

# Adolescent alcohol use and injury

A summary and critical review of the literature

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H. A. SINDELAR, N. P. BARNETT, A. SPIRITO

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**Background.** Survey research indicates that alcohol use and misuse by adolescents is prevalent worldwide and has been associated with multiple negative health, social, and economic consequences. Physical injury is one of the negative consequences of alcohol use that appears to be on the rise among adolescents.

**Methods.** A retrospective review was conducted of published data currently available regarding alcohol use and injury among adolescents. Studies were reviewed if 1) the sample included adolescents between the ages of 13 and 19 years, 2) the study site was a medical setting, and 3) data were collected regarding alcohol ingestion.

**Results.** Data indicate that rates of adolescent alcohol use range from 5% among general emergency department (ED) admissions to nearly 50% among trauma admissions. Alcohol-positive adolescents are more likely than alcohol-negative adolescents to be injured, have a prior history of injury, require trauma service care, and have injury complications. One-third to one-half of alcohol-positive adolescents are referred for or receive intervention related to their alcohol use.

**Conclusions.** Alcohol use by adolescents is associated with increases in severity of injury and cost of medical treatment. Screening of adolescent trauma unit admissions for alcohol use might be justified based on the literature. Optimal methods of screening, identification, and brief intervention for alcohol abusing ad-

*Center for Alcohol and Addiction Studies,  
Brown University,  
Providence, Rhode Island, USA*

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olescents within the medical setting are discussed.

Key words: **Adolescence - Alcohol drinking - Alcoholism, complications - Alcohol related disorders.**

Adolescents worldwide appear to be using alcohol at high rates, despite being below the legal drinking age in their country. Results of the 1996 Child Health Survey, conducted by the World Health Organization (WHO), indicate that across 25 countries including the United States, more than 75% of youth surveyed (ages 11 and up) had experimented with alcohol, and 13% reported drinking weekly, with rates as high as 20% in Wales, Northern Ireland and France, and as low as 5% in Greenland and Norway.<sup>1</sup> Similarly, a large-scale survey in Madrid, Spain indicates that 85% of 14-20 year-old high school and technical school students have tried alcohol.<sup>2</sup> Data from the 2001 Monitoring the Future (MTF) survey, which assesses the prevalence of substance use among American youth, indicate that by 12<sup>th</sup> grade, 80% of adolescents in the United States have used alcohol.<sup>3</sup> The Youth Risk Behavior Surveillance Survey

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Address reprint requests to: H. A. Sindelar, Center for Alcohol and Addiction Studies, Box G-BH, Brown University, Providence, Rhode Island 02912, USA.  
E-mail: Holly\_Sindelar@brown.edu

(YRBS), conducted by US Centers for Disease Control, reports similar prevalence rates of alcohol use.<sup>4</sup> With regard to problematic alcohol use, the MTF survey results indicate that over 30% of 12<sup>th</sup> graders in the US reported having had a binge-drinking episode (*i.e.*, 5+drinks in a row) in the past month, while more than half have been drunk (62%).<sup>3</sup> According to the YRBS Survey, 31.5% of all high school students reported binge-drinking within the past month.<sup>4</sup> In the Spanish survey, 24% of 14-20 year olds reported consuming alcohol "regularly" or "everyday".<sup>2</sup> Likewise, an epidemiological review of data by the National Health and Medical Research Council of Australia indicates that 60% of Australian males aged 14-24 years consume alcohol at least weekly, while binge-drinking is practiced by 40% of 16-17 year olds.<sup>5</sup> Within the past decade, adolescents appear to have become more approving of substance experimentation and perceive fewer harmful effects of such behaviors, at least in the U.S.<sup>3</sup> With respect to self-recognition of risk, 94% of a sample of U.S. high school seniors who were regular alcohol users indicated that there was either no chance (71%) or only a mild chance (23%) of ever becoming an alcoholic.<sup>6</sup> Thus, adolescent alcohol use and abuse remains a salient public health issue, while self-recognition of potential harm and risk may be declining.

Although cultural and national differences may exist with regard to the acceptance of alcohol use by adolescents, the potential for harm that may result secondary to alcohol use is of universal concern. Alcohol misuse has been associated with multiple negative social and economic consequences worldwide, including progression to illicit drug use, motor vehicle crashes (MVC), high-risk sexual behavior, violence, crime, work or school absenteeism and impaired performance, and injury.<sup>1, 5, 7, 9</sup> While much is known about the consequences of alcohol misuse among adults, much less is known with regard to adolescents. Few studies have been conducted that assess the prevalence of alcohol use among adolescents seeking medical treatment, and there is little information regarding medical injury and treatment associated with

alcohol use among adolescents. The present review is an attempt to compile and summarize the data currently available regarding alcohol use and injury among adolescents.

Published research studies investigating the role of alcohol in adolescent hospital admissions were reviewed. Studies were identified *via* database searches (*i.e.*, PubMed and PsycInfo databases) for research articles or abstracts published in English using the key words "alcohol", "adolescent" and "injury". Additional studies were identified by checking the references of articles obtained in the initial database search. Studies were included if: the sample included adolescents, in part or whole, between the ages of 13 and 19 years; the study site was in a medical setting; data collection included some measure of alcohol ingestion. Due to the small number of published studies found, investigations using both retrospective and prospective data collection method were included to provide a comprehensive review of relevant findings.

A total of 11 retrospective studies were identified that focused on or included adolescents in the study sample. Studies were categorized as "retrospective" if the sampling method was archival, with available medical records reviewed for relevant data. Nine prospective studies were identified, and 2 of these included a matched case control group for comparison (See *Appendix* for a summary of the individual studies). A study was categorized as "prospective" if active consent was obtained from the adolescents and their families in order to collect data from the adolescents or request formal alcohol testing. In conducting research, it is preferable to collect data prospectively in order to sample the population randomly by design and to maintain statistical control over information collected. It is worth noting, however, that in many of the prospective studies reviewed here, significant sample selection bias is present. For example, convenience sampling methods were often used as opposed to probability or random sampling. In contrast, however, many of the retrospective medical record review studies analyzed all records of patients in the age range specified. In some

cases, therefore, retrospective studies may yield more representative information regarding true rates of alcohol misuse among adolescent patients. However, retrospective reports detect only what was recorded at the time of the ED visit, and therefore are likely and underestimate of total cases. Readers should be mindful of these issues when reviewing the research summarized here and in the appendix.

### Prevalence of alcohol involvement

The degree to which alcohol is involved in adolescent medical hospital admissions varies widely by the setting from which participants are sampled. As might be expected based on the adult alcohol and injury literature, alcohol is involved with increasing frequency among adolescents as the level of intensity of treatment increases. Thus, among samples drawn from general ED admissions (*i.e.*, treatment for intoxication, illness, or injury), alcohol has been reported to be present in 4% to 6% of adolescents and young adults screened, with rates rising to 15% in some urban trauma centers.<sup>10-12</sup> One retrospective review of laboratory test results reported a 31% positive alcohol test rate among 13-19 year olds.<sup>13</sup> In this sample, however, alcohol screening was not universal; rather, testing was completed at the discretion of the treating physician. Therefore, testing was likely completed if alcohol use was suspected or reported by the patient, which is likely to inflate the incidence of positive test results. One prospective study reported positive alcohol tests among 39% of injured adolescents, although only 10% of eligible patients were recruited for the study, indicating a likely sample selection bias.<sup>14</sup> Among studies of adolescent trauma admissions (*i.e.*, indicating a more intensive degree of injury care), the prevalence of alcohol involvement is higher and more consistent across studies. Studies report alcohol to be present in 32-45% of adolescent trauma admissions.<sup>15-20</sup> For example, Loiselle *et al.* prospectively compared 13-19 year-old trauma service admissions to an age-matched control group of asthma patients

admitted to the ED.<sup>16</sup> Thirty-four percent of the adolescents admitted for trauma-related injuries tested positively for alcohol or drugs, while only 2% of control subjects tested positive for alcohol. Similarly, in a retrospective review of all 12-25 year-old trauma database admissions, Porter found that 32.5% tested positive for alcohol.<sup>18</sup>

Other studies have reported lower rates than those described above. Two retrospective reviews of the U.S. National Pediatric Trauma Registry database records indicated alcohol-positive test rates of 2% among 10-14 year olds and 15.5% among 12-17 year olds.<sup>21, 22</sup> The young age range included in these samples is likely to account for the lower rates reported. Another study reported that only 12% of adolescent trauma patients tested positive for alcohol, while 25% tested positive for alcohol or other drugs. This study is unique, however, in that participants were almost entirely African-American (93%).<sup>23</sup> This difference in racial demographics of this U.S. sample may explain the disparate findings, given that African-American adolescents in the U.S. report significantly lower rates of problematic alcohol use.<sup>3, 4</sup>

When mortality rather than morbidity data are examined, rates of alcohol use may be higher. One study retrospectively examined the public death records for one U.S. county.<sup>24</sup> This record review indicated that nearly 40% of all adolescent deaths involved alcohol to some degree, with over 1/3 of all alcohol-positive cases at the level of legal intoxication in the U.S. (BAL  $\geq$ 100 mg/dL).

### Demographic differences

While adolescents at all ages do report alcohol misuse to some degree, adolescents who test positive for alcohol are often older than adolescents who do not test positive.<sup>12-16, 18, 21, 22</sup> However, age differences do not always emerge.<sup>17, 25</sup> Rates of alcohol involvement in ED admissions do not appear to differ by sex or race of the adolescents,<sup>12, 17, 21-23</sup> although there is some evidence that males are more likely to test positive for alcohol than females.<sup>13, 15, 21, 26</sup>

### Risk and consequences of alcohol use

Medical consequences associated with adolescent alcohol use requiring treatment are higher. Alcohol-positive adolescent patients are most commonly treated for intoxication without the presence of injury, comprising up to 71% of cases.<sup>25, 27, 28</sup> However, common types and mechanisms of injury (*e.g.*, falls, assaults) are also prevalent among adolescents who use alcohol. Of note, one Australian record review indicated that male adolescents were most frequently treated for an injury (41%), while females were most frequently treated for intoxication or overdose (13% and 24%, respectively).<sup>10</sup> Across the medical settings studied, adolescents who tested positive for alcohol were more likely to be injured than alcohol-negative adolescents.<sup>12, 18</sup> There were typically no differences between alcohol-positive and alcohol-negative adolescents in the type and mechanism of injury,<sup>14</sup> although one study of 10-14 year olds found those who tested positive for alcohol or other drugs to be injured *via* assault or a self-inflicted wound.<sup>21</sup> Alcohol-positive adolescents also were more likely to be injured *via* assault or a self-inflicted wound.<sup>21</sup> Alcohol-positive adolescents also were more likely than alcohol-negative adolescents to report a history of prior injury.<sup>17, 25, 28</sup> In one study of 10-20 year olds, for example, about half of those testing positive for alcohol reported a prior history of injury, as compared to only 8% of alcohol-negative patients.<sup>25</sup>

Adolescents who use alcohol appear, more specifically, to be at high risk for being involved in a motor vehicle crash (MVC).<sup>15, 22, 24, 26</sup> Overall, as many as 13-19% of adolescents in MVCs tested positive for alcohol in the studies reviewed.<sup>12, 25, 28</sup> Among those testing positive for alcohol, Spain *et al.*<sup>20</sup> found that 21% of 15-20 year olds were involved in a MVC, while Rivara *et al.*<sup>19</sup> found that 44% of 18-20-year-old trauma admissions were being treated for injuries secondary to a MVC. In the Spain *et al.* study, 65% of those adolescents injured in a MVC were the intoxicated driver in the accident.<sup>20</sup>

Alcohol-positive adolescents also appear to be at high risk for experiencing serious injury requiring trauma admission.<sup>11, 21, 22, 25</sup> Bates

*et al.*, for example, found that 20% of alcohol-positive patients aged 10-20 years were admitted for a traumatic injury, as compared to only 8% of alcohol-negative patients in the same age range.<sup>25</sup> Data on specific measures of injury severity (*e.g.*, Injury Severity Score, Glasgow Coma Scale, Trauma Score) are mixed. That is, in some studies, the presence or degree of alcohol involvement was related to increased injury severity,<sup>11, 15, 26</sup> while in other studies, there was no relationship between presence of alcohol and objective measures of injury severity.<sup>16-18, 23</sup> There is additional evidence that injury complications that can interfere with treatment, such as altered mental status, are associated with significantly higher alcohol levels.<sup>25</sup>

### Screening and treatment referral

All studies were reviewed to identify the rate of alcohol screening across medical settings. Overall, alcohol and/or toxicology screening was conducted by hospital staff in 48-68% of adolescent trauma admission patients.<sup>15-18, 20, 23</sup> The rate was 60% in a setting where it was stated that no specific ED policy or triage criteria were in place regarding alcohol testing,<sup>17</sup> while the testing rate was 68% in a setting where the trauma laboratory protocol was stated to include urine toxicology screening.<sup>23</sup> Screening rates as low as 12% were reported in two retrospective reviews of the same trauma registry at different points in time.<sup>21, 22</sup> These patients were younger adolescents (ages 10-17), however, which may account for the lower level of screening.

Social services or substance abuse treatment referrals of alcohol-positive adolescents vary and do not appear to be a universal facet of clinical care. The Maio *et al.* study, for example, indicated that only 34% of adolescent trauma patients with a positive alcohol test on record were documented to have received substance use counseling or referral for such counseling during their admission.<sup>17</sup> The Mader *et al.* review found that only 59% of 12-17 year-old alcohol-positive trauma patients received any type of social services intervention referral.<sup>22</sup> Of note, Spirito *et al.* found that one-half of a sample of 13-17 year-old alcohol-positive ED admissions report-

ed a level of alcohol involvement indicative of a need for further evaluation of alcohol abuse.<sup>28</sup>

### Discussion and conclusions

This paper reviews available data regarding adolescent alcohol misuse and associated medical consequences. Drawing firm conclusions is difficult because the available studies range widely in the age of participants, frequently lack control groups, and include other sample selection biases. In addition, the sample sites differed across studies, ranging from all emergency department (ED) admissions to trauma admissions and, in one case, death records. Keeping these limitations in mind, however, the available data can provide insight into the extent of alcohol use and associated medical consequences among adolescents.

Overall, as might be expected, alcohol use appears to be involved with increasing frequency as the severity of injury and need for treatment increases. The prevalence of alcohol use among adolescent patients treated in the ED is relatively small, about 5%, but the rate increases to about one-third to one-half among adolescent trauma admissions. No other relationships were consistently found, however, between the presence of alcohol and age, sex, or race. Alcohol-positive adolescent patients seen in the hospital, overall, are more likely than alcohol-negative patients to be injured or have a history of prior injury, to be admitted to the hospital trauma unit, and to have injury complications that can affect treatment (*e.g.* altered mental status). Thus, it is clear that alcohol misuse is associated with more severe injury and more intensive and costly treatment.

With the exception of trauma admissions status, no distinct profile emerges from the available data to warrant adoption of a method of selective screening for the presence of alcohol among adolescents being treated in the hospital. Screening of all adolescent trauma admissions for the presence of alcohol could be justified based on the literature. With 1/3 to nearly half of adolescents screened

testing positive in the studies reviewed here, it is likely that an even higher percentage of adolescent trauma admissions would test positive if alcohol screening was universally conducted as part of clinical care. Future prospective, matched-control studies using random sampling techniques will serve to further clarify the extent and nature of alcohol misuse and injury among adolescents, but the present review indicates that, especially among adolescent trauma patients, screening and intervention/referral efforts with regard to alcohol misuse are clinically indicated.

Biochemical testing of adolescents in the hospital is useful. But, by relying solely on biochemical testing to identify adolescents with problematic alcohol use, many adolescents are likely to be missed who are in need of intervention but may not have been consuming alcohol at the time of their current admission. A brief screening tool is likely to be more efficient in identifying alcohol-involved adolescents who are in need of referral or treatment, regardless of current alcohol level. The Alcohol Use Disorders Identification Test (AUDIT),<sup>29</sup> for example, is a 10-item questionnaire developed from a 6-country WHO collaborative project that covers the domains of alcohol consumption, drinking behavior, and alcohol-related problems. In a recent test of brief screening measures for use with adolescents in a medical setting,<sup>30</sup> the AUDIT demonstrated the best performance at a cut-score of 4, as compared to both the CAGE<sup>31</sup> and the TWEAK.<sup>32</sup> Increased use of such brief screening measures in the ED may lead to better care for these adolescents.

Regardless of whether screening is implemented at any level in the medical setting, the review presented here indicates that alcohol use should be investigated among adolescents seeking medical treatment. Physicians are very likely to encounter adolescents in their clinical practice who have significant alcohol-related problems and are in need of intervention. Events such as treatment for alcohol intoxication or an alcohol-related injury have been conceptualized as "teachable moments",<sup>33</sup> indicating that pa-

tient motivation to consider changing their harmful behavior may be increased as a result of their experience. To this end, brief interventions (*i.e.* 20-30 min) administered in the ED have proven successful in reducing alcohol use and alcohol-related problems among both adults and adolescents seeking medical treatment.<sup>33, 34</sup>

### Riassunto

*Consumo di alcol da parte di adolescenti e ferite traumatiche: riassunto e rassegna critica della letteratura*

Indagini ad ampio raggio indicano che il consumo e l'abuso di alcol da parte degli adolescenti è presente in tutto il mondo ed è associato a molteplici conseguenze negative di tipo sanitario, sociale e economico. Le ferite traumatiche rappresentano una delle conseguenze negative del consumo di alcol che sembrano essere in aumento fra gli adolescenti.

È stata condotta un'indagine retrospettiva dei dati pubblicati e attualmente disponibili circa il consumo di alcol e le ferite traumatiche fra gli adolescenti. Sono stati inclusi gli studi rispondenti a queste caratteristiche: 1) il campione includeva adolescenti di età compresa tra i 13 e i 19 anni, 2) lo studio veniva condotto in ambiente ospedaliero, e 3) venivano raccolti i dati sul consumo di alcol.

I dati indicano che i tassi di consumo alcolico da parte degli adolescenti variano dal 5% tra le ammissioni generali al pronto soccorso fino a quasi il 50% tra le ammissioni per trauma. Gli adolescenti con anamnesi positiva per consumo di alcool presentano una probabilità maggiore di riportare ferite traumatiche rispetto agli adolescenti con anamnesi negativa, inoltre hanno dei precedenti di ferita traumatica, necessitano di un servizio di assistenza per i traumi e riportano complicanze da ferita. Da un terzo a metà degli adolescenti con anamnesi positiva per consumo di alcool vengono inviati dal medico oppure ricevono interventi terapeutici per il loro consumo di alcool.

Il consumo di alcool da parte degli adolescenti è associato a un aumento della gravità del danno traumatico e dei costi del trattamento medico. Basandosi sulla letteratura è possibile giustificare l'attuazione di uno screening delle ammissioni degli adolescenti in unità traumatica per assunzione di alcol. Vengono qui discussi i più efficaci metodi di screening, di identificazione e di rapido intervento per gli adolescenti che abusano di alcol nell'ambito delle strutture ospedaliere.

Parole chiave: Adolescenza - Alcolismo, complicanze - Traumi.

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## APPENDIX

### Summary of empirical studies reviewed

Barnett NP, Spirito A, Colby SM, Vallee JA, Woolard R, Lewander W *et al.* **Detection of alcohol use in adolescent patients in the emergency department.** *Acad Emerg Med* 1998;5:607-12.

*Sample.* Part 1: n=522; ages 13-19 (m=17.5); 67% male; 69% white, 15% black, 9% Hispanic, 1% Asian, 6% other; Part 2: n=99; ages 13-19 (m=17.6); 70% male; 76% white; 14% black; 8% Hispanic; 1% Asian; 1% other); Part 3: n=119; ages 13-17 (m=16.3); 49% male; 63% white, 16% black, 13% Hispanic, 1% Asian, 7% other.

*Site and sampling method.* One Level One trauma (e.g., entire hospital on alert, with key departments being coordinated, accessible and ready to respond 24 hours a day) urban pediatric hospital in Rhode Island, USA.

*Experimental design.* Part 1: retrospective cohort medical record review of adolescents with positive blood alcohol test results. Part 2: retrospective cohort medical record review of adolescents receiving an ICD-9 diagnosis related to alcohol. Part 3: prospective cohort

study of saliva alcohol test results among injured adolescent emergency department admissions.

*Assessment measures.* Parts 1 and 2: medical record review (age, gender, race, socioeconomic status, time and details of injury; prior psychiatric treatment, and whether patient was referred for counseling upon discharge). Part 3: saliva alcohol test.

*Results.* Part 1: of 522 blood alcohol tests conducted, 31% were positive (m=142 mg/dL). Alcohol-positive patients were significantly older than alcohol-negative patients and more likely to be male. Blood alcohol levels increased with age. Injured alcohol-positive patients were older and had lower alcohol levels than non-injured alcohol-positive patients. Part 2: during the same 1-year period as Part 1, 99 patients received an alcohol-related discharge diagnosis. Those who received a diagnosis had a higher alcohol level and were more likely to have been treated for alcohol ingestion only (i.e., had no injury) than alcohol-positive patients who did

not receive a diagnosis. Part 3: of 336 injured 13-17 year-old patients treated in the ED, 36% were approached, with 2 patients refusing to participate. Only 1 of the teens tested had a positive alcohol level.

*Summary.* The largest group of alcohol-positive patients was identified by retrospective review of laboratory test results (6.5% tested, 31% of those tested had positive results). Review of billing records over the same time period revealed a smaller sample, while a positive detection rate of only 2.5% was found among a sample of teens prospectively sampled and tested for alcohol. The authors conclude that multiple methods should be used in identifying the true rate of adolescent alcohol use and injury.

*Notes.* Selection bias may have occurred during Part 3, where prospective sampling was conducted, due to the fact that only 1/3 of all eligible patients were approached for recruitment. This may underestimate the true incidence of alcohol involvement among injured adolescents.

Bates BA, Shannon MW, Woolf AD. **Ethanol-related visits by adolescents to a pediatric emergency department.** *Pediatr Emerg Care* 1995;11:89-92.

*Sample.* N=45; ages 10-20 (m=16.1); 53% male; no race data reported. Control group N=37; ages 10-20 (m=15.6); 38% male; no race data reported.

*Site and sampling method.* One Level I trauma urban Pediatric Hospital in Massachusetts, USA. All 10-20 year-old ED patients with a toxicologic screen completed during 7 months between 1990 and 1991 were examined. The study and control groups were distinguished by whether alcohol was identified. Patients were excluded if their medical record was unavailable for review.

*Experimental design.* Retrospective cohort medical record review study.

*Assessment measures.* Medical record review (age, gender, chief complaint, type of product ingested, reason for ingestion, histo-

ry of coingestion, past medical and psychiatric history, mental status on arrival, presence and type of injury, laboratory results, and admission status).

*Results.* Among the alcohol-positive patients, ingestion was the chief admission complaint (71%), followed by trauma (20%), as compared to complaints of behavioral change (30%) and pain (13%) among the alcohol-negative patients. Within a 3-category classification of mental status, a significant difference was found in the mean alcohol concentrations between "sober" patients and "altered mental status-unarousable" patients (~100 mg/dL *versus* ~226 mg/dL). A history of having sustained prior injury was present in 51% of alcohol-positive patients *versus* 8% of control patients (p<0.001), with assault (30%) and motor-vehicle crashes (MVC) (26%) the most common injuries reported. Male and female alcohol-positive patients were more likely to have sustained a prior injury than their alcohol-negative counterparts. There were no age differences between groups with and without a history of prior injury.

*Summary.* Alcohol-positive 10-20 year-old ED patients were more likely than alcohol-negative patients to be admitted for ingestion or trauma and to have a history of having sustained prior injury.

*Notes.* The authors did not indicate the percentage of total cases that were tested for alcohol, although they reported that the decision to obtain a toxicologic screen was at the complete discretion of the attending physician.

Delaunay C, Balkau B, Papoz L. **The frequency of alcoholisation among young people injured in accidents in France.** *Alcohol Alcohol* 1991;26:391-7.

*Sample.* N=1,423; ages 15-24; 75% male; no race data reported.

*Site and sampling method.* Twenty-one EDs in France. All 15-24 year-old injured patients in 1982-1983 were eligible for enrollment if they were injured, at least 15 years old, and

gave consent to complete a blood alcohol test within 3 hours of their accident.

*Experimental design.* Prospective cohort assessment study of ED patients

*Assessment measures.* Self-report of age, sex, employment status, activity the day of the accident, mechanism of injury, injury severity (requiring hospitalization, moderate or severe vital risk); blood alcohol level, mean corpuscular volume (MCV) and activity of  $\gamma$ -glutamyltransferase (GGT).

*Results.* Overall, 20% of male and 6% of female accident victims had an alcohol level of 50 mg/dL or higher. Motor-vehicle crashes (MVC) accounted for nearly half of all injuries (42% of males, 50% of females). Among patients with alcohol levels >50 mg/dL, traffic accidents (24% of males, 5% of females) and fights (48% of males, 17% of females) were the most common mechanisms of injury. Increasing alcohol levels were associated with more severe accidents among males, with severe accidents (requiring hospitalization, with moderate or severe risk) occurring in 25% of males with an alcohol level >200 mg/dL. There was a strong linear relationship for alcohol levels to increase with increasing age for both males and females.

*Summary.* Among 15-24 year-old injured patients treated in ED's in France, 20% of males and 6% of females had alcohol levels of 50 mg/dL or higher. Motor-vehicle crashes (MVCs) and fights were the most common injury mechanism among alcohol-positive patients. Alcohol levels and chronicity of drinking increased with age.

*Notes.* Sample is large, but includes individuals up to 24 years of age, which may overestimate levels of drinking among adolescents.

Friedman IM. **Alcohol and unnatural deaths in San Francisco youths.** *Pediatrics* 1985;76:1913.

*Sample.* N=57; ages 12-24 (M=20; range 14-24); 74% male; no race data reported.

*Site and sampling methods.* Public records of deaths recorded by the Medical Examiner

of the city and county in California, USA. All death records of city/county residents aged 12-24 years were included.

*Experimental design.* Retrospective cohort medical record review study

*Assessment measures.* Medical examiner record review (age, sex, reports of pathology and toxicology studies, findings of the coroner's investigation, cause of death).

*Results.* Overall, 39% of cases had alcohol concentrations of 20 mg/dL or higher; 31% of all cases had alcohol concentrations of 100 mg/dL or higher. Fifty percent of all motor-vehicle crashes (MVC) victims and 50% of all other accident victims were intoxicated (*i.e.*, BAL  $\geq$ 100 mg/dL) at the time of their death. Twenty-five percent of suicide victims had consumed alcohol prior to the event, while 21% of homicide victims were intoxicated at the time of the lethal event. Of all deaths, 21% occurred among patients 18 years old or younger. Of all adolescent cases, 92% had consumed alcohol, while 42% of adolescent cases were intoxicated at the time of their event.

*Summary.* Among 50 reported cases of death among 12-24 year-old residents of a city/county in California, USA, 31% of all cases were considered intoxicated. MVCs accounted for 25% of cases, while alcohol was also significantly involved in other causes of unnatural death. Of those cases 18 years old or younger, almost all had consumed alcohol prior to the lethal event.

*Notes.* Small sample size that only included cases of death, which is likely unrepresentative of alcohol's involvement in non-fatal injuries.

Gordon S, Toepper WC, Blackman SC. **Toxicology screening in adolescent trauma.** *Pediatr Emerg Care* 1996;12:36-9.

*Sample.* N=125; ages 13-18 (m=15); 77% male; 93% African-American.

*Site and sampling method.* One Level I Inner-City urban combined adult and pediatric trauma suite in Illinois, USA. All 13-18 year-old consecutive admissions to the ED from 4/90 through 12/90 with a "serious trau-

matic injury" (*i.e.*, penetrating trauma to the trunk or extremities, head or neck injury with altered mental status, blunt trauma with unstable vital signs, or injuries requiring spinal immobilization) were eligible for the study.

*Experimental design.* Prospective cohort medical record review study of significant trauma patients.

*Assessment measures.* Medical record review [age, gender, race, length of hospital stay, mental status, mechanism of injury (including violent or nonviolent distinction), trauma score, injury severity score, urine toxicology screen results].

*Results.* Overall, 68% of patients received toxicology screens, with 25% of those screened testing positive for alcohol or drugs. Forty-eight percent of positive screens were for alcohol, which was 12% of all patients screened. There were no significant differences between positive and negative screen patients with regard to age, gender, race, trauma/injury severity scores, mechanism of injury, or mental status. In this sample, however, younger teens (ages 13-15 years) were more likely to have been screened than older teens (ages 16-18).

*Summary.* Among 13-18 year-old serious trauma admissions, 68% received urine toxicology screens, with 25% of screenings positive for alcohol or drugs. Half (48%) of positive screens were for alcohol (12% of all patients screened).

*Notes.* Uneven compliance with drug screening protocol led to a higher screening rate for pediatric (ages 13-15) versus adult (ages 16-18) ED admissions, which may underestimate the alcohol and drug involvement of these adolescent trauma patients. The sample was 93% African-American, which is atypical in this line of research, although rate of positive toxicology screening parallels other studies.

Hicks BA, Morris JA Jr, Bass SM, Holcomb GW III, Neblett WW. **Alcohol and the adolescent trauma population.** *J Pediatr Surg* 1990;25:944-9.

*Sample.* N=878; ages 16-20 (m=18); 74% male; no race data reported. Comparison

sample: N=748; ages >25; 83.3% male; no race data reported.

*Site and sampling method.* One Level I University hospital in Tennessee, USA. All consecutive trauma registrations of patients ages 16-20 between 1984 and 1989. All admissions from the ED with a primary diagnosis of traumatic injury are reported to the registry. Patients excluded from the registry include those injuries but released after ED treatment, or those declared dead at the scene of the accident.

*Experimental design.* Retrospective medical record review of the hospital trauma database.

*Assessment measures.* Medical record review [age, gender, accident description, transportation time, medical interventions performed, ICD-9 diagnoses, procedure codes, health insurance, charges, payments, coma score (GCS), injury severity (ISS), trauma score (RTS), and probability of survival].

*Results.* Overall, 53% of 16-20 year-old trauma admissions had a blood alcohol test completed, with positive alcohol detected in 45% of cases tested. Average blood alcohol concentration was 111.4 mg/dL, with an average hospital stay of 8.9 days. Compared to the alcohol-negative patients, the alcohol-positive patients were more often male (64% vs 83%), older (18 vs 18.5), and more likely to be injured later in the day (6 hours after noon vs 8.7 hours after noon). There were no significant differences in the injury-related variables analyzed. Compared to the adult (>25 years old) alcohol-positive patients, the adolescent alcohol-positive patients were more likely to be involved in a motor-vehicle crash (MVC) (58.7% vs 78.7%), less likely to have a penetrating injury (18.3% vs 6.3%), injured later in the day (7.6 hours after noon vs 8.7 hours after noon), and less intoxicated (165.7 mg/dL vs 111.4 mg/dL), although exceeding the legal limit to drive in the state. There were no significant differences, however, on injury-related variables (*e.g.*, ICU days, length of stay, complications).

*Summary.* Among 16-20 year-old trauma admissions, 45% of those tested were positive for alcohol. Their average blood alcohol con-

centration was above the legal limit in the U.S. at 111.4 mg/dL, and nearly 60% of their injuries were due to a MVC. They were more likely to be older, male, and injured later in the day than alcohol-negative adolescents. They were less intoxicated than adult trauma patients, but they experienced similar injury severity and injury consequences.

*Notes.* This sample included only those with traumatic injuries requiring admissions, with average length of stay nearly 9 days. In addition, only half of the trauma cases were screened for alcohol, indicating that selection bias is likely to have occurred.

Hulse GK, Robertson SI, Tait RJ. **Adolescent emergency department presentations with alcohol- or other drug-related problems in Perth, Western Australia.** *Addiction* 2001;96:1059-67

*Sample.* N=160; ages 12-19 (M=17); 61% male; 12% Aboriginal Australians.

*Site and sampling methods.* Three teaching hospitals and 1 children's hospital in Perth, Western Australia. Sample included all alcohol or other drug-positive 12-19 year-old patients presenting to the ED.

*Experimental design.* Retrospective cohort medical record review study.

*Assessment measures.* Medical record review (no details provided of information obtained).

*Results.* Alcohol/drug use was reported or identified in 15% of 1064 possible cases; alcohol alone was reported in 6% of cases. Alcohol was the most frequently identified drug, either alone (41%) or in combination with other drugs (11%). The most frequent cause for admission was injuries (31%), followed by overdose/intoxication (29%). Of those injured, 58% were by assault, 8% were by vehicle accident, 6% were by falls, 10% were by lacerations, and 18% were classified as "other".

*Summary.* Alcohol or drugs were present in 15% of 12-19-year-old ED admissions in Western Australia, while alcohol alone was

present in 6% of admissions. Alcohol was the drug cited most frequently (41%), and injuries (31%) and overdose (29%) were the most common causes of admission.

*Notes.* Rates of alcohol use parallel those found in U.S. samples. The presence of alcohol or drug involvement was determined by clinical assessment, not necessarily including biochemical assay.

Li G, Chanmugam A, Rothman R, DiScala C, Paidas CN, Kelen GD. **Alcohol and other psychoactive drugs in trauma patients aged 10-14 years.** *Inj Prev* 1999;5:94-7.

*Sample.* N=1,356; ages 10-14 (63% ages 10-13; 37% age 14); 69% male; no race data reported.

*Site and sampling method.* National Pediatric Trauma Registry (NPTR) comprising 85 hospitals across the U.S. Sample included all patients ages 10-14 reported to the registry from 1990-1995 with a blood alcohol test completed.

*Experimental design.* Retrospective medical record review of regional trauma database.

*Assessment measures.* Trauma registry record review (demographics, injury circumstances, pre-hospital and post-hospital trauma management, functional status at discharge, blood alcohol level, if tested).

*Results.* Within the entire database sample of 10-14 year olds, 12% were tested for the presence of alcohol, with 2% of those screened testing positive for alcohol. Blood alcohol levels ranged from 7-230 mg/dL (m=138 mg/dL), and there was no difference in alcohol level between males and females. The total number of positive tests rose to 9% when other drugs of abuse were included. The most common other drug detected was marijuana, with 2.4% of the patients screened testing positive. Among adolescents testing positive for alcohol or other drugs (AOD), 40% were injured in an MVC, 27% were involved in an assault, 25% were injured in some other way, and 8% had self-inflicted injuries. Those who were

AOD positive were more likely than AOD negative patients to be older, male, have a pre-existing mental disorder, and to have a self-inflicted or assault injury.

*Summary.* Among 10-14 year-old trauma registrants, 12% had toxicology screenings completed. Of those tested, 2% were positive for alcohol, and 2.4% were positive for marijuana. AOD positive patients were more likely than AOD negative patients to be older, male, have a pre-existing mental disorder, and to have a self-inflicted or assault injury.

*Notes.* This sample is much younger than other adolescent samples studied, which may account for the much lower positive test rate.

Loiselle JM, Baker MD, Templeton JM Jr, Schwartz G, Drott H. **Substance abuse in adolescent trauma.** *Ann Emerg Med* 1993;22:1530-4.

*Sample.* N=134; ages 13-19 (m=15); 81% male; no race data reported. Control subjects: N=49; ages 13-19 (M=15); 47% male; no race data reported.

*Site and sampling method.* One Level I Urban Pediatric trauma center in Pennsylvania, USA. All patients 13-19 years of age fully evaluated in the ED and treated in the trauma service over a 20-month period were enrolled in the study. Control population included patients with asthma requiring venipuncture as part of routine medical management enrolled through the ED.

*Experimental design.* Prospective, age-matched controlled cohort study of significant trauma patients.

*Assessment measures.* Medical record review (blood and urine toxicology screen results, age, sex, Glasgow Coma Scale (GCS) score, Trauma Score, mechanism of injury, length of hospital stay, and need for operative intervention).

*Results.* Toxicology screens completed on 65 patients (49%), with 22 (34%) testing positive for alcohol or drugs. Twelve percent of screens were positive for alcohol, and 11% of screens

were positive for >1 substance. The number of positive toxicology screens was significantly higher among trauma patients than among controls (34% versus 2%); this finding remained significant when all unscreened trauma patients were included as having a negative test finding. Patients with intentional injuries (e.g., gunshot wounds, stab wounds, assaults) were significantly more likely than patients with unintentional injuries (e.g., fall, motor-vehicle crash) to be older (m=15.1 years versus 14.5 years) and to have a positive toxicology screen (50% versus 4%).

*Summary.* Over 1/3 of 13-19 year-old trauma admissions tested positive for alcohol or other drugs. Patients with intentional injuries were significantly more likely than patients with unintentional injuries to have a positive toxicology screen.

*Notes.* There were significantly more males in the trauma group (81%) than in the control group (47%), which may have inflated the difference in number of positive screens between the groups. The sample only included patients admitted from the ED to the trauma service. In addition, only half of the sample had toxicologic screens conducted, which indicates potential selection bias.

Mader TJ, Smithline HA, Nyquist S, Letourneau P. **Social services referral of adolescent trauma patients admitted following alcohol-related injury.** *J Subst Abuse Treat* 2001;21:167-72.

*Sample.* N=751; ages 12-17 (m=15.5); no sex or race data reported.

*Site and sampling method.* National Pediatric Trauma Registry (NPTR) comprising 85 hospitals across the US. Sample included all patients ages 12-17 reported to the registry from 1994-1998 with a blood alcohol test completed.

*Experimental design.* Retrospective medical record review of regional trauma database.

*Assessment measures.* Medical record review (demographics; pre-existing conditions;

mechanism and severity of injury; lab results, referrals, diagnosis and outcome).

*Results.* Within the entire database sample of 12-17 year olds, 12.5% were tested for the presence of alcohol, with 15.5% of those screened testing positive. Those adolescents testing positive for alcohol were more likely than alcohol-negative patients to be older, to have been involved in an MVC, and to have a history of prior substance abuse. A total of 59% of these alcohol-positive trauma admissions had record of receiving referral for a social services intervention during their hospital stay. Those who referred for social services intervention were more likely than those who were not referred to be younger, to be a racial minority, to be more severely injured, have a worse functional outcome, to have a higher alcohol level, and to have a history of prior substance abuse. The only significant predictor of social services referral was whether the patient was the driver in a MVC.

*Summary.* The frequency of alcohol screening among adolescent significant trauma patients was low (12.5%). Almost half (41%) of those testing positive were not referred for any social services intervention. Those referred were more likely to be younger, racial minority adolescents with worse injuries, higher alcohol levels, and a positive history of substance abuse. Being a driver in a MVC was the only predictor of whether adolescents were referred for intervention.

*Notes.* No details about the specific nature of the social service referrals was known. Nearly half (46%) of alcohol-negative adolescents were also referred, indicating other factors contributed to whether adolescents were referred.

Maoi RF, Portnoy J, Blow FC, Hill EM. **Injury type, injury severity, and repeat occurrence of alcohol-related trauma in adolescents.** *Alcohol Clin Exp Res* 1994;18:261-4.

*Sample.* N=176 of 300 eligible medical records identified. Case exclusion criteria in-

cluded: injury occurred >8 hours before admission (n=87), recent surgery re-admissions (n=40), medical record could not be found (n=7).

*Site and sampling method.* University medical center in Michigan, USA. Sample included all trauma admissions (presence of ICD-9 trauma code) between 13 and 18 years of age from 1/89-12/90.

*Experimental design.* Retrospective cohort medical record review study of significant trauma patients.

*Assessment measures.* Medical record review, including serum alcohol concentration (SAC) documentation, gender, age, mechanism of injury (motor vehicle crash or not), presence of psychiatric history, and prior (past 5 years) or subsequent (1 year after admission) injury, length of stay, cost of care, survival, and Injury Severity Score (ISS) derived from the Abbreviated Injury Scale (AIS).

*Results.* One hundred and six of 176 cases had an alcohol test performed. Patients with no alcohol test performed were younger, had lower injury severity and mortality, and were less likely to have injuries from a motor vehicle crash (MVC). Thirty-six percent of alcohol tests performed were positive, almost 20% of the alcohol-positive patients were 13-15 years old. Alcohol-positive patients were more likely than alcohol negative patients to have a positive psychiatric history (24% versus 2%), with the majority reflecting substance abuse problems. There was a non-significant trend for alcohol-positive patients to have a prior or subsequent trauma admission (21% versus 11%). Alcohol-negative patients were more likely to have a severe injury (24% versus 8%) and higher mortality (15% versus 3%). Thirty-five percent of alcohol-positive patients received or were referred for substance abuse counseling during their admission.

*Summary.* Of the alcohol tests performed on 13-18 year-old trauma admissions, 36% were positive. Alcohol-positive patients were more likely to have a positive psychiatric history and to have had a prior trauma admission. Only about a third of alcohol-positive

patients received or were referred for substance abuse counseling.

*Notes.* Only ED patients who were subsequently admitted to trauma service were included in this analysis. Retrospective chart review provided limited data. Small sample size may have limited power to detect true group differences.

Maio RF, Shope JT, Blow FC, Copeland LA, Gregor MA, Brockmann LM *et al.* **Adolescent injury in the emergency department: opportunity for alcohol interventions?** *Ann Emerg Med* 2000;35:252-7.

*Sample.* N=263 (92% of eligible patients identified); ages 12-20 (m=17, SD=2.6); 58% male; no race data reported.

*Site and sampling method.* Two ED sites in Michigan, USA. Level I trauma university hospital and Level II trauma urban teaching hospital. All non self-inflicted injury ED admissions between ages 12 and 20 years were approached for recruitment during hours of high-volume admission (*i.e.*, evening and weekends); 84% of those recruited consented to participate.

*Experimental design.* Prospective cohort assessment study of ED patients.

*Assessment measures.* Medical record review (age, sex, time of injury, ED disposition, and E-code); Injury Severity Score (ISS); saliva alcohol test (QED); self-administered questionnaire of current and past alcohol use/misuse to determine alcohol frequency/quantity index (AFQ), index of alcohol misuse (negative consequences, trouble with peers and adults), other alcohol-related problem behaviors, and the CAGE questionnaire.

*Results.* Average time since injury was 1.3 hours, with an average mean ISS of 2.12 (12.5% hospital admission rate). Positive saliva-alcohol rate was 4% (range 10 mg/dL to 215 mg/dL). Nearly 30% reported drinking in the past week, and 36% reported binge-drinking. Fifteen percent reported drinking and driving, and 41% reported riding with a

drinking driver. Alcohol use/misuse was present at all ages and increased with age.

Comparisons revealed higher values on 7 of 11 measures among the more seriously injured respondents, including saliva-alcohol level. Those with motor vehicle crash (MVC) injuries had lower saliva-alcohol levels than non-MVC injured respondents (3.1 *versus* 6.2) but scored higher on 8 of the 10 other self-report measures of alcohol use/misuse and problem behaviors.

*Summary.* Of all 12-20 year-old ED study participants, 4% tested positive for alcohol. One-third reported current drinking. Higher alcohol levels were found in more seriously injured patients, and MVC injured patients reported higher alcohol misuse and problem behaviors than non-MVC injured patients.

*Notes.* Alcohol use rates paralleled rates reported from a school-based survey conducted in the region. Only descriptive statistics were employed in this study, so statistical significance of reported group differences cannot be determined.

Mannenbach MS, Hargarten SW, Phelan MB. **Alcohol use among injured patients aged 12 to 18 years.** *Acad Emerg Med* 1997;4:40-4.

*Sample.* N=231 (10% of eligible population); ages 12-18 (no sample mean age reported); no sex or race data reported.

*Site and sampling method.* One Urban pediatric trauma center in Minnesota, USA. Convenience sample of 12-18 year-old injured ED admissions over 8 months in 1993. Patients were excluded if their injury occurred >6 hours before their admission, if they reported use of antihistamine or cold medication on the day of their injury, or if their medical record was incomplete.

*Experimental design.* Prospective cohort descriptive study of injured ED patients.

*Assessment measures.* Medical record review (type, mechanism, location, and time of injury); urine alcohol test.

*Results.* Thirty-nine percent of patients tested positive for alcohol. Alcohol-positive patients were significantly older than alcohol-negative patients ( $m=16.0$  vs  $15.3$  years) and were more likely to report tobacco cigarette use. Rate of alcohol involvement was present at all ages and increased with age ( $>10\%$  among 12 year-olds up to  $>50\%$  among 18 year-olds). Alcohol was present in 33% of motor-vehicle collision (MVC) victims, 38% of MVC drivers, 44% of assault victims, and 37% of suicide attempters. There were no differences on injury-related variables between alcohol-positive and alcohol-negative patients.

*Summary.* Among 12-18 year-old injured ED patients, nearly 40% tested positive for alcohol, and rate of alcohol involvement increased steadily with age. There were no differences between alcohol-positive and alcohol-negative patients on injury-related variables.

*Notes.* Convenience sample that included any injured ED patient, and included only 10% of eligible patient population, indicating possible selection bias.

Meropol SB, Moscati RM, Lillis KA, Ballow S, Janicke DM. **Alcohol-related injuries among adolescents in the emergency department.** *Ann Emerg Med* 1995;26:180-6.

*Sample.*  $N=295$ ; ages 10-21 ( $m=16$ ,  $SD=3.2$ ) (95% of sample under U.S. legal drinking age of 21); 63% male; 74% white, 19% black, 3% Hispanic, 1% Asian, 3% other.

*Site and sampling method.* Four hospital ED's in upstate New York, USA: an Urban Level I trauma Center, an Urban Level I children's trauma center, a suburban hospital, and a rural hospital. Injured patients were consecutively sampled over a 14-day period from 7/93-8/93 and again from 11/93-1/94. Participants were excluded if their injury occurred  $>24$  hours before the ED visit or if injuries were related to alleged sexual abuse. Of the 321 eligible patients approached for recruitment, 92% were enrolled.

*Experimental design.* Prospective cohort descriptive study of ED patients.

*Assessment measures.* Documentation of demographic information, injury information and medications used in preceding 24 hours; saliva alcohol test (QED); serum or breath alcohol test information, if available.

*Results.* Five percent of the sample tested positive for alcohol, with saliva ethanol concentrations ranging from 10 to 135 mg/dL. The highest percentage of positive alcohol test was at the urban trauma center, where 15% of the total sample and 22% of participants ages 17-21 years tested positive. Of those who tested positive for alcohol, 73% had not been tested by their ED physician. Seventeen-21 year-old participants were 14 times more likely than 10-16 year-old participants to test positive. Participants from the suburban ED were also 3 times more likely than participants from the other sites to test positive. Most common mechanisms of injury were: athletics-related (23%), falls (19%), assaults (11%), injuries caused by sharp objects (11%), and motor-vehicle crashes (MVC) (9%). Alcohol positive tests were identified in 18% of assaults, 14% of MVCs, 33% of suicide attempts, 4% of falls, and 3% of sharp object injuries.

*Summary.* Only 5% of 10-21 year-old ED admissions tested positive for alcohol, but almost 1/4 of 17-21 year-olds at the urban trauma center had been drinking at the time of their injury (22%). Alcohol was involved in nearly 20% of assaults and 14% of MVCs among all participants. The majority of alcohol positive admissions (73%) had not been tested for alcohol by their ED physician.

*Notes.* This was a multi-site study with a diverse population. Suicide attempters were included in analyses, which may have increased the degree of alcohol involvement in ED admissions.

Porter S. **Alcohol and injury in adolescents.** *Pediatr Emerg Care* 2000;16:316-20.

*Sample.*  $N=4,309$ ; ages 12-25 (33% ages 12-17; 28% ages 18-20; 39% ages 21-25); no sex or race data reported.

*Site and sampling method.* All trauma centers in Pennsylvania, USA. All patient ages 12-25 treated at a trauma center in 1996 who were reported to the state trauma registry. Criteria for reporting included: death, initial admission to intensive care unit, admission to an inpatient unit for 3 or more days, or transfer to a trauma or trauma-specialty center.

*Experimental design.* Retrospective medical record review of state database of significant trauma patients.

*Assessment measures.* Medical record review (age, mechanism of injury (E-Code), blood alcohol concentration (BAC), Injury Severity Score, survival).

*Results.* Overall, 63% of patients were tested for alcohol (50% of 12-17 year olds; 70% of 18-20 year olds; 69% of 21-25 year olds). Thirty-two percent of patients tested were positive for alcohol, with 64% at BAC of 100 mg/dL or higher. Among 12-17 year olds, 13% of those tested were positive for alcohol, with 35% at BAC of 100 mg/dL or higher. Among 18-20 year olds, 29% tested positive for alcohol, with 63% at BAC of 100 mg/dL or higher. Among 21-25 year olds, 47% tested positive for alcohol, with 70% at BAC of 100 mg/dL or higher. Percentage of alcohol-positive patients among motor-vehicle crash (MVC) drivers at the three age groups was 17%, 33% and 55%, respectively. Percentage of alcohol-positive patients among all who were injured in a fall at the three age groups was 18%, 47% and 37%, respectively. Percentage of alcohol-positive patients among all assault victims at the three age groups was 13%, 26% and 43%, respectively. Overall, positive BAC was associated with lower injury severity score. There was no significant difference in mortality rate between alcohol-positive and alcohol-negative patients.

*Summary.* Of all 12-25 year-old trauma patients tested, 32% were positive for alcohol (21% of total sample), with 64% at BAC of 100 mg/dL or more. Percentage of alcohol-positive patients increased with age. Alcohol was involved in 17-55% of MVCs, 18-37% of falls, and 13-43% of assaults. Positive BAC was associated with lower injury severity.

*Notes.* Sample included only significant trauma admissions (ICU or length of stay >3 days), which may overestimate alcohol involvement of ED admissions overall.

Reichler BD, Clement JL, Dunner DL. **Chart review of alcohol problems in adolescent psychiatric patients in an emergency room.** J Clin Psychiatry 1983;44:338-9.

*Sample.* N=76 (17% of total sample); ages 13-19 (m=16); 49% male; males 92% white, females 59% white.

*Site and sampling method.* One emergency trauma center, Washington, USA. All medical records of 13-19 year-old psychiatric evaluation admissions in 1980-1981 were reviewed. All patients with an alcohol level >100 mg/dL were eligible for the study.

*Experimental design.* Retrospective cohort medical record review study.

*Assessment measures.* Medical record review (age, sex, ethnic background, history of psychiatric disturbance, data on family history, when available).

*Results.* Sixteen percent of the male and 17% of the female alcohol-positive patients examined met criteria for this study (alcohol level >100 mg/dL). Average alcohol levels were 227 mg/dL for males and 216 mg/dL for females, with 14% of males and 18% of females with alcohol levels >300 mg/dL. Eight percent of alcohol-positive males were non-white, as compared to 41% of females. Twenty-four percent of alcohol-positive males and 33% of alcohol-positive females were recorded to have an alcoholic parent.

Overall, 46% of male patients and 54% of female patients had at least one psychiatric diagnosis, with the majority for depression (35% of males and 46% of females). Thirty percent of males and 41% of females were suicidal. Conduct disorder was seen in 30% of males and 18% of females. The mean age of onset of drinking (recorded for 28% of the sample) was 13 years, with no significant difference between the sexes.

*Summary.* Among 13-19 year-old psychiatric evaluation admissions, 16% of males and 17% of females had alcohol levels >100 mg/dL. Of these, females were more likely than males to be non-white (41% vs 8%). Approximately half of males and females had at least one psychiatric diagnosis. One-quarter of males and one-third of females had a positive family history of alcohol abuse.

*Notes.* Psychiatric admission sample with significant alcohol involvement at admission and frequent family history of alcohol abuse. Generalization to other populations is cautioned.

Rivara FP, Gurney JG, Ries RK, Seguin DA, Copass MK, Jurkovich GJ. **A descriptive study of trauma, alcohol, and alcoholism in young adults.** *J Adolesc Health* 1992;13:663-7.

*Sample.* N=319 (of 392 eligible); ages 18-20 (33% age 18; 32% age 19; 35% age 20); 78% male; 71% white (non-Hispanic).

*Site and sampling method.* One Level I Urban trauma center in Washington, USA. All 18-20 year-old patients with blunt or penetrating trauma admitted within 24 hours of their injury (between 1989-1991) were eligible to participate. Patients were enrolled if they were willing to consent to a blood alcohol test in addition to routine admission blood tests.

*Experimental design.* Prospective cohort assessment study of ED patients.

*Assessment measures.* Medical record review (age, gender, race, insurance, employment status, blood alcohol level, injury severity score); short form the Michigan Alcohol Screening Test (SMAST).

*Results.* Forty-two percent of enrolled participants had a positive blood alcohol level, and 23% had a blood alcohol level of  $\geq 100$  mg/dL. Forty-four percent of motor-vehicle crash (MVC) injured patients were alcohol positive. Overall, patients with unintentional injuries were less likely to have a positive blood alcohol level (36%) than those with injuries resulting from assaults (51%) or self-

inflicted injuries (50%). A SMAST score of 3+ (29% of participants), which is indicative of an alcohol problem, was associated with having a positive blood alcohol level (66% versus 30% and 34% among those with lower SMAST scores).

*Summary.* Among 18-20 year-old serious injury ED admissions, 42% had a positive blood alcohol level (23%  $\geq 100$  mg/dL). Twenty-nine percent of participants screened positive for alcohol problems. Patients with the highest alcoholism screening score were more likely to have a positive blood alcohol level than those with a borderline or low score.

*Notes.* Sample participants were older adolescents and young adults, which may lead to a bias toward heavier drinking patterns. Patients who refused to participate (18% of those eligible) were less severely injured than those who enrolled.

Spain DA, Boaz PW, Davidson DJ, Miller FB, Carrillo EH, Richardson JD. **Risk-taking behaviors among adolescent trauma patients.** *J Trauma* 1997;43:423-6.

*Sample.* N=648; ages 13-20. Overall sample of adult and adolescent admissions; 66% male; no race data reported.

*Site and sampling method.* One Level I University trauma center in Kentucky, USA. All records of trauma admissions reported to the hospital's trauma registry from 1993-1996 were reviewed.

*Experimental design.* Retrospective medical record review of hospital trauma admission database.

*Assessment measures.* Medical record review (age, mechanism of injury, alcohol level, toxicology results, seatbelt use, helmet use, Injury Severity Score, Glasgow Coma Score, outcome).

*Results.* Fifty-seven percent of adolescents were tested for alcohol, with 37% of those tested with positive results. Alcohol was involved in all mechanisms of injury: 44% of falls, 25%

of violence-related injuries, 21% of motor-vehicle crashes (MVCs), 9% of pedestrian accidents, 8% of thermal/electrical injuries, and 8% of motorcycle/moped crashes. Among patients injured in a MVC, 65% were the intoxicated driver, while only 7% were wearing seatbelts (a state law in the region). Drug screens were positive in 9% of adolescents, with cannabinoids the most common drug detected. Fifty percent of alcohol-positive adolescents injured in a motorcycle accident were wearing helmets. Overall, unhelmeted motorcycle crash patients had more severe head injuries, higher injury severity, and higher mortality.

*Summary.* Of 13-20 year-old trauma admissions, 57% were tested for alcohol, with 37% testing positive. Alcohol was involved in all mechanisms of injury and was associated with high levels of risk-taking behavior (e.g., seatbelt use, motorcycle helmet use).

*Notes.* Large sample, but records were reviewed retrospectively and limited to trauma admissions, which may overestimate substance use in the general ED population. Also, there was no comparison made of risk-taking behavior among alcohol-negative adolescents, making it difficult to conclude whether alcohol increased risky behavior patterns.

Spirito A, Barnett NP, Lewander W, Colby SM, Rohsenow DJ, Eaton CA *et al.* **Risks associated with alcohol-positive status among adolescents in the emergency department: a matched case-control study.** *J Pediatr* 2001;139:694-9.

*Sample.* N=150 (68% of eligible patients); ages 13-17 (m=16); 65% male; 71% white, 19% Hispanic, 7% African-American, 2% Asian/Pacific Islander, <1% American Indian, <1% unknown. Control cases N=150 (of 400 total control sample), matched by age, sex and race. Alcohol-negative patients had higher school grades than alcohol-positive patients.

*Site and sampling method.* One Level I Urban trauma center in Rhode Island, USA. Adolescents 13-17 years old treated for an injury in the pediatric or adult ED were re-

cruited for participation. Patients were excluded if they were suicidal, in police custody, not-oriented, non-English speaking, in severe pain, or had sustained severe trauma.

*Experimental design.* Prospective matched case-control cohort study.

*Assessment measures.* Medical record review (blood alcohol level); Adolescent Drinking Questionnaire; Adolescent Drinking Index; Adolescent Injury Checklist; Young Adult Drinking and Driving Questionnaire; Center for Epidemiological Studies - Depression Scale; Reckless Behavior Questionnaire; self-report of cigarette smoking status; parent report of perceptions and rules of drinking; parent self-report on Short Michigan Alcoholism Screening test.

*Results.* Average alcohol level in the alcohol-positive patients was 140 mg/dL. Chief complaints in the alcohol-positive group were for ingestion (54%), motor-vehicle crashes (MVC) (19%), assaults (11%), falls (10%), and other injuries (7%). Alcohol-negative patients were treated for MVCs (35%), athletic injuries (22%), other injuries (21%), falls (17%) and assaults (4%). Alcohol-positive patients, when compared to alcohol-negative patients, reported higher levels on all alcohol-related variables, including 30-day frequency of drinking (4.2 *vs* 1.5), binge-drinking (2.4 *vs* 0.6), and drunkenness (2.4 *vs* 0.6). Alcohol positive patients also reported more alcohol-related problem behaviors: past year alcohol-related injury (21% *vs* 3%), lifetime drinking and driving (31% *vs* 9%), and riding with a drinking driver (59% *vs* 40%). Self-report of depressive symptoms was also higher among alcohol-positive patients (17 *vs* 14), as was daily use of tobacco cigarettes (51% *vs* 19%). Many other problem behaviors were also more often endorsed by alcohol-positive patients: unsafe sex (34% *vs* 21%), stealing (30% *vs* 14%), marijuana use (73% *vs* 32%), and other illicit drug use (13% *vs* 4%). There were no significant differences between the parents of alcohol-positive and alcohol-negative patients in the parent's self-report of alcohol problems. Parents of alcohol-positive patients were more likely than parents of alcohol-negative patients to report that their child

had come home intoxicated (63% *vs* 21%) but were less likely to ask their child where they were going at night.

*Summary.* Among 13-17 year old ED patients treated for an injury, average alcohol level was 140 mg/dL. Alcohol-positive patients, compared to alcohol-negative matched controls, reported significantly higher rates

of alcohol use, alcohol-related problems, and other problem behaviors. Overall, patients did not differ in their self-report of alcohol problems, rules about teen drinking or in their monitoring behavior.

*Note.* Teen alcohol use was based on self-report, and other drug use was not examined at the time of the ED admission.