The Epidemiology of Acute Poisoning Hospital Discharges in Women of Reproductive Age and During Pregnancy, California, 2000-2003

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The Epidemiology of Acute Poisonings in Women of Reproductive Age and During Pregnancy, California, 2000–2004

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Abstract The aims of this study were to describe and compare the epidemiology of acute poisoning hospital discharges in women of reproductive age and during pregnancy (aged between 15 and 44) to include the incidence rate, risk factors, substances involved, rates of intentional versus unintentional poisonings, and in pregnant women, distribution over trimesters. Through a cohort study design, the California patient discharge dataset and linked vital statistics-patient discharge database were used to identify cases of acute poisoning hospital discharges from 2000 to 2004 among women of reproductive age and among pregnant women. Odds ratios (OR) were calculated to identify risk factors using logistic regression. Of 4,436,019 hospital discharges in women of reproductive age, 1% were for an acute poisoning (115.3/100,000 person-years). There were 2,285,540 deliveries and 833 hospital discharges for an acute poisoning during pregnancy (48.6/100,000 person-years). Pregnancy was associated with a lower risk of acute poisoning ($OR = 0.89$, $P = 0.0007$). Poisonings were greatest among young black women regardless of pregnancy status and among those with substance abuse or mental health problems. Analgesic and psychiatric medications were most commonly implicated. The majority of poisonings among women of reproductive age (69.6%) and among pregnant women (61.6%) were self-inflicted. Efforts to reduce acute poisonings among women of reproductive age should include education regarding the use of over-the-counter medications and interventions to reduce self-inflicted harm.

Keywords Pregnancy · Reproductive age · Poisoning · Injury · Self-inflicted injury · Analgesics

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Introduction

Injuries are a major source of preventable morbidity and mortality. For instance, in women of reproductive age (ages 15–44) in 2005 injuries were the leading cause of death (rate 29.7/100,000). The rate of non-fatal injury related hospitalization was 337/100,000. Furthermore, the leading causes of injury hospitalization in women of reproductive age were: poisonings (30.9%), motor vehicle occupant injuries (24.3%) and falls (12%) [1]. Poisoning has also been reported as the most frequent method of self-inflicted, non-fatal injury in women [2].

Injuries during pregnancy are a major public health concern, with approximately 6–7% of women experiencing a medically treated injury throughout the course of their pregnancy. Moreover, two lives, that of the mother and the fetus, are at risk. In a study examining injury hospitalizations during pregnancy the leading causes were reported as: motor-vehicle occupant related injuries (27.1%), falls (21.2%) and poisonings (16.4%) [3]. In addition, ingestion of a drug overdose or corrosive substance was reported as the leading mechanism of attempted suicide among pregnant women in California [4].

Several population-based studies have reported the incidence and risks resulting from hospitalized injury during pregnancy. However, in recent years, pregnancy associated injury research has focused on traumatic mechanisms of injury during pregnancy, with the majority of publications investigating the risks and outcomes of motor vehicle crashes [5–9] and assaults [10–12].

Despite the relative proportion of injuries that are attributed to poisonings, little is known not only about the characteristics of women of reproductive age who are poisoned, but those who are poisoned during pregnancy. The vast majority of publications examining poisoning during pregnancy are simple case studies [13–24] and case series [25–37]. These publications are limited by small sample sizes, evaluations of a single substance, or are restricted to investigations of self-poisonings [28–31]. There is a clear absence of population based data regarding poisoning in women of reproductive age and specifically during pregnancy. Consequently, this study aims to describe and compare the epidemiology of acute poisoning hospital discharges in women of reproductive age (aged between 15 and 44) and during pregnancy to include the incidence rate, risk factors, substances involved, rates of intentional versus unintentional poisonings, and in pregnant women, distribution over trimesters.

Materials and Methods

Through a retrospective cohort study design, two datasets, the Patient Discharge Dataset (PDD) and the Linked Vital Statistics-Patient Discharge Database (LVSPDD), both maintained by the California Office of Statewide Health Planning and Development, for the years 2000–2004, were analyzed. All California licensed hospitals are mandated to submit semi-annually specific data on every discharged patient. These data include: patient demographic information, diagnostic and treatment information, total hospital charges, and payer source. The LVSPDD includes data from several sources including: California patient discharge data, vital statistics birth certificate data, vital statistics death certificate data, the vital statistics fetal death file and the vital statistics birth cohort file. It also includes maternal antepartum and postpartum hospital records for the 9 months prior to and 1 year post-delivery. The database also includes birth records and all infant readmissions occurring during the first year of life. Linkage was successful in 98% of the cases. Detailed linkage procedures have been described previously [32].

This study was approved by the University of Pittsburgh institutional review board, the California department for the protection of human subjects, and the California office of statewide health planning and development. No unique patient identifiers were included in the database.

Operationalization of Variables

Hospital discharges for acute poisonings were identified by the following International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and external cause of injury codes: 960–979 (poisoning by drugs, medicinal, and biological substances), 980–989 (toxic effects of substances chiefly nonmedicinal as to source), E850–E858 (accidental poisoning by drugs, medicinal substances, and biologicals), E860.2–E869 (accidental poisoning by other solid and liquid substances, gases, and vapors), E905 (venomous animals and plants as the cause of poisoning and toxic reactions), E950–E952 (suicide and self-inflicted poisoning), E962 (assault by poisoning) and E980–E982 (poisoning, undetermined whether accidentally or purposely inflicted). Irrespective of maternal or fetal outcome, all hospital discharges for acute poisoning were identified for women between 15 and 44 years old in the PDD and compared to all other non-poisoning hospital discharges in women between 15 and 44 years during the 5 years period 2000–2004. All hospital discharges for acute poisonings in pregnant women aged between 15 and 44 who had a pregnancy outcome consisting of a live birth or fetal death that occurred within gestational ages 20–42 weeks, in the LVSPDD, were identified and compared to all other non-poisoning hospital discharges in pregnant women aged between 15 and 44 who had a pregnancy outcome consisting of a live birth or fetal death that occurred within gestational ages 20–42 weeks during the same 5 years period. Reported last menstrual period (LMP) was used to estimate gestational age. Data on deliveries prior to 20 weeks gestation are not captured by the state and thus are excluded from the dataset. Clinical Classifications Software (CCS), developed at the Agency for Healthcare Research and Quality (AHRQ), was used to define concomitant mental illness and substance abuse. Specifically, mental illness was defined using CCS categories 657 (mood disorders), 658 (personality disorders), and 659 (schizophrenia and other psychotic disorders). Substance abuse was defined using CCS categories 660 (alcohol-related disorders) and 661 (substance-related disorders).

Statistical Analyses

To determine if pregnancy was associated with the risk of acute poisoning, the rate of acute poisoning hospital discharges in all women of reproductive age was compared to that of acute poisoning hospital discharges during pregnancy. This comparison, rather than a pregnant verus nonpregnant group was done for several reasons. Mainly, because the goal is to compare pregnant to nonpregnant women, the comparison done in this study using person-year denominators considers the 3 month period out of each year that a pregnant woman is not pregnant [5].

Incidence rates were calculated per 100,000 person years, following the methodology used by Greenblatt et. al. [33]. For the pregnant population, denominators were adjusted downward to account for the nine of 12 months of the year a pregnant woman is gravid. In accord with the methods of Greenblatt et. al. [33] and Dannenberg et. al. [34] the consequences of multiple births and spontaneous and induced abortions in the person-year calculations were ignored because of their assumed small effect.

The demographic characteristics between women with acute poisoning hospital discharges were compared to those with non-poisoning hospital discharges. Data were summarized as means (standard deviation) or medians (interquartile range) for continuous variables and frequencies for categorical variables. In order to determine statistical significance, *T*-tests or Wilcoxon rank sum tests were computed for continuous variables and the chi-square test for categorical variables. Odd ratios (OR) and 95% confidence intervals (CI) were calculated for risk factors using logistic regression analyses. Rates are presented as the number of acute poisoning hospital discharges per 100,000 person-years, unless otherwise noted. To compare incidence rates, group specific rate ratios and their 95% CI were calculated according to Rosner [35]. Generalized estimating equations were utilized to determine if pregnancy was a significant risk factor for poisoning when controlling for potential confounders, identified apriori based on previously published literature, including age, race, and insurance payer.

All analyses were calculated using SAS 8.2 software. All *P*-values were two sided and *P*-values <0.05 were considered statistically significant.

Results

Acute Poisoning Hospital Discharge Among Women of Reproductive Age

There were 4,436,019 hospital discharges in women aged between 15 and 44 identified in the PDD. Of these, 44,393 (1.00%) were for an acute poisoning during the study period, resulting in a rate of 115.28 hospital discharges per 100,000 person-years. Utilizing E-codes, 30,890 (69.6%) of the 44,393 acute poisoning hospital discharges were identified as intentional, 9,526 (21.5%) as unintentional and 2,687 (6.05%) of undetermined intent (rates 80.2, 24.7, and 6.98/100,000 person-years, respectively). In poisoned women with non-missing record linkage numbers ($N = 32,353$), 2,945 (9.10%) women were discharged twice during the 5 years study period for an acute poisoning, 589 (1.82%) three times, and 362 (1.12%) discharged four or more times during the 5 years study period for an acute poisoning.

The overall rate of acute poisoning hospital discharges in women of reproductive age was greatest among the younger women aged between 15 and 19 (156.0/100,000 person-years). The rate of intentional acute poisoning hospital discharges was also greatest among women aged between 15 and 19 (125.4/100,000 person-years), while unintentional poisoning hospital discharges were greatest in women aged between 40 and 44 (36.3/100,000 person-years).

The diagnostic codes of the five leading substances implicated in acute poisoning hospital discharges for women of reproductive age are presented in Table 1. In addition, the five leading substances identified by E-codes, stratified by intent, are also listed. Analgesics and sedatives were most commonly implicated.

The demographic characteristics of women of reproductive age with acute poisoning hospital discharges are presented in Table 2. Compared to women of other age groups, women aged between 15 and 19 had the greatest likelihood of acute poisoning, followed by women aged between 40 and 44. White women were more likely to be hospitalized for an acute poisoning compared to non-white women as were non-Hispanic women when compared to Hispanic women. The concomitant diagnoses of substance abuse and mental illness were associated with higher odds of acute poisoning hospital discharge.

Acute Poisoning Hospital Discharge During Pregnancy

There were 2,285,540 deliveries identified in the LVSPDD from 2000 to 2004, accounting for 2,471,524 hospital discharges. A total of 833 hospital discharges for an acute poisoning during pregnancy were identified (48.6/100,000 person-years). Seven hundred ninety-four (0.03% of deliveries) women accounted for the 833 hospital discharges (population-based rate 46.3/100,000 person-years); 37 women were admitted two or more times during the same pregnancy for an acute poisoning.

The distribution of poisoning hospital discharges by gestational age is presented in Fig. 1. Of all poisoning

Table 1 The five leading substances implicated in acute poisoning hospital discharges and substance specific rates in women of reproductive age by diagnosis code and E-code, stratified by intent, California, 2000–2004

	Rate (per 100,000 person-years)
All (Diagnosis code)	
Poisoning by aromatic analgesics, NEC	22.90
Acetanilid; Paracetamol (acetaminophen); Phenacetin (acetphenetidin)	
Poisoning by benzodiazepine-based tranquilizers	19.89
Chlordiazepoxide; Diazepam; Flurazepam; Lorazepam; Medazepam; Nitrazepam	
Poisoning by antidepressants	17.40
Amitriptyline; Imipramine; Monoamine Oxidase (MAO) Inhibitors	
Poisoning by other opiates and related narcotics	6.93
Codeine (methylmorphine]; Meperidine (pethidine); Morphine	
Toxic effect of ethyl alcohol	6.92
Denatured alcohol; ethanol; grain alcohol	
Intentional (E-code)	
Suicide and self-inflicted poisoning by tranquilizers and other psychotropic agents	33.33
Suicide and self-inflicted poisoning by analgesics, antipyretics, and antirheumatics	33.18
Suicide and self-inflicted poisoning by other specified drugs and medicinal substances	23.74
Suicide and self-inflicted poisoning by other and unspecified solid and liquid substances	6.54
Suicide and self-inflicted poisoning by other sedatives and hypnotics	3.68
Unintentional (E-code)	
Accidental poisoning by benzodiazepine-based tranquilizers	3.33
Chlordiazepoxide; Diazepam; Flurazepam; Lorazepam; Medazepam; Nitrazepam	
Accidental poisoning by aromatic analgesics, NEC	3.20
Acetanilid; Paracetamol (acetaminophen); Phenacetin (acetophenetidin)	
Accidental poisoning by other opiates and related narcotics	3.16
Codeine (methylmorphine); Meperidine (pethidine); Morphine; Opium (alkaloids)	
Accidental poisoning by psychostimulants	2.38
Amphetamine; Caffeine	
Accidental poisoning by antidepressants	1.80
Amitriptyline; Imipramine; Monoamine oxidase (MAO) inhibitors	

hospital discharges during pregnancy, 35.9, 28.3, and 35.8% occurred in the first, second, and third trimesters, respectively. The rate of acute poisoning hospital discharges did not significantly differ across trimesters (17.5, 13.8, and 17.3 per 100,000 person-years, respectively). There were 128 (16.1%) deliveries that occurred at the time of poisoning hospitalization.

Utilizing E-codes, 513 (61.6%) of the 833 documented cases of acute poisonings were identified as intentional (29.9/100,000 person-years). Of the remaining cases, 241 (28.9%) were classified as unintentional and 34 (4.08%) as undetermined intent (14.1 and 1.98 per 100,000 person-years, respectively).

Intentional poisonings peaked in the first months of gestation, while the greatest numbers of unintentional poisonings were observed during the final months of gestation. The rate of intentional poisonings was significantly greater in the first trimester than in the second and third (13.4 versus 9.33 and 7.23 per 100,000 person-years, respectively; $P < 0.05$). The rate of unintentional poisonings was significantly greater in the third trimester in comparison to the first and second (7.47, 3.33, and 3.25 per 100,000 person-years, respectively; $P < 0.05$).

The diagnostic codes of the five leading substances implicated in acute poisoning hospital discharges during pregnancy are presented in Table 3. In addition, the 5 leading substances identified by E-codes, stratified by intent, are also listed. Analgesics were the most common substance implicated, regardless of intent.

Demographic characteristics of women with an acute poisoning hospital discharge during pregnancy are shown in Table 4. The overall rate of acute poisoning hospital discharge during pregnancy was greatest among women aged between 15 and 19 (91.9/100,000 person-years); this age group also exhibited the highest rates of both intentional (66.4/100,000 person-years) and unintentional

Table 2 Demographic characteristics of women with acute poisoning hospital discharges and non-poisoning hospital discharges, women of reproductive age (15–44), California, 2000–2004

Characteristic	Category	Non-poisoning hospital discharges n	Acute poisoning hospital discharges		OR	95% CI
			n	%		
Age	15–19	443,560	9,569	2.11	3.58	3.47,3.70
	20–24	821,488	6,452	0.78	1.3	1.26,1.35
	25–29	925,014	5,570	0.6	1	Ref
	30–34	944,500	6,516	0.69	1.15	1.11,1.19
	35–39	716,868	7,588	1.05	1.76	1.70,1.82
	40–44	540,196	8,698	1.58	2.67	2.59,2.77
Race	White	2,929,533	33,129	1.12	1	Ref
	Black	377,887	3,768	0.99	0.88	0.85,0.91
	Asian	363,891	2,762	0.75	0.67	0.65,0.70
	Other	662,382	4,123	0.62	0.55	0.53,0.57
Ethnicity	Hispanic	1,718,981	10,017	0.58	0.45	0.44,0.46
	Non-hispanic	2,589,698	33,446	1.28	1	Ref
Insurance	Medicare/other government	182,409	3,610	1.94	2.7	2.60,2.80
	Medi-Cal	1,684,765	12,361	0.73	1	Ref
	Private	2,252,601	19,257	0.85	1.17	1.14,1.19
	County indigent services/charity	150,075	5,818	3.73	5.28	5.12,5.45
	Self-pay	71,215	2,792	3.77	5.34	5.13,5.57
	Other	49,651	534	1.06	1.47	1.34,1.60
Substance abuse	Yes	216,765	18,013	7.67	13.15	12.90,13.41
	No	4,174,861	26,380	0.63	1	Ref
Mental illness	Yes	381,865	28,502	6.95	18.83	18.47,19.21
	No	4,009,761	15,891	0.39	1	Ref

CI confidence interval; *OR* odds ratio

All $P < 0.0001$ for comparisons

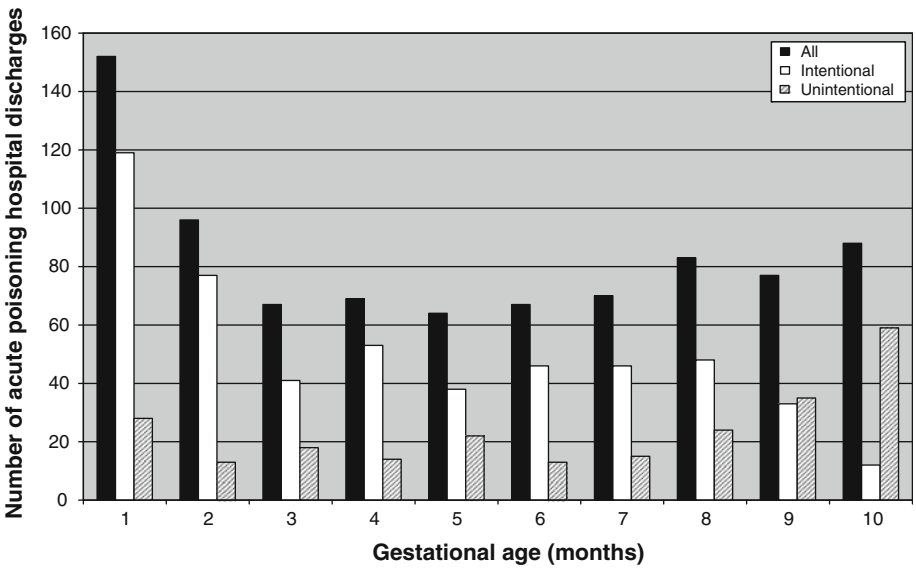

Fig. 1 Number of acute poisoning hospital discharges during pregnancy by gestational age at time of poisoning; overall and stratified by intent, California, 2000–2004

Table 3 The five leading substances implicated in acute poisoning hospital discharges during pregnancy and substance specific rates by diagnosis code and by E-code, stratified by intent, California, 2000–2004

	Rate (per 100,000 person-years)
All (Diagnosis code)	
Poisoning by aromatic analgesics, NEC	10.79
Acetanilid; Paracetamol (acetaminophen); Phenacetin (acetphenetidin)	
Poising by antidepressants	4.38
Amitriptyline; Imipramine; Monoamine Oxidase (MAO) Inhibitors	
Poisoning by benzodiazepine-based tranquilizers	3.38
Chlordiazepoxide; Diazepam; Flurazepam; Lorazepam; Medazepam; Nitrazepam	
Poisoning by antirheumatics (antiphlogistics)	3.03
Propionic acid derivatives Fenoproten; Fluriprofen; Ibruprofen; Ketoprofen; Naproxen; Oxaprozin	
Poisoning by salicylates	2.92
Acetylsalicylic acid (aspirin); Salicylic acid salts	
Intentional (E-code)	
Suicide and self-inflicted poisoning by analgesics, antipyretics, and antirheumatics	14.41
Suicide and self-inflicted poisoning by other specified drugs and medicinal substances	9.92
Suicide and self-inflicted poisoning by tranquilizers and other psychotropic agents	7.88
Suicide and self-inflicted poisoning by other and unspecified solid and liquid substances	1.75
Suicide and self-inflicted poisoning by other sedatives and hypnotics	0.64
Unintentional (E-code)	
Accidental poisoning by aromatic analgesics, NEC	1.75
Acetanilid; Paracetamol (acetaminophen); Phenacetin (acetophenetidin)	
Venomous spiders causing poisoning and toxic reactions	1.28
Black widow spider; Brown spider; Tarantula (venomous)	
Accidental poisoning by anticonvulsant and anti-parkinsonism drugs	0.99
Amantadine; Hydantoin derivatives; Levodopa (L-dopa); Oxazolidine derivatives (paramethadione) (trimethadione); Succinimides	
Accidental poisoning by second-hand tobacco smoke	0.99
Accidental poisoning by psychostimulants	0.88
Amphetamine; Caffeine	

(23.0/100,000 person-years) poisonings. Black women were more likely to be hospitalized for an acute poisoning during pregnancy when compared to white women. Non-Hispanic women were significantly more likely to be hospitalized for an acute poisoning during pregnancy when compared to Hispanic women. Both substance abuse and mental illness were each associated with higher odds of acute poisoning during pregnancy. Neither parity nor initiation of prenatal care was associated with acute poisoning hospital discharge during pregnancy.

Comparison: Rates of Acute Poisoning Hospital Discharge Among Women of Reproductive Age versus the Rates of Acute Poisoning Hospital Discharge During Pregnancy

Rate ratios and their associated 95% CI for acute poisoning hospital discharges during pregnancy and acute poisoning hospital discharges in all women of reproductive age are shown in Table 5. The crude rates of acute poisoning were greater in women of reproductive age than during pregnancy, irrespective of intent.

The rates of acute poisoning hospital discharges during pregnancy and in women of reproductive age stratified by age and race are presented in Fig. 2. The rates of acute poisoning hospital discharges (both white and nonwhite) during pregnancy were lower than that in women of reproductive age.

In a multivariable model controlling for age, race, insurance payer, and ethnicity, pregnancy remained to be significantly inversely associated with acute poisoning hospital discharges ($OR = 0.89$, 95% CI: 0.83,0.95, $P = 0.0007$). Furthermore, in a multivariable model controlling for race, insurance payer, and ethnicity, interactions between pregnancy and age and pregnancy and race were statistically significant ($P < 0.0001$).

Table 4 Demographic characteristics of women with acute poisoning hospital discharges during pregnancy and non-poisoning hospital discharges during pregnancy, California, 2000–2004

Characteristic	Category	Non-poisoning hospital discharges during pregnancy	Acute poisoning hospital discharges during pregnancy		OR	95% CI
		n	n	%		
Maternal age	15–19	234,746	148	0.06	2.44	1.95,3.04
	20–24	556,034	222	0.04	1.54	1.26,1.89
	25–29	641,472	166	0.03	1	Ref
	30–34	617,240	173	0.03	1.08	0.88,1.34
	35–39	339,859	96	0.03	1.09	0.85,1.40
	40–44	81,340	28	0.03	1.33	0.89,1.99
Race	White	1,967,593	624	0.03	1	Ref
	Black	157,674	104	0.07	2.08	1.69,2.56
	Asian	296,404	79	0.03	0.98	0.75,1.30
	Other	41,517	25	0.06	0.96	0.72,1.28
Ethnicity	Hispanic	1,122,697	330	0.04	0.77	0.67,0.89
	Non-hispanic	1,299,812	495	0.03	1	Ref
Maternal education	Less than high school	690,821	279	0.04	1	Ref
	Completed high school	686,473	250	0.04	0.9	0.76,1.07
	Some college, no degree	475,268	176	0.04	0.92	0.76,1.11
	College	573,331	106	0.02	0.46	0.37,0.57
Insurance	Medicare/other government	25,300	33	0.13	3.75	2.63,5.36
	Medi-Cal	1,069,770	372	0.03	1	Ref
	Private	1,304,717	307	0.02	0.68	0.58,0.79
	County indigent services/charity	52,389	77	0.15	4.23	3.31,5.40
	Self-pay	3,535	34	0.95	27.66	19.44,39.36
	Other	14,626	10	0.07	1.97	1.05,3.69
Parity	Nulliparous	4,854	*	*	1	Ref
	1	955,581	325	0.03	0.83	0.21,3.32
	2	784,331	203	0.03	0.63	0.16,2.53
	≥3	725,152	303	0.04	1.01	0.25,4.08
Prenatal care	First trimester	2,140,703	680	0.03	1.01	0.33,3.15
	Second trimester	254,252	124	0.05	1.56	0.50,4.89
	Third trimester	49,617	19	0.04	1.22	0.36,4.13
	None	9,569	*	*	1	Ref
Substance abuse	Yes	26,899	237	0.87	36.13	31.06,42.02
	No	2,443,792	596	0.02	1	Ref
Mental illness	Yes	17,521	374	2.09	114.09	99.45,130.88
	No	2,453,170	459	0.02	1	Ref

CI confidence interval, *OR* odds ratio

* = cell frequency <5: data not reported

Discussion

This is the first study to address the prevalence and risk of poisonings in women of reproductive age and during pregnancy in a large population-based sample. The rates of acute poisoning hospital discharges in women of reproductive age documented in this study (both fatal and nonfatal) correspond well to the overall rate and the rates of intentional and unintentional hospitalized nonfatal poisoning related injuries among women ages 15–44 reported by the Centers for Disease Control Web-based Injury Statistics Query and Reporting System (WISQARS) [1] (115.3, 80.2 and 24.7 per 100,000 person-years in contrast to 118.6, 88.4 and 30.2 per 100,000 persons, respectively). The similarity between the rates in this study and those reported by WISQARS further increases confidence in these results. CDC WISQARS provides reliable national estimates of injuries in the United States (US).

Table 5 Rates of acute poisoning hospital discharges during pregnancy and in women of reproductive age, stratified by intent, California, 2000–2004

	Pregnant (rate per 100,000 person-years)	Women of reproductive age (rate per 100,000 person-years)	Rate ratio	95% CI
All acute poisoning Hospital discharges	48.60	115.28	0.42	0.38,0.45
Intentional	29.93	79.08	0.37	0.34,0.40
Unintentional	14.06	24.74	0.57	0.50,0.65
Undetermined	1.98	6.98	0.28	0.20,0.39

CI confidence interval

This study went beyond the scope of WISQARS and are a compilation of data from AAPCC and are therefore

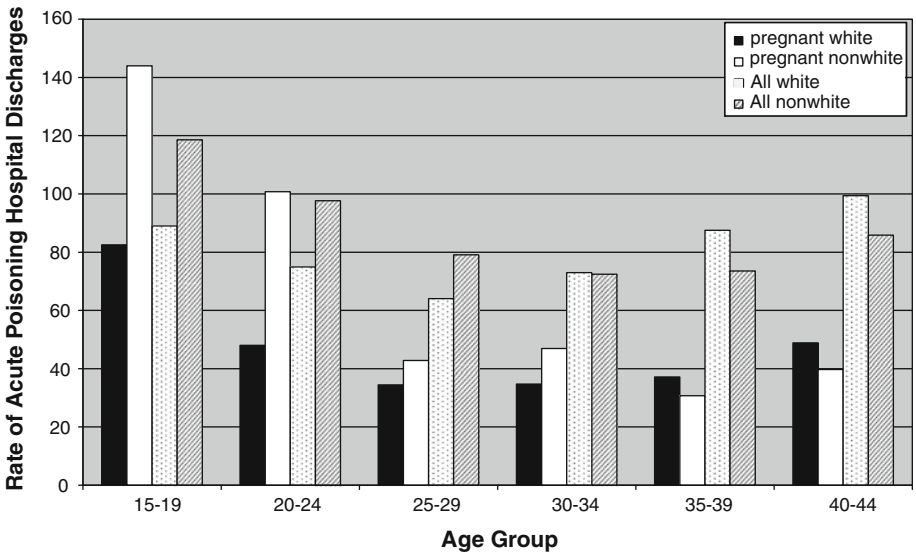

Fig. 2 Rates (per 100,000 person-years) of acute poisoning hospital discharges during pregnancy and in women of reproductive age stratified by age group and race, California, 2000–2004

American Association of Poison Control Centers (AAPCC) data to report the rates of acute poisoning hospital discharges specifically among pregnant women.

Weiss (1999) studied pregnancy-associated injury in Pennsylvania and reported a rate of pregnancy-associated poisoning hospital discharges of 132 per 100,000 person-years and the rate ratio of acute poisoning hospital discharges in pregnant women compared to women of reproductive age as 0.71(95% CI: 0.59, 0.86) [3]. The rate and associated rate ratio reported in this study ((48.6/100,000 person-years, 0.42(95% CI: 0.38, 0.45)), although of the same magnitudes, are significantly lower. The reasons for these differences are unclear; however, it is thought that racial and ethnic differences, which vary considerably between Pennsylvania and California, may account for at least a portion this disparity.

The most common substances implicated in acute poisoning hospital discharge in women of reproductive age were analgesics, sedatives and antidepressants, similar to other reports utilizing AAPCC and Toxic Exposure Surveillance (TESS) system data [36–38]. AAPCC data are limited; not every poison exposure is reported. TESS data subject to the same limitations. These limitations are addressed in this study by reporting results from a population-based dataset with emphasis on acute poisoning hospital discharges specific to women aged between 15 and 44.

Specific to pregnancy, the most common substances implicated in intentional poisoning hospital discharges during pregnancy were analgesics, antipyretics, antirheumatics, tranquilizers and antipsychotic agents. Similarly, ingestion of 50 different types of over-the-counter and prescription drugs consisting primarily of analgesics, iron, sedatives, antibiotics and antihistamines or decongestants were identified in a study of 111 suicide attempts by overdose during pregnancy reported to a metropolitan poison control center (PCC) [38]. This is in contrast to Sein Anand et al. 2005 [29], who reported that the most commonly ingested drugs used in suicide attempts during pregnancy were benzodiazepines. The results in this study are more comprehensive due to the limited sample size in the Sein Anand et al. (2005) study ($N = 19$). However, a benefit to their design was the ability to more completely describe the factors associated with self-inflicted poisonings. This study was limited to the data collected as part of a statewide

hospital administrative system and therefore factors such as suicidal intent (unplanned pregnancy, abortion induction, etc.) could not be examined.

The 2004 TESS annual report indicated that of all 2,438,644 poison exposures called into PCCs, 8,431 occurred in pregnant women: 32.0% in the first, 37.6% in the second and 30.5% in the third trimesters, respectively [37]. A similar trend was revealed in this study. Although the overall rate of acute poisoning hospital discharges did not differ significantly across trimesters, the rate of intentional poisonings was significantly greater in the first trimester of pregnancy. Similarly, in a population-based prospective examination of the timing and outcomes following self-poisoning by pregnant women for the years 1985–1993 in Budapest, Hungary Czeizel et al. (1999) reported a striking inverse relationship between the numbers of suicide attempts across postconceptional months [28]. Due to the high number of intentional poisonings in the first few months of gestation and the quick decline thereafter, it may be speculated that the rates of intentional poisonings decrease due to increasing awareness of pregnancy.

Although unsettlingly high, the proportion (62%) of intentional poisonings was not unexpected; poisonings are the most frequent method of self-inflicted, non-fatal injury in women [2]. Furthermore, Gandhi et al. (2006) [4] who also used California VSPDD, reported that of all pregnant women attempting suicide in California, 86% attempted by ingestion of a drug overdose or corrosive substance.

The documented decreased risk taking behavior in pregnant women is further supported because, after controlling for potential confounding factors, the risk of acute poisoning hospital discharges was significantly lower during pregnancy compared to all women of reproductive age. Also of interest, a significant interaction between age and pregnancy persisted, such that in pregnant women, age increase was associated with decreasing rates of poisoning. A second interaction, between race and pregnancy, was also significant; black race was associated with a higher risk of acute poisoning hospital discharges during pregnancy. The distribution of the pregnant population, being younger and more often of minority race may aid in elevating the base rate of acute poisoning hospital discharges in pregnant women.

This is the first study to examine the epidemiology of acute poisoning hospital discharges during pregnancy and in women of reproductive age. In addition, this is the first paper to present population-based estimates of acute poisoning hospital discharges during pregnancy to include poisonings in the first weeks of pregnancy; most data sources are limited to recognizable pregnancies.

A limitation of this study, inherent in the utilization of retrospective, administrative data is possible coding and reporting errors. This study may also have selection bias as the dataset included hospitalized poisonings only, excluding deliveries prior to 20 weeks gestation and coroner's cases, which may lead to an underestimate of the true number of acute poisoning cases (including those that result in early fetal death). The power to show the differences in risk between the pregnant and nonpregnant groups is slightly lowered due to the assumption that population rates computed for all women of reproductive age are similar to nonpregnant women of the same age. This assumption also has the potential to introduce bias by age, race, and other factors associated with pregnancy. In addition, these data are specific to the state of California and thus results may not be generalizable to populations with other sociodemographic and socioeconomic distributions. Finally, LMP date was the only available source for estimating gestational age from birth certificates in California prior to 2007, introducing small potential for case misclassification.

This study provides vital information which can be used by health care professionals to develop screening, intervention and prevention programs in susceptible female populations. Interestingly, the leading substances implicated in acute poisoning hospital discharges in women of reproductive age and among pregnant women, regardless of intent, were over-the-counter analgesics. Efforts to reduce acute poisonings among women of reproductive age should include education regarding the use of over-the-counter medications and interventions to reduce self-inflicted harm.

Future research in the field of acute poisonings should make an effort to distinguish poison severity. Currently, neither the Injury Severity Score System nor hospital administrative data provide indications of the dose of substance implicated in a poisoning. For a greater understanding of factors associated with acute poisonings during pregnancy, and better define a target for intervention, future studies should focus data collection efforts to include: (1) the time the woman became aware of her pregnancy in relation to the time of the poisoning, (2) the true intent of the poisoning, (3) whether the pregnancy was a planned pregnancy, and (4) history of mental illness or substance abuse. Furthermore, additional research should investigate the effects of acute poisoning during pregnancy on maternal and neonatal outcomes.

References

1. Centers for disease control and prevention, national center for injury prevention and control. Web-based Injury Statistics Query and Reporting System (WISQARS). (http://www.cdc.gov/ncipc/wisqars). (Accessed Jan 7 2007).
2. Schnitzer, P. G., & Runyan, C. W. (1995). Injuries to women in the United States: An Overview. *Women and Health, 23*(1), 9–27.

3. Weiss, H. B. (1999). Pregnancy-associated injury hospitalizations in Pennsylvania, 1995. *Annals of Emergency Medicine, 34*, 626–636.
4. Gandhi, S. G., Gilbert, W. M., McElvy, S. S., et al. (2006). Maternal and neonatal outcomes after attempted suicide. *Obstetrics and Gynecology, 107*, 984–990.
5. Weiss, H. B., Lawrence, B., & Miller, T. (2002). Prevalence and risk of hospitalized pregnant occupants in car crashes. *Annual Proceedings/Association for the Advancement of Automotive Medicine, 46*, 355–362.
6. Schiff, M. A., & Holt, V. L. (2005). Pregnancy outcomes following hospitalization for motor vehicle crashes in Washington State from 1989 to 2001. *American Journal of Epidemiology, 161*(6), 503–510.
7. Sirin, H., Weiss, H. B., Sauber-Schatz, E. K., et al. (2007). Seat belt use, counseling and motor-vehicle injury during pregnancy: Results from a multi-state population-based survey. *Maternal and Child Health Journal, 11*(5), 505–510.
8. Hyde, L. K., Cook, L. J., Olson, L. M., et al. (2003). Effect of motor vehicle crashes on adverse fetal outcomes. *Obstetrics and Gynecology, 102*(2), 279–286.
9. Weiss, H. B., & Strotmeyer, S. (2002). Characteristics of pregnant women in motor vehicle crashes. *Injury Prevention, 8*(3), 207–210.
10. El Kady, D., Gilbert, W. M., Xing, G., et al. (2005). Maternal and neonatal outcomes of assaults during pregnancy. *Obstetrics and Gynecology, 105*(2), 357–363.
11. Rachana, C., Suraiya, K., Hisham, A. S., et al. (2002). Prevalence and complications of physical violence during pregnancy. *European Journal of Obstetrics, Gynecology, and Reproductive Biology, 103*(1), 26–29.
12. Weiss, H. B., Lawrence, B. A., & Miller, T. R. (2002). Pregnancy-associated assault hospitalizations. *Obstetrics and Gynecology, 100*(4), 773–780.
13. Kamha, A. A., Al Omary, I. Y., Zalabany, H. A., et al. (2005). Organophosphate poisoning in pregnancy: A case report. *Basic and Clinical Pharmacology and Toxicology, 96*(5), 397–398.
14. Hantson, P., Lambermont, J. Y., & Mahieu, P. (1997). Methanol poisoning during late pregnancy. *Journal of Toxicology-Clinical Toxicology, 35*(2), 187–191.
15. Konje, J. C., Otolorin, E. O., Sotunmbi, P. T., et al. (1992). Insecticide poisoning in pregnancy. A case report. *Journal of Reproductive Medicine, 37*(12), 992–994.
16. Lacoste, H., Goyert, G., Goldman, L. S., et al. (1992). Acute iron intoxication in pregnancy: Case report and review of the literature. *Obstetrics and Gynecology, 80*(3 Pt 2), 500–501.
17. Boyer, J. C., Hernandez, F., Estorc, J., et al. (2001). Management of maternal Amanita phalloides poisoning during the first trimester of pregnancy: A case report and review of the literature. *Clinical Chemistry, 47*(5), 971–974.
18. Zurawski, J. M., & Kelly, E. A. (1997). Pregnancy outcome after maternal poisoning with brodifacoum, a long-acting warfarin-like rodenticide. *Obstetrics and Gynecology, 90*(4 Pt 2), 672–674.
19. Tran, T., Wax, J. R., Steinfeld, J. D., et al. (1998). Acute intentional iron overdose in pregnancy. *Obstetrics and Gynecology, 92*(4 Pt 2), 678–680.
20. Hansen, L. M., Megerian, G., & Donnenfeld, A. E. (1997). Haloperidol overdose during pregnancy. *Obstetrics and Gynecology, 90*(4 Pt 2), 659–661.
21. Olenmark, M., Biber, B., Dottori, O., et al. (1987). Fatal iron intoxication in late pregnancy. *Journal of Toxicology-Clinical Toxicology, 25*(4), 347–359.
22. Mazurek, A., & Mazurek, J. (1975). Acute barbiturate poisoning in the 39th week of pregnancy. Case report. *Anaesthesia, Resuscitation, & Intensive Therapy, 3*(2), 193–196.
23. Hoffman, R. S. (2000). Thallium poisoning during pregnancy: A case report and comprehensive literature review. *Journal of Toxicology-Clinical Toxicology, 38*(7), 767–775.
24. Wang, P. H., Yang, M. J., Lee, W. L., et al. (1997). Acetaminophen poisoning in late pregnancy. A case report. *Journal of Reproductive Medicine, 42*(6), 367–371.
25. McElhatton, P. R., Sullivan, F. M., & Volans, G. N. (1997). Paracetamol overdose in pregnancy. Analysis of the outcome of 300 cases referred to the teratology information service. *Reproductive Toxicology, 11*, 85–94.
26. Gidai, J., Acs, N., Banhidy, F., et al. (2008). A study of the effects of large doses of medazepam used for self-poisoning in 10 pregnant women on fetal development. *Toxicology and Industrial Health, 24*, 61–68.
27. Gidai, J., Acs, N., Banhidy, F., et al. (2008). A study of the teratogenic and fetotoxic effects of large doses of chlordiazepoxide used for self-poisoning by 35 pregnant women. *Toxicology and Industrial Health, 24*, 41–51.
28. Czeizel, A. E., Timar, L., & Susanszky, E. (1999). Timing of suicide attempts by self-poisoning during pregnancy and pregnancy outcomes. *Int J Gynaecol Obstet, 65*, 39–45.
29. Sein Anand, J., Chodorowski, Z., Ciechanowicz, R., et al. (2005). Acute suicidal self-poisonings during pregnancy. *Przeglad Lekarski, 62*(6), 434–435.
30. Czeizel, A. E., Tomcsik, M., & Timar, L. (1997). Teratologic evaluation of 178 infants born to mothers who attempted suicide by drugs during pregnancy. *Obstetrics and Gynecology, 90*(2), 195–201.
31. Flint, C., Larsen, H., Nielsen, G. L., et al. (2002). Pregnancy outcome after suicide attempt by drug use: A Danish population-based study. *Acta Obstetricia et Gynecologica Scandinavica, 81*, 516–522.
32. Herrchen, B., Gould, J. B., & Nesbitt, T. S. (1997). Vital statistics linked birth/infant death and hospital discharge record linkage for epidemiological studies. *Computers and Biomedical Research, 30*, 290–305.
33. Greenblatt, J. F., Dannenberg, A. L., & Johnson, C. J. (1997). Incidence of hospitalized injuries among pregnant women in Maryland, 1979–1990. *American Journal of Preventive Medicine, 13*, 374–379.
34. Dannenberg, A., Carter, D., Lawson, H., et al. (1995). Homicide and other injuries as causes of maternal death in New York City, 1987 through 1991. *American Journal of Obstetrics and Gynecology, 172*, 1557–1564.
35. Rosner, B. (1994). *Fundamental of biostatistics* (4th ed.). Belmont (CA): Duxbury Press.
36. Forrester, M. B., & Stanley, S. K. (2004). Exposures and treatments among women of childbearing age and pregnant women reported to Texas poison centers. *Veterinary and Human Toxicology, 46*, 210–212.
37. Watson, W. A., Litovitz, T. L., Rodgers, G. C., et al. (2005). 2004 annual report of the American association of poison control centers toxic exposure surveillance system. *American Journal of Emergency Medicine, 23*, 589–666.
38. Rayburn, W., Aronow, R., DeLancey, B., et al. (1984). Drug overdose during pregnancy: An overview from a metropolitan poison control center. *Obstetrics and Gynecology, 64*, 611–614.