their families, with potential consequences across generations. The goals of this study were 1) to describe and compare the prevalence of patterns of injury requiring emergency department (ED) visits among SUD-positive and SUD-negative women and 2) among SUD-positive women, to investigate the association of specific categories of injury with type of substance used.

Methods—This study was a secondary analysis of a large, multisource health care utilization data set developed to analyze SUD prevalence, and health and substance abuse treatment outcomes, for women of reproductive age in Massachusetts, 2002 through 2008. Sources for this linked data set included diagnostic codes for ED, inpatient, and outpatient stay discharges; SUD facility treatment records; and vital records for women and for their neonates.

Results—Injury data (ICD-9-CM E-codes) were available for 127,227 SUD-positive women. Almost two-thirds of SUD-positive women had any type of injury, compared to 44.8% of SUD-negative women. The mean ($\pm$SD) number of events also differed (2.27 $\pm$ 4.1 for SUD-positive women vs. 0.73 $\pm$ 1.3 for SUD-negative women, $p < 0.0001$). For four specific injury types, the proportion injured was almost double for SUD-positive women (49.3% vs 23.4%), and the mean ($\pm$SD) number of events was more than double (0.72 $\pm$ 0.9 vs. 0.26 $\pm$ 0.5, $p < 0.0001$). The numbers and proportions of motor vehicle incidents and falls were significantly higher in SUD-positive women (22.5% vs. 12.5% and 26.6% vs. 11.0%, respectively), but the greatest differences were in self-inflicted injury (11.5% vs. 0.8%; mean $\pm$ SD events = 0.19 $\pm$ 0.9 vs. 0.009 $\pm$ 0.2, $p < 0.0001$) and purposefully inflicted injury (11.5% vs 1.9%, mean $\pm$ SD events = 0.18 $\pm$ 0.1 vs. 0.02 $\pm$ 0.2, $p < 0.0001$). In each of the injury categories that we examined, injury rates among SUD-positive women were lowest for alcohol disorders only and highest for alcohol and drug disorders combined. Among 33,600 women identified as using opioids, 2,132 (6.3%) presented to the ED with overdose. Multiple overdose visits were common (mean $\pm$ SD = 3.67 $\pm$ 6.70 visits). After adjustment for sociodemographic characteristics, psychiatric history, and complex/chronic illness, SUD remained a significant risk factor for all types of injury, but for the suicide/self-inflicted injury category, psychiatric history was by far the stronger predictor.

Conclusions—The presence of SUD increases the likelihood that women in the 15- to 49-year age group will present to the ED with injury. Conversely, women with injury may be more likely to be involved in alcohol abuse or other substance use. The high rates of injury that we identified among women with SUD suggest the utility of including a brief, validated screen for substance use as part of an ED injury treatment protocol and referring injured women for assessment and/or treatment when scores indicate the likelihood of SUD.

Substance use disorder (SUD), defined as illicit drug abuse, prescription drug misuse and dependence, and alcohol abuse and dependence, is a complex public health problem affecting a diverse spectrum of women and their children from all geographies, races, ethnicities, social classes, communities, and ages, with potential consequences across generations.[1–7]

Emergency departments (EDs) are both an important venue for providing services to patients with SUD and the site of entry for treatment of many injuries. Among respondents to the National Survey on Drug Use and Health and the National Epidemiologic Survey on Alcohol and Related Conditions, ED patients generally report higher rates of coexisting alcohol and drug use and spend more days using drugs and are more likely to have alcohol or drug use disorders compared with respondents who did not use the ED as a source of health care.[8,9] The Drug Abuse Warning Network (DAWN) in 2011 estimated that 1.25 million ED visits were for illicit drugs, and 35% of those patients were identified as women.[10]

Injury rates are also high. In 2010, among 130 million ED visits for all presenting patients, almost one-third (38 million) were attributed to injury. Women overall represented nearly half of these injury visits,[11] and among them, there were 7.4 million injured women aged 15 to 49 years (10% of U.S. women and 19% of ED visits in this age group).[12]

The data sets from which these estimates are drawn represent probability and weighted samples and do not link data on injury and alcohol and drug abuse. Moreover, most studies of substance use and injury are restricted to specific anatomic regions (e.g., traumatic brain, spinal, or orofacial),[13–16] specific causes of injury (e.g., motor vehicle incidents or intimate partner or nonpartner violence),[17–20] focus on the age outliers of adolescents or older adults,[21,22] or on alcohol only[23] or drugs only.[24] These studies are limited by small sample sizes, single sites, or restricted numbers of settings and self-report of drug history or, in some cases, limitations of toxicology screening or lack of toxicology screening at the time of injury.[24] Although most ED studies have focused on drug and alcohol use prior to injury to determine causal relationships, very few have had the capacity to determine the effect of preexisting SUD on the likelihood of injury presenting to the ED.[25] Furthermore, no population-based studies to date have examined the risk of injury for women of reproductive age with SUD.

The goals of this study were 1) to describe and compare the prevalence of patterns of injury requiring ED visits among SUD-positive and SUD-negative women in a multisource, statewide data system, and 2) among SUD-positive women, to investigate the association of specific categories of injury with type of substance used.

METHODS

Study Design

This study was a secondary analysis of a large, multisource health care utilization data set designed to investigate SUD prevalence, and health and substance abuse treatment outcomes for women in Massachusetts. This study was approved by the Boston University Medical Campus, Massachusetts General Hospital Partners, and the Massachusetts Department of Public Health institutional review boards.

Study Setting and Population

We present here results from analysis of ED and inpatient discharge records, maternal delivery hospitalization records, birth certificates, and substance abuse treatment system admissions occurring between 2002 and 2008. This linked data system was used to identify the proportion of women identified with SUD who were subsequently injured during the study period, to compare injury prevalence by SUD identification (yes/no), and to describe injury rate by type of substance used. We examined six categories of injury: 1) total injuries of all types ("all e-coded injury"), 2) motor vehicle crashes (MVCs)/pedestrian injury, 3) falls, 4) suicide/self-inflicted injury, 5) homicide/purposefully inflicted injury, and 6) any of the four specific marker injuries (injury types 2–5).

Data Sources—We used three major data sources to capture documentation of SUD among women of reproductive age in Massachusetts: 1) the Massachusetts Center for Health Information and Analysis (CHIA), which provided International Classification of Diseases, 9th Edition, Clinical Modification (ICD-9-CM) diagnostic codes for statewide hospital discharge data, including E-codes, from all inpatient, observational stay, and ED discharges for all women aged 15–49 years, including medical inpatient substance abuse treatment

services; 2) the Massachusetts Pregnancy to Early Life Longitudinal (PELL) data system, which provided evidence of SUDs from both maternal and infant records and birth and fetal death records corresponding to hospital delivery discharge records; and 3) the Massachusetts Bureau of Substance Abuse Services (BSAS) treatment data set, which provided information about SUD treatment need and utilization in all publicly funded specialty programs.

Study Sample—The study sample included all women aged 15 to 49 years who received any inpatient, observational stay, ED services or SUD specialty treatment in Massachusetts hospitals or SUD treatment programs at any time from January 1, 2002, to December 31, 2008, and any infants born (live or stillborn) to them between January 1, 2003, and December 31, 2007.

Study Protocol

Data Linkage and Identification of Individual Women From Incident-level Data
—A multistep linkage algorithm was developed to identify multiple treatment records belonging to individual women in the CHIA data set. The CHIA episodic-level hospital use data contained 6,347,310 discharge records from 2002 to 2008. All records from women who were aged 15 to 49 years at any point during the study period were included. The individual universal hospital identification number (an encryption of the patient's social security number), date of birth, and hospital medical record number were used to link and aggregate multiple records belonging to the same woman, for a final sample of 1,748,748 unique women.

SUD Prevalence: The first phase of this investigation focused on the development of a gender-specific algorithm that uses ICD-9-CM codes for women and their neonates, along with vital statistics and substance abuse treatment admission records, to identify probable SUD among women of reproductive age (the Explicit Mention of Substance Abuse Need for Treatment in Women [EMSANT-W] unpublished data, see authors for details). EMSANT-W is built on a methodologically rigorous measure of variation in the rates of substance abuse/dependence and unmet treatment need among the general population, the Substance Need Index. This index was developed by McAuliffe and colleagues[26–28] using multiple years of inpatient hospital discharge data mortality data and arrest records.

We specified three criteria for tailoring this algorithm to female gender: 1) the tool would be sensitive enough to capture discharge diagnoses strongly suggestive of an SUD in need of further assessment, 2) the tool would be specific enough to distinguish SUD from background mental health conditions, and 3) the tool would be tailored to women of reproductive age using indirect sources of information about substance use that are not usually included in gender-neutral grouping algorithms. Women were therefore classified as affected by SUD based on 1) specific ICD-9-CM codes for women or their neonates (ED, observational stay, and hospital discharge records), 2) birth certificate mention of a positive neonatal toxicology screen, or 3) a BSAS treatment system record (fuller details available on request). Women who appeared in the hospital data set for reasons unrelated to SUDs, who had no other evidence of SUD, were classified as "non-SUD."

Substance Type: Use of specific substances was aggregated from several potential sources: 1) discharge ICD-9-CM codes from hospital admissions, ED visits, observation stays, and newborn hospital admissions; 2) the substance type data entry field from the BSAS admissions data set; and 3) the substance type data field from birth and fetal death records. For example, opiates were defined by codes 96500, 96501, 96502, 96509, 9701x, E8500, E8501, E8502, E9350, and E9800. Codes 3041x, 3054x, 9670x, 9671x, 9672x, 9673x, 9674x, 9675x, 9676x, 9678x, 9679x, 9682x, 9683x, E851x, E852x, E8551, and E9801 were grouped as "sedatives, barbiturates, hypnotics, anesthetics." The cannabis category included 3043x, 3052x, and E8541. Alcohol abuse or dependence was defined by the 303 (dependence), 305 (abuse), and 291 (alcohol induced disorders) code series, with the exception of code 303.3 (in remission), which was excluded.

Injury Prevalence: The "all E-coded injury" category was based on any listing of ICD-9-CM codes E800 to E969 in conjunction with an ED visit following after the first identification of SUD in the data set, for SUD-positive women, and from the first injury-related ED visit for SUD-negative women. Hospital admissions and discharges for injury were not included in these counts, and we set a 72-hour interval between codes for the second ED visit to be eligible for counting as a separate injury.

We specified four types of injury as specific markers for the events most commonly associated with substance use: 1) MVCs and pedestrian injury (codes E810 to E825), 2) falls (codes E880 to E899), 3) suicide/self-inflicted injury (codes E951 to E959), and 4) homicide/purposefully inflicted injury (codes E960 to 969). We also further combined data for these four injury types to create an "any specific marker injury" variable for evidence of any one of these marker injuries. Because poisoning codes encompass drug overdose, we chose to include poisonings in criteria for identification of SUD and thus exclude them from the injury variables.

Independent Predictors: Standard categories for race (African American, Asian/Pacific Islander, white, and other), ethnicity (Hispanic vs. non-Hispanic), age, and insurance type were obtained from hospital discharge data (CHIA) and treatment system (BSAS) discharge data at first admission. Insurance status was characterized as public versus private. The complex/chronic illness variable was derived from CHIA data using the schema developed by Mertens et al.[29] for tracking alcohol- and drug-related conditions and tested using matched controls in a Kaiser Health Maintenance Organization system database. The psychiatric history variable included codes for mood disorders, psychoses, paranoid and anxiety states, personality disorders, adjustment disorders, posttraumatic stress disorder, and stress reactions. It excluded codes from either end of the age spectrum (developmental disorders at one end and delirium, dementia, and organic brain disease at the other), drug-related conditions (alcohol abuse and dependence, drug abuse and dependence, because these codes were included in the definition of SUD), and unspecified disorders. Similarly, codes for suicide gesture, attempt, or suicidal ideation were not included in the psychiatric history variable because they were measured within the definition of the suicide/self-inflicted injury outcome variable.

Data Analysis

We initially conducted descriptive analyses to 1) estimate the prevalence of SUD among women of reproductive age in Massachusetts, across categories of race/ethnicity, age, and insurance status; 2) establish the prevalence of injury among SUD-affected and non–SUD-affected women; and 3) describe injury rates by types of drugs used by women positive for SUD. In unadjusted descriptive analyses, we computed means, standard deviations (SDs), 95% confidence intervals (CIs), medians, and interquartile ranges (IQRs). In adjusted descriptive analyses, we computed means, SDs, and 95% CIs. Chi-square tests of significance were performed to identify differences by SUD identification and by type of drug used. For normally distributed continuous variables, t-test statistics were used to identify differences by SUD status, and Wilcoxon rank-sum testing was used for nonparametric distributions.

We planned a retrospective cohort study with 82,811 SUD-positive women (exposed subjects) and 799,141 SUD-negative women (unexposed subjects), representing the total number of women in the final data set who had evidence for an ED visit. We estimated the probability of injury exposure among unexposed women was 0.4. With a true probability of injury exposure among exposed women of 0.6, we had statistical power of 100% at a two-sided alpha of 0.05 in the analysis sample of over 800,000. Moreover, when comparing exposed and unexposed women in terms of an incident rate ratio (IRR), the study sample size supports IRRs computed in a Poisson model less than 0.10 with 100% power at a two-sided alpha of 0.05. We performed these power computations using nQuery Advisor version 7 and GPower version 3.1.

We performed both unadjusted and adjusted analyses to estimate the association of a documented SUD diagnosis with the frequency of injury during the study period. Poisson regression was used to estimate the IRR of specific types of injury associated with SUD (model 1, adjusted only for time). Our Poisson models incorporated a scaled deviance adjustment for the standard errors of the model coefficients.

For SUD-negative women, we counted the number of months from the first appearance of an injury-related code until the last clinical encounter in the data set. For SUD-positive women, we counted the number of months from the first injury-related episode after appearance of an SUD indicator to the last clinical encounter. Adjusting for time in model 1 prevented confounding from potentially unequal number of injury-possible months (exposure) between groups.

Model 2 additionally controlled for covariates of women's race, Hispanic ethnicity, private insurance, region of residence in Massachusetts, history of psychiatric illness, and complex/chronic illness along with time. White race, non-Hispanic ethnicity, and absence of psychiatric history or complex/chronic illness served as the reference groups. Data were analyzed using SAS 9.2.

RESULTS

Prevalence of SUDs Among Women of Reproductive Age

Altogether, 1,748,748 individual women who received medical or SUD treatment services in Massachusetts were identified in the linkage of CHIA, PELL, and BSAS data sources spanning 2002 to 2008. Among them, 8.5% ($n = 147,998$) were SUD-positive based on ICD-9-CM codes for themselves and their neonates, BSAS admissions for SUD treatment, and birth and death certificate data, while 1,600,750 women had no indication of SUD. ED, observational stay, and hospital discharge records were available for 127,227 women who were SUD-positive. An additional 20,771 SUD-positive women had records solely in the SUD treatment system with no linkage to hospital discharge data and were excluded from the sample for this investigation because no injury information was available (no use of ED services, observational stays, or hospital admissions during the study period). The sample for this investigation thus consists of the 1,728,027 women who were identified in CHIA data (see Figure 1).

Comparison of Injury Incidence by SUD Status (Table 1)

Among these 1,728,027 women, the proportion of records that were injury-related differed by SUD identification. In the "any E-coded injury" category, 65.1% of SUD-positive women had injuries compared to 44.8% of women who were SUD-negative. On average, women with SUD had more events than SUD-negative women (mean $\pm$ SD = 2.27 $\pm$ 4.1 for SUD-positive women vs. 0.73 $\pm$ 1.3 for SUD-negative women, $p < 0.0001$). In the "any specific marker injury" category, the proportion injured was more than double for SUD-positive women (49.3% vs. 23.4%), and the mean number of events was more than double (mean $\pm$ SD = 0.72 $\pm$ 0.9 vs. 0.26 $\pm$ 0.50, $p < 0.0001$). The proportions of women injured in motor vehicle incidents and falls were significantly higher in SUD-positive women versus SUD-negative women (22.5% vs. 12.5% and 26.6% vs. 11.0%, respectively), but the greatest differences were observed in suicide/self-inflicted injury (11.5% vs. 0.8%; mean $\pm$ SD = 0.19 $\pm$ 0.9 events, $p < 0.0001$) and homicide/purposefully inflicted injury (11.5% vs 1.9%; mean $\pm$ SD = 0.18 $\pm$ 0.7 events vs. 0.02 $\pm$ 0.2 events, $p < 0.0001$).

Variations in Injury Incidence by Type of Drug Identified (Table 2)

In each injury category, injury rates among SUD-positive women were lowest for alcohol disorders only, higher for drug disorders only, and highest for alcohol and drug disorders combined. Marijuana use disorder was the least likely to be associated with injury (mean $\pm$ SD = 2.4 $\pm$ 4.1 events) and opioids the most likely (mean $\pm$ SD = 3.3 $\pm$ 5.6 events). The range in injury prevalence among types of drugs was narrow (66.7% to 75.5%), but differences were statistically significant ($p < 0.0001$).

Opioid Overdose

During the study period, there were 7,824 ED visits for opioid overdoses. Among 33,600 women who were identified as using opioids, 2,132 (6.3%) presented to the ED with overdoses. Multiple overdose visits were common; the mean ($\pm$SD) number of visits among

those with an ED visit for overdose was 3.67 (±6.70) visits per woman during the study period.

Contribution of SUD to the Likelihood of Injury

Time in Months of Potential Injury—SUD-positive women had a mean (±SD) of 28.7 (±27.4) months in the CHIA data set and a median of 41.0 months (IQR = 5.6 to 65.2 months), compared to a mean (±SD) of 19.0 (±24.4) months and a median of 2 months (IQR = 0.3 to 36.5 months) for women with no SUD (p < 0.0001).

Model 1, Adjusted Only for Differences in Time (Table 3)—Women identified with SUD at any time in the study period were slightly less likely to experience any type of injury (yes/no) than non-SUD women, but more likely to have any one of the four specific marker injuries. The risk of suicide/self-inflicted injury was highest, at nine times the rate for women with indication of SUD, followed by a threefold risk for homicide/injury inflicted by others. The risk of falls was also greater among SUD-positive women. The risk of MVCs and pedestrian injuries was the lowest of the four, but still elevated among women with SUD.

Model 2, Adjusted for Time of Exposure, Demographic, and Health Care Variables (Table 4)—Substance use disorder remained a significant risk factor for all E-coded injuries after adjusting for demographic factors, type of insurance, and psychiatric and medical history, as well as number of months of exposure (details in Data Supplement S1, available as supporting information in the online version of this paper). For MVC/pedestrian injury, the IRR increased after adjustment. The relative risk for falls also increased slightly. In both of these cases, SUD identification was the strongest of the predictors included in the analysis. For suicide/self-inflicted injury, the IRR was substantial, but a non–suicide-related psychiatric history was by far the stronger predictor. SUD identification remained the strongest predictor of homicide after adjustment, but public insurance and psychiatric history were still important factors. SUD was also the strongest predictor of both "any e-coded injury" and "any of the specific-marker injuries" after adjustment.

DISCUSSION

Substance use disorder is a very important contributor to injury among women of childbearing age. Massachusetts women aged 15 to 49 years with indicators for SUD had twice the proportion of injured women and more than double the mean number of ED injury visits in the "any specified marker injury" category, compared to women with no evidence for SUD. Differences were greater for self and purposefully inflicted injuries compared to MVC- and fall-related injuries. This finding was not unexpected, because impairments in perception, cognition, and psychosocial functioning associated with SUD are also likely to predispose to increased likelihood of these four injury types. Injury rates among SUD-positive women varied by patterns of alcohol and drug use and were lowest for alcohol only and highest for alcohol in combination with other drugs, a finding that may be surprising to emergency physicians, who have been exposed more broadly to risks associated with alcohol than those associated with other substances of abuse.

Among drug types identified in the study, marijuana had the lowest association with injury and opioids had the highest. After adjustment for the number of months of exposure, demographic characteristics, prior psychiatric history, and chronic disease status, SUD continued to be a substantial risk factor for injury. SUD-positive women had an elevated risk of MVC/pedestrian and falls injuries compared to SUD-negative women, but the risk for suicide/self-inflicted injury and homicide/purposefully inflicted injury was more than double the risk for MVC/pedestrian and fall-related injuries. For suicide/self-inflicted injuries, however, a psychiatric history was a stronger predictor of risk than SUD. These findings, while not unexpected, underscore the importance of identifying drug and alcohol disorders as predictors of injury.

We did not find differences in our data for the "any E-coded injury category" in model 1, which adjusted only for time. However, the increase in prevalence for all E-coded injury among women with SUD was again demonstrated in model 2, which adjusted for major known demographic and psychosocial predictors of injury. This finding suggests that unadjusted analyses of injury prevalence in particular population subgroups may not be sufficiently nuanced to produce results that can be used for program and policy development. If we had not run an adjusted model for all E-coded injury, we would not have appreciated a small but significant difference between SUD-positive and SUD-negative women.

This statewide population-based study represents a novel opportunity to look broadly at the association of SUD with key types of injury among women of reproductive age. There are a number of studies that examine alcohol and drug use related to motor vehicle trauma, falls, and violence, but these studies are limited by small samples, self-report data, or weighted samples. Studies of injury do not generally have comprehensive information available about SUDs or the methodologies to differentiate SUD effects from medical care episode data, and studies of women with SUD often lack good information about injury.[24] Studies focused on individuals in substance abuse treatment programs may also have problems with generalizability.[25] Single-focus studies (violence-related injury, intentional injury, anatomic region-specific injury, or trauma setting studies, for example)[13–20,25,30–32] may be biased by sample selection and circumstances of injury. Broad studies of injury often lack specificity by gender and age. There is much information, for example, about falls in adolescents[33] and in older adults,[21,34] but very little about the combined effects of age, sex, SUD, and injury for women in the reproductive age group. National plans to drop the DAWN reporting mechanism for substance abuse and include SUD in the National Ambulatory Medical Care/ Emergency Department Survey may provide a more robust data source in the future for measuring the association of SUD with injury on the national level.

In our multisource Massachusetts-wide study, we were able to distinguish a group of women with likely SUD diagnoses, based on ICD-9-CM coding, and use that categorization to describe differences in injury risk based on alcohol and drug use disorders. In any population perspective, there is a trade-off; with our method, we do not approach the detail and depth possible in a small sample or more focused study based on interviews or primary data, nor can we say anything from these data about causality or motivation, determinants of behavior, or mediating factors. On the other hand, this type of secondary analysis attempts to

include every woman who sought care in a Massachusetts hospital (ED visits, outpatient stays, and inpatient admissions), and these data are not limited by selective sampling of records or insurance company data sets, or selection bias in subject recruitment. The Massachusetts requirement that all injuries be recorded using the E-code system provided an opportunity to measure injury more completely.

The findings we report here for women aged 15 to 49 years are important for what they tell us about an age group that receives much attention for its reproductive health needs, but less attention than younger girls or older women receive for injury and associated sequelae.[35] Yet an injury to a woman in her middle years can have many concentric circles of impact beyond her immediate diagnostic condition, since this is typically the time of life that society relies on women to manage household and job and care for both children and elders.[36] Both incapacity due to injury and unaddressed SUD that may be a factor in that injury can contribute significantly to a large social cost. Falls among women in this age group, for example, involve 1.4 million ED visits and carry a mean cost of $771 for the visit at a total societal cost of $1.1 billion. Work loss expenses account for an additional $4.2 billion, and the extra expense of paying substitutes for caregiving responsibilities after falls means the total cost of this type of injury is even greater.[12] Efforts to identify and address the drug and alcohol use that increases the risk of falls among adult women could make a significant contribution to reducing health care costs.

LIMITATIONS

Potential sources for sampling bias include missing data, miscoding errors, miscategorization of substance use or injury type, and restriction of the sample to women who used hospital-based services or substance abuse services. This multisource data set is the largest resource for analysis of women with identified SUD, but several groups of women may have been undercounted: 1) women who did not seek any health care from EDs, hospitals, or Massachusetts substance abuse treatment facilities that accept some publically funded clients; 2) women who had health care encounters in Massachusetts, but SUD was missed; and 3) women who received medical care in Massachusetts but went outside the state to seek substance abuse services or were treated within Massachusetts in private facilities that did not contract with BSAS. Our results therefore are likely somewhat undercounted.

Secondary data analysis depends on coding accuracy, but is limited by both human error and reluctance of physicians to introduce stigmatized diagnoses into patient records. This concern is balanced, however, by the benefit to reimbursement of documenting a complex diagnosis to justify patient billing time.

The years 2002 through 2008, concluding just prior to implementation of health care reform in Massachusetts, provide an important baseline for future comparison. Generalizability of results from this time frame may be limited by subsequent changes in health care delivery and policy and by variation in the socioeconomic context of injury.

CONCLUSIONS

Use of a large, multisource, statewide data set permits characterization of women of reproductive age who are likely to meet clinical criteria for substance use disorder, identification of injury rates, and comparison of injury prevalence by substance use disorder identification and by type of drug use. Among women of reproductive age who sought medical treatment in Massachusetts hospitals between 2002 and 2008, those with substance use disorder had a greater likelihood of injury, and among women with an substance use disorder, those who combined alcohol and drugs, had the greatest likelihood of any injury.

The strength of the association between substance use disorder and injury in women of reproductive age suggests the importance of targeted screening for drug and alcohol use disorders when injured women present to the ED. Positive scores for validated short-form instruments, such as the three-question form of the Alcohol Use Disorders Identification Test (AUDIT-C)[37] and the 10-question Drug Abuse Screen Test (DAST-10)[38] indicate a risk for reinjury if substance use is not addressed with brief intervention, referral for assessment, or treatment.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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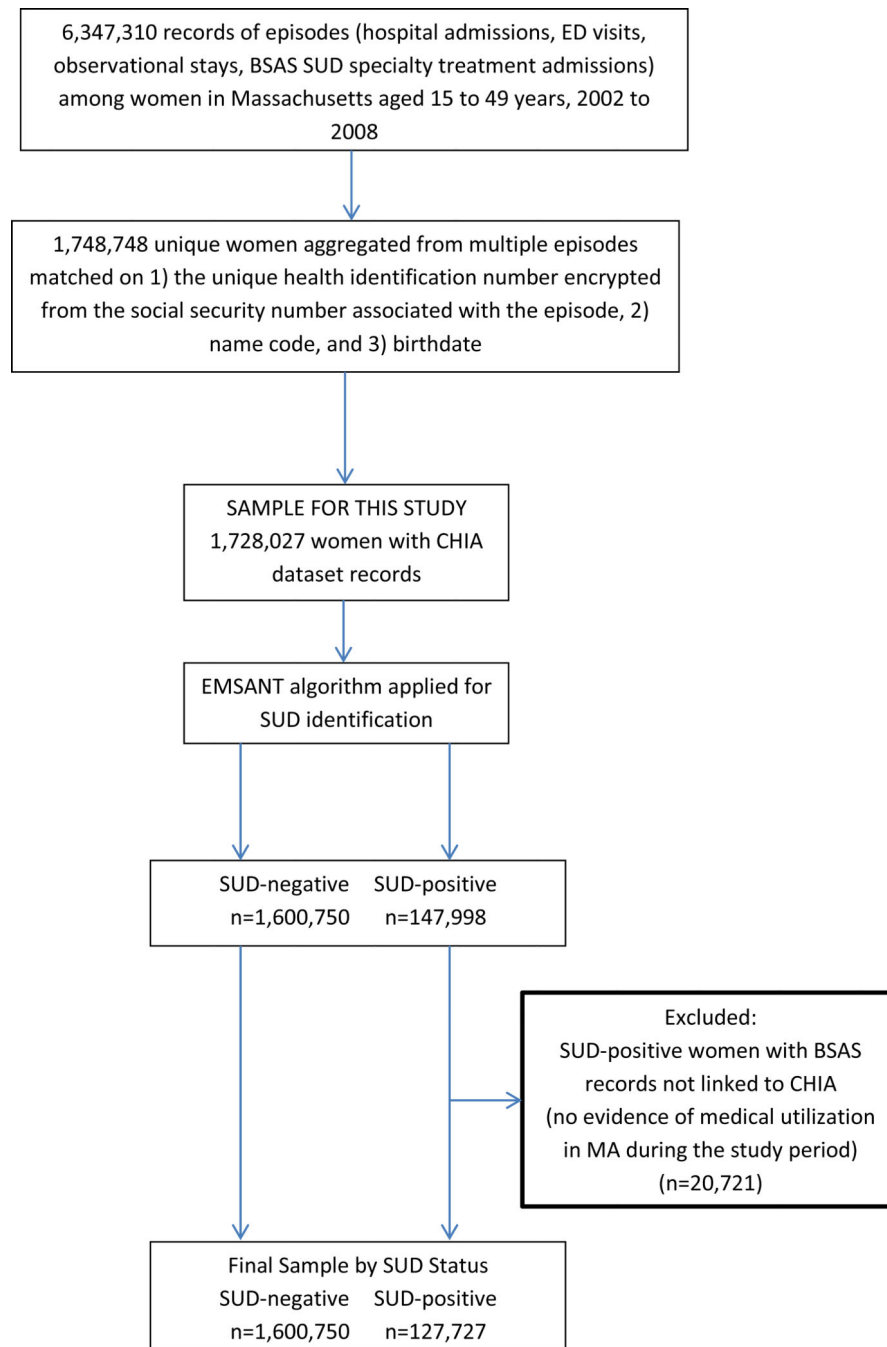
Figure 1.
Strobe diagram: sample selection. BSAS = Bureau of Substance Abuse Services; CHIA = Center for Health Information and Analysis; EMSANT = Explicit Mention of Substance Abuse Need for Treatment; SUD = substance use disorder.

Table 1

Prevalence and Incidence of Injury in Massachusetts Women of Reproductive Age, 2002–2008 by SUD, Among 4,839,706 ED visits

Variable	Number (%) of Women With E-code Indicating Injury		Mean (±SD) Number of Injuries (95% CI)	
	SUD-positive	SUD-negative	SUD-positive	SUD-negative
All E-coded injury (*n* = 800,763)	82,811 (65.1)	717,952 (44.8)	2.27 (4.1) (2.25–2.29)	0.73 (1.3) (0.73–0.73)
Any of the four specified marker injuries (*n* = 437,501)	62,691 (49.3)	374,810 (23.4)	0.72 (0.9) (0.72–0.73)	0.26 (0.5) (0.26–0.26)
Motor vehicle injuries (*n* = 228,721)	28,650 (22.5)	200,071 (12.5)	0.34 (0.8) (0.34–0.35)	0.15 (0.5) (0.15–0.15)
Falls (*n* = 209,924)	33,855 (26.6)	176,069 (11.0)	0.52 (1.5) (0.51–0.53)	0.13 (0.1) (0.13–0.14)
Suicide/self-inflicted injury (*n* = 27,690)	14,645 (11.5)	13,045 (0.8)	0.19 (0.9) (0.18–0.19)	0.01 (0.2) (0.01–0.01)
Homicide/purposeful injury (*n* = 45,522)	14,636 (11.5)	30,886 (1.9)	0.18 (0.7) (0.17–0.18)	0.02 (0.2) (0.02–0.02)

SUD = substance use disorder.

Table 2

Prevalence of Injuries among Massachusetts Women of Reproductive Age, 2002–2008, by Type of Drug Use, Among 4,839,706 ED Visits, *n* = 1,728,027

Injuries Among SUD-positive Women with Known Type of Substance Use	*n*	Number (%) of Women with E-code Indicating Injury	Mean Number of Events (95% CI)
Any E-coded injury			
By substance category			
Alcohol only	40,786	21,925 (53.7)	1.3 (1.25–1.30)
Drugs only	39,653	26,992 (68.0)	2.5 (2.46–2.55)
Alcohol and drugs	44,319	32,272 (72.8)	4.0 (2.95–3.04)
By use of specific drugs			
Marijuana	25,036	16,713 (66.7)	2.4 (2.38–2.48)
Cocaine	30,207	21,770 (72.0)	3.0 (2.99–3.10)
Opioids	33,600	24,400 (72.6)	3.3 (3.24–3.36)
Other drugs	55,173	41,671 (75.5)	3.0 (3.26–3.35)
Specified marker injury	437,501		
Alcohol only	40,786	16,107 (39.5)	0.50 (0.50–0.51)
Drugs only	39,653	19,739 (49.8)	0.72 (0.72–0.73)
Alcohol and drugs	44,319	25,917 (58.5)	0.92 (0.92–0.94)
Motor vehicle injuries	228,721		
Alcohol only	40,786	7,048 (17.3)	0.23 (0.23–0.24)
Drugs only	39,653	9,772 (24.6)	0.39 (0.38–0.40)
Alcohol and drugs	44,319	11,354 (25.6)	0.40 (0.40–0.41)
Falls	209,924		
Alcohol only	40,786	8,661 (21.2)	0.31 (0.31–0.32)
Drugs only	39,653	10,490 (26.5)	0.55 (0.53–0.57)
Alcohol and drugs	44,319	14,209 (32.1)	0.68 (0.67–0.70)
Suicide/self-inflicted injury	27,690		
Alcohol only	40,786	1,927 (4.7)	*0.06 (0.06–0.06)
Drugs only	39,653	4,222 (10.7)	0.16 (0.16–0.17)
Alcohol and drugs	44,319	8,402 (19.0)	0.50 (0.33–0.35)
Homicide/purposeful injury	45,522		
Alcohol only	40,786	2,979 (7.3)	*0.09 (0.09–0.10)
Drugs only	39,653	4,276 (10.8)	*0.15 (0.15–0.16)
Alcohol and drugs	44,319	7,219 (16.3)	*0.27 (0.27–0.28)

CIs are narrow because the sample is large and estimates are precise.

SUD = substance use disorder.

*Point estimates for several variables differ but appear similar because of rounding.

Table 3

Model 1—The Association of SUD With Categories of Injury, Adjusting for the Number of Injury-possible Months in the Data System (Time): IRRs

Outcome	IRR	95% CI
Any E-coded injury	0.96	0.95–0.96
MVC	1.19	1.17–1.20
Falls	1.59	1.57–1.61
Suicide/self-inflicted injury	9.30	9.08–9.52
Homicide/purposefully inflicted injury	3.93	3.85–4.00
Any of the specific marker injuries	1.39	1.37–1.40

MVC = motor vehicle crash; IRR = incident rate ratio; SUD = substance use disorder

Table 4

Model 2—The Association of SUD With Categories of Injury, Adjusted for Time, Demographic Factors, and Psychiatric and Medical History[*] With IRRs

Outcome	Variable	IRR	95% CI
Any E-coded injury	SUD	1.22	1.21–1.23
MVC	SUD	1.50	1.48–1.52
Falls	SUD	1.69	1.67–1.71
Suicide/self-inflicted injury	SUD	3.90	3.80–4.00
Homicide/purposefully inflicted injury	SUD	3.30	3.23–3.38
Any of the specific marker injuries	SUD	1.59	1.58–1.61

IRR = incident rate ratio; MVC = motor vehicle crash; SUD = substance use disorder.

[*]
Adjusted for number of injury possible months, age, race, health insurance status, psychiatric history, and chronic/complex medical conditions.