ALCOHOL IN HEAD-INJURED AIRCREW EVALUATED BY THE

AEROMEDICAL CONSULT SERVICE, 1982-2002

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REPORT DOCUMENTATION PAGE			*Form Approved OMB No. 0704-0188*

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE 11.Jul.03	3. REPORT TYPE AND DATES COVERED THESIS

4. TITLE AND SUBTITLE "ALCOHOL IN HEAD-INJURED AIRCREW EVALUATED BY THE AEROMEDICAL CONSULT SERVICE, 1982-2002`	5. FUNDING NUMBERS
6. AUTHOR(S) LT COL STORMS PATRICK R	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) UNIVERSITY OF TEXAS HSC HOUSTON (SAN ANTONIO)	8. PERFORMING ORGANIZATION REPORT NUMBER CI02-994
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) THE DEPARTMENT OF THE AIR FORCE AFIT/CIA, BLDG 125 2950 P STREET WPAFB OH 45433	10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT Unlimited distribution In Accordance With AFI 35-205/AFIT Sup 1	12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

14. SUBJECT TERMS	15. NUMBER OF PAGES 76
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT

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DEDICATION

To my loving wife, [redacted] my precious daughter [redacted], and my two hearty and loving sons, [redacted] I apologize for the long hours of my time lost to you while I toiled away on this document. Your love will sustain me long after this manuscript has turned to dust. I love you all.

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THESIS

Presented to the Faculty of The University of Texas

Health Science Center at Houston

School of Public Health

in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF PUBLIC HEALTH

THE UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON
SCHOOL OF PUBLIC HEALTH
Houston, Texas
May, 2003

PREFACE

A manuscript has been developed from this thesis and submitted for consideration for publication to the journal Aviation, Space, and Environmental Medicine.

ACKNOWLEDGEMENTS

I gratefully acknowledge the support and guidance given to me by my advisor, Dr. Jimmy Perkins, and the other member of my master's thesis committee, Dr. Alfonso Holguin. Thanks as well to Col Dan Van Syoc and Lt Col Bob Ireland, from the Aeromedical Consult Service at Brooks Air Force Base, for their unwavering support.

Thesis submitted to the M.P.H. Committee on February 14, 2003.

ALCOHOL IN HEAD-INJURED AIRCREW EVALUATED BY THE

AEROMEDICAL CONSULT SERVICE, 1982-2002

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Head injury in the flying community has special significance, from both a personal and operational standpoint. Alcohol use is often associated with traumatic injury, but its use in a population of head-injured aircrew members has not been previously addressed. This study describes alcohol use in head-injured aircrew presenting for evaluation by the Aeromedical Consult Service (ACS) between 1982 and 2002.

An extant dataset of head-injured aircrew, prepared and maintained by the ACS, was the source of data. Demographic information regarding this population was compared to general Air Force and Air Force aircrew populations. Alcohol use at the time of injury was assessed by data relating to blood alcohol levels drawn at the time of injury, and by the presence or absence of a history of alcohol use at the time of injury. Baseline alcohol use, based on patient self-report, was reviewed.

Information regarding alcohol use at the time of injury was available in just 26 of 88 cases, but in 17 of those 26 cases alcohol was felt to contribute to the head injury. Thus at a minimum, 19.3% of cases presenting to the ACS for evaluation of head injury had alcohol as a contributing factor, representing a significant Operational Risk Management issue and warranting further study.

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INTRODUCTION

BACKGROUND

Alcohol is a readily available, socially acceptable psychotropic drug with physiologic effects that increase the chance that an intoxicated individual will become the victim of a traumatic injury. This premise is supported by numerous studies that have demonstrated a high prevalence of alcohol exposure in trauma patients presenting to emergency departments and trauma units. It is estimated that nearly half of the roughly 35,000 automobile accident deaths in the US each year are alcohol-related, and that for every one arrest for drunk driving, 1,000 episodes go undetected (Angell, 1994). Cost to the US in terms of lost production, crime, accidents, and treatment of alcohol abuse exceeded $136 billion in 1990 (Modell, 1990). Among trauma patients, head injury is a source of considerable morbidity, both short and long term. Head injury in the military flying community has special significance, due to the impact of this injury on the member's ability to resume flying duties, and the operational impact caused by the loss of a qualified aircrew member. While ample literature has addressed the association of alcohol and head injury in the civilian population, little information exists regarding this association in the military arena. Anecdotal evidence suggesting a frequent association of alcohol use with head injury in aircrew (Ireland, 2002), bears further investigation.

REVIEW OF THE LITERATURE

HISTORY

Recorded evidence of alcohol consumption dates back to pre-dynastic Egypt, with the description of barley beer around 4200 BC. Wine appeared around 3000 BC, made from grapes, figs, and pomegranates. Descriptions of alcoholism and the consequences of excessive drinking likewise abound, with an admonition contained in the Anastasi Papyrus IV: "Beer makes him cease being a man… now you stumble and fall over upon your belly, anointed with dirt". An additional warning, found in the Making of the Scribe Ani, 1500 BC:

> "Make not thyself helpless in drinking in the beer shop. For will not the words of thy report repeated slip out of from thy mouth without thy knowing that thou has uttered them. Falling down, thy limbs will be broken and no one will give thee a hand to help. As for thy companions in the swilling of beer, they will get up and say 'Outside with this drunkard'" (el-Guebaly, 1981).

PHYSIOLOGY

Alcohol is rapidly absorbed from the gastrointestinal tract. On an empty stomach, 20% of the dose is absorbed in the stomach and the remaining 80% is absorbed in the small intestine. The optimal concentration for maximum absorption of alcohol is 20% ethanol by volume (Brook, 1989). As a small molecule, soluble in both water and fat, alcohol is distributed throughout the body, including the central nervous system. Alcohol is a primary and continuous suppressant of the central nervous system. In moderate doses, it impairs information processing, the ability to abstract and conceptualize, the ability to use a large number of situational cues presented simultaneously, and the cognitive ability to determine meaning from incoming information (Modell, 1990). The mild euphoria and apparent stimulatory effect on behavior is due to depression of inhibitory centers within the brain. Impairment of motor and cognitive skills can increase the likelihood of an unintended injury, particularly when participating in an activity such as driving a motor vehicle. One of the most disturbing features of alcohol use is a user's lack of recognition of their own performance decrements (Brook, 1989). A person under the influence of alcohol is less likely to be able to appreciate and integrate the dangers or costs of a course of action, and can act on impulse without fully appreciating the consequences of their actions (Modell, 1990).

MEASUREMENT

A "standard drink" is 44ml (1.5oz) of distilled liquor (80 proof, or 40% alcohol by volume), 360ml (12 oz) of beer (5% alcohol), or 150ml (5oz) of wine (12% alcohol). Blood alcohol concentration is expressed in a number of ways in the literature. It is often expressed as milligrams of ethanol per deciliter (mg/dl or mg%). 80mg/dl or 80 mg% is the same as 0.08g/dl and 0.08%. A standard 70kg person taking one standard drink will have a peak blood alcohol concentration of 0.02 – 0.04%, depending on the rate of ingestion and absorption. Alcohol is metabolized at a rate of 8g per hour, so about two hours of time is required to metabolize a single "standard drink". Impairment of judgment and fine motor skill is seen at blood alcohol concentrations as low as 0.025%. Impairment of gross motor skill and higher intellectual functions are seen at concentrations exceeding 0.05% (Modell, 1990). The definition of "legal intoxication" differs by region, but is generally in the range of 0.08 – 0.1%.

QUANTIFYING ALCOHOL USE

There are several methods in use to quantify a person's alcohol consumption. Most frequently, individuals self-report their alcohol use in response to questionnaires or interviews. Self-reports of drinking behavior are often maligned as being unreliable, but a 1982 review of five methods of self-report studies found reasonable correlation in reported and actual alcohol use. The methods used in self-report validation include: collateral reports, official records, sales coverage, observation, and chemical/mechanical methods.

Collateral Reports/Official Reports

Collateral reports, in which a spouse or household contact validates the alcohol intake of the subject, revealed a high degree of agreement in sixteen studies reviewed, both in clinical and general population environments. Official record validation has the disadvantage of being able to interpret only that specific information contained in an official report, is time-sensitive, and loses validity as the time between alcohol consumption and evaluation/arrest lengthens (Midanik, 1982)

Alcohol Sales Data

Alcohol sales data generally exceeds self-reported alcohol consumption for a population, with self reports accounting for only 30-60% of alcohol sales in an area. The surveys used as the point of comparison to sales often do not interview certain populations of drinkers within the sales area: homeless individuals, teen drinkers, and those "traveling through" the area at the time of their alcohol purchase. No distinction is made between alcohol sold for consumption by the surveyed individual, and that sold for gift-giving or use in cooking. It is commonly found that some individuals purchase alcohol that they do not drink, and some drink alcohol that they have not purchased (Midanik, 1982). One study, separate from Midanik's general review, attempted to control for the difference between alcohol sold and surveyed consumption by including atypical consumption figures, and under-age drinking. While adding these two additional variables did close the gap slightly, the difference was not significant. Matches were closer between self-reported alcohol purchases, and actual sales figures (Fitzgerald, 1987).

Observational Studies

Observational studies, in which the subject is directly observed for drinking behavior in a controlled research environment, often delivers close correlation between reported and measured drinking behavior, but these studies may be biased by the fact that direct observation can change the drinking behavior of the subject (Midanik, 1982).

Self-Reported Drinking Behavior

An attempt to validate self-reports of remote drinking history involving 69 paid volunteers from an addiction treatment center demonstrated good correlation between remote drinking recall across two survey instruments (Sobell, 1988). In one interesting study, in which alcohol abusers were asked their opinions about how to best validate their own self-reported drinking behavior, a sample of 208 alcohol abusers reported that they felt that their own self-reports of drinking behavior were valid if given when sober, and that spouses/close friends were accurate collateral sources of data. They also reported that they were more likely to be accurate in their alcohol use reporting if interviewed in their homes or in a research setting, and would be less candid if interviewed by telephone (Sobell, 1992).

Blood Alcohol Testing

The use of a blood alcohol test from either blood sample or breathalyzer is often considered the "gold standard" for quantifying alcohol consumption, but this test can only measure relatively recent ingestion of alcohol, and cannot be used to establish drinking patterns without ongoing monitoring and surveillance. In one sample of 1,330 trauma patients, the blood alcohol test demonstrated a sensitivity in the diagnosis of alcohol dependence of only 20% (Cherpital, 1995). In another study of 1,118 trauma patients, its sensitivity as a determiner of alcohol dependency was only 52% (Soderstrom, 1997). The blood alcohol level was negative in 34% of patients with current alcohol dependence in a review of 684 male trauma patients, demonstrating the poor reliability of blood alcohol level drawn in the ER as an indicator of chronic alcohol abuse (Ryb, 1999). Of the 20% of alcohol dependent patients surveyed in an ER study of motor vehicle accident injuries, 47% had a negative blood alcohol level (Maio, 1995).

Structured Interview Techniques

Structured interviews, such as the Short Michigan Alcohol Screening Test (SMAST), the CAGE questionnaire, and the Alcohol Use Disorders Identification Test (AUDIT) attempt to better identify drinking patterns and activities that suggest the development of alcohol dependency (Cherpital, 1995). The CAGE questionnaire, for instance, is a simple four-question test:

1. Have you ever felt the need to Cut down on your drinking?
2. Have people Annoyed you by criticizing your drinking?
3. Have you ever felt Guilty about your drinking?
4. Do you ever have a drink first thing in the morning to steady your nerves or get rid of a hangover (Eye-opener)?

A response of "yes" to two or more questions suggests a high probability of alcoholism (Milzman, 1994).

The use of an abbreviated form of the AUDIT was used in one study of 1,216 crash victims reporting to a single trauma center. The first two questions from the AUDIT instrument were used to screen for problem drinking and the results were compared to the "gold standard", the Psychoactive Substance Use Disorder tool. These two questions were:

1. How often do you have a drink containing alcohol?

2. How many drinks containing alcohol do you have on a typical day when you are drinking?

This frequency/amount survey had a sensitivity of 80%, and a specificity of 82% for identifying individuals with alcohol dependence. In the same study, the sensitivity of blood alcohol level in detecting alcohol dependence was only 65%. Based on this review, it was suggested that problem drinking be defined as greater than 14 drinks per week or greater than 4 drinks per occasion (Soderstrom, 1998).

EPIDEMIOLOGY OF ALCOHOL USE

Currently, most Americans consume alcohol, with about 100 million people drinking alcohol regularly (Angell, 1994). Overall, 65% of those age 12 and older have consumed alcohol at least once in the last year, with 51% reporting alcohol use in the last month. These figures increase to 75% using alcohol in the past year and 60% in the past month among those age 18 to 25 (Soderstrom, 2001). Society treats alcohol differently from other mind-altering drugs. Drinking is legal for adults, tolerated among adolescents, and is a common part of business and social functions. The price of alcohol is within the reach of most Americans, and sale of alcohol brings in $14 billion in tax revenues yearly (Angell, 1994). Alcohol use can be classified into four patterns: abstinence, social use, abusive use, and dependence. Dependence has been defined as "loss of control over alcohol use, despite adverse consequences" (Milzman, 1994).

Alcohol Use in Military Populations

Alcohol use in the military population mirrors that among civilians. Alcohol consumption was reported in 79.6% to 86.5% of respondents across five Department of Defense surveys, dating from 1980 to 1992. "Heavy" use was reported in 15.2% to 20.8% (Bray, 1992). Comparing data from the 1985 Worldwide Survey of Alcohol and Nonmedical Drug Use Among Military Personnel with that from the 1985 National Household Survey on Drug Abuse, one author noted that 84% of military respondents reported alcohol use, compared to 76.5% of the surveyed civilian population, and that heavy alcohol use was also more common in the military population (20.8% vs 11%) (Bray, 1991). Data drawn from the 1995 Department of Defense Survey of Health Related Behavior revealed that of the 16,193 respondents, 18.8% of the men met the author's definition of "heavy drinking", that of drinking 5 or more drinks per typical drinking occasion at least once per week over the past 30 days (Bray, 1999), compared to 11.9% of men reporting heavy drinking in the 1985 survey (Bray, 1989).

Alcohol Use in Air Force Populations

The 1985 survey also revealed that Air Force members alcohol consumption was lower than that of the other military services (Bray, 1989). A 1979 Rand Corporation study surveyed 13 Air Force bases across the US, Pacific, and Europe. 4.6% of the respondents were felt to be alcohol dependent, based on a definition of being unable to stop drinking prior to becoming intoxicated. 9.3% were felt to be "nondependent alcohol abusers", those encountering some serious problem with alcohol over the preceding year, though they did not meet the criteria for dependence. An overall 10.4% rate of "problem drinking" in the military members compared to a civilian figure of 9.3% (Polich, 1979).

ALCOHOL USE AND INJURY

Deaths from alcohol-related medical disease and injury make alcohol the third leading cause of non-cancer death in the US (Soderstrom, 2001). The literature is replete with evidence to link alcohol use with injury, but risk estimates are not generally reported due to lack of a suitable control group for determining risk. In one study, trauma admissions to Parkland Hospital, Dallas, Tx, were reviewed from Sep 1998 to Feb 1999. 301 patients received an interview screen for alcohol dependency (AUDIT screening tool). Acute or chronic alcohol use was reported in 41% of patients. 111 of the 301 patients had a blood alcohol level drawn, with 23.3% positive for alcohol. 18.6% of those with a positive blood alcohol level denied drinking at the time of their injury, compared to 38.3% of the total population, who reported drinking at the time of their injury. Of interest, 77% of those with a positive AUDIT had a positive alcohol blood level, or a reported a history of alcohol use at the time of their injury (Field, 2001).

One review of 17 ER-based studies reported a positive blood alcohol level in 6-34% of those injured, and 1-19% of those not injured. Where blood alcohol levels were determined on those injured and non-injured, the injured were much more likely than the non-injured to be legally intoxicated. In addition, all ER populations exceeded general population figures for alcohol use and alcohol-related problems (Cherpitel, 1993). A metaanalysis of 331 medical examiner studies published between 1975 and 1995 looked at fatal nontraffic injuries, with 7,459 unintentional injuries, 28,969 homicides, and 19,347 suicides aggregated. Blood alcohol levels of > 0.1% were reported in 31.5% of homicides, 31% of unintentional injuries, and 22.7% of suicides (Smith, 1999). Smith also looked at the role of alcohol in occupational injuries. In a review of alcohol use among workers at seven railroad companies, only 4% of injuries involved alcohol, suggesting that occupational injuries are less likely to involve alcohol use than other forms of injury (Smith, 1988).

Alcohol Dependence and Injury

Outlining some of the difficulties in performing this type of research, one author noted that of the 1,909 patients eligible for study at a regional shock trauma center, 689 were not approached due to: early discharge, weekend discharge, language barriers, emotional distress, and physical discomfort. The 1,118 patients evaluated were assessed for alcohol use and dependence, revealing positive blood alcohol levels in 36.6% of males and 21.4% of females. 54.3% of those with positive blood alcohol levels were found to be alcohol dependent, as were 34.2% of blood alcohol negative patients. Overall, the prevalence of alcohol dependence in this population was more than three times higher than the estimated one year prevalence of alcohol dependence of 7.2% for the US population at-large (Soderstrom, 1997).

Drinking Behavior in Trauma Patients

Drinking behavior was studied in a group of 1,613 trauma patients. They were surveyed about their drinking habits and given either a breathalyzer or blood alcohol test on admission. 14.2% denied any alcohol use, and 18% reported frequent, heavy drinking. 33.7% reported taking at least seven standard drinks per typical drinking session. Of those who admitted heavy drinking at least three times per week, 69% had a negative blood alcohol level (Yates, 1987). 32% of 1,300 injured patients with positive blood alcohol levels were positive for harmful drinking patterns, and 19% for alcohol dependence in a study of ER patients at the University of Mississippi Medical Center (Cherpital, 1995). In reviewing data from the 1986 National Mortality Followback Survey, conducted by the National Center for Health Statistics, those dying of injury were 1.4 times more likely to consume 5 or more alcoholic drinks per drinking occasion than were those dying of disease. 33% of those dying from injury were categorized as "heavy drinkers", compared to 25% of those dying from disease (Li, 1994).

In a prospective study of 13,251 subjects involved in the National Health and Nutrition Examination Survey Epidemiologic Follow-up Study (NHANES), 7.1% of the cohort reported usual consumption of 5 or more alcoholic drinks per occasion. 81 of 2,022 recorded deaths were due to injuries, with motor vehicle accidents as the leading cause of injury death. Those reporting consumption of 5 or more alcoholic drinks per drinking occasion were twice as likely to die from injuries (RR 1.9) compared to those drinking fewer drinks per occasion. The risk was three times as high for those consuming 9 or more alcoholic drinks per drinking occasion (Anda, 1988).

Risk of Injury in Alcohol-Using Patients

A case-control study of ER trauma patients looked at 797 cases and 797 uninjured community controls, matched to suburb of residence. A higher proportion of injured cases reported alcohol consumption in the 3 months, 24 hours, and 6 hours prior to the time of injury, compared to controls. 45% of cases reported consumption of "harmful levels" of alcohol (> 60 gms in 6 hours) at least once per month, compared to 18% of controls. Overall, those drinking greater than 60gm of alcohol per drinking occasion suffered a three-fold higher risk of injury. Those consuming over 90gm of alcohol per drinking occasion were five times more likely to suffer injury (McLeod, 1999).

Risk-Taking Behavior

One possible explanation for an increase in injuries among alcohol-using individuals is the increase in risk-taking behavior. In a study of 2,058 survey respondents, moderate-to-heavy drinkers were noted to have more injuries in the previous year than the surveyed non-drinkers, and risk taking/impulsivity was associated with quantity and frequency of drinking (Cherpitel, 1993). The Parkland study, noted above, also reported that 77% of their population engaged in at least one of four unsafe driving practices as assessed by the Youth Risk Behavior Surveillance Study, and 39.9% reported one of three aggressive behaviors. These risk behaviors were much more common in those with problem drinking (Field, 2001). Risky driving behavior was also felt to play a part in injuries on motorcycles. 56.5% of 3,236 motorcycle accident trauma patients had a positive blood alcohol level within four hours of their crash. Helmet use in the drinking drivers was only 18.6%, compared to 33.5%

in non-drinkers (Peek-Asa, 1996). Age at the time of injury may also contribute to the observation of risk-taking behavior as a contributor to alcohol-related injury. In a study of 3,523 patients presenting to a trauma center, those aged 21-39 had the highest rate of positive blood alcohol level (Soderstrom, 1997).

Physiologic Consequences of Alcohol Use in the Trauma Patient

Aside from the risk of injury associated with alcohol use, one author expressed concern that alcohol may modify an individual's ability to tolerate a traumatic injury. Alcohol has a cardiodepressant effect and can cause bradycardia. It may also aggravate hypotension and arrhythmias. Acute intoxication also inhibits platelet aggregation, potentially contributing to hemorrhage. All of these effects can have a negative impact on the survival of a trauma patient. In addition, alcoholic patients may experience withdrawl symptoms during the course of their treatment, adding additional hazard to their recovery (Milzman, 1994).

Alcohol and Injury in the Military

There are few studies relating alcohol use to injury in military populations. In one review of 293 death certificates on Air Force members for the year 1990, injuries accounted for 73% of deaths in the sample, and motor vehicle accidents made up 31% of the total deaths. Utilizing the Alcohol Related Disease Impact computer model, the author determined that 23% of the deaths were attributable to alcohol use (Stout, 1993). In a case series of three military aviators, all of whom had clear evidence of alcoholism on presentation for evaluation, none of the three had their alcoholism documented by their attending physician. The reasons outlined by the author include: the attending physician's effort to prevent stigmatizing the patient, and the naïve rationale that helping the patient deny his/her alcohol dependence is the same as being compassionate. In the author's experience, higher ranking patients were even less likely to get proper referral for alcohol abuse, or even a correct diagnosis (Pursch, 1974).

IDENTIFYING ALCOHOL USE

Identification of those with alcohol as a contributing factor to trauma is important, since the rate of recurrent injury is higher in those that continue to drink. In one prospective study of 2,578 patients with blunt or penetrating trauma, those intoxicated on presentation to the ER were 2.5 times more likely to be readmitted in the future, compared to those that were not intoxicated on admission. 47% of these patients had positive blood alcohol levels on admission, and 75% of those intoxicated on admission had a positive SMAST study, compared to a positive SMAST in 25% of those not intoxicated on admission (Rivara, 1993).

Physician Recognition of Intoxication

The importance of divining an alcohol history has been stressed by the American College of Surgeons, with a recommendation of drug and alcohol screening as "essential" for all level 1 and 2 trauma centers, and "desirable" for level 3 trauma centers. This is due, in part, to the fact that physician recognition of intoxication and alcohol dependence is poor outside of formal screening. In one study of 1,613 patients, 32% of those with blood alcohol levels between 0.085 and 0.2% were felt by their attending physician to be sober. Another 33% of those with blood alcohol levels greater than 0.2% were felt to be sober or "only mildly inebriated" (Yates, 1987).

Frequency of Alcohol Use Screening

In practice, while resources exist for blood alcohol testing in 99.4% of surveyed trauma centers, routine blood alcohol levels were obtained in only 67% of level 1 and 2 trauma centers, and in only 47.4% of level 3 centers. In 91% of non-testing centers, the reason given for their failure to test was that testing was "not clinically important" (Soderstrom, 1994). In a survey of 241 trauma surgeons, only 18.7% reported routinely screening for alcohol use in their acute trauma patients. The most common reason for failing to screen, cited by 46.6% of non-screeners, was that they were "too busy". 29.6% of non-screeners felt that screening was intrusive and offensive to patients (Danielsson, 1999). One author opined that blood alcohol screening was infrequently used because a positive result could cause legal problems for the patient. In a review of 2,649 brain injured patients in San Diego, only 44% had blood alcohol levels checked (Kraus, 1989).

Alcohol Treatment Program Referrals

Beyond detection of alcohol consumption/abuse, one study revealed that even though a 33% rate of intoxication was recognized in a group of 242 adult trauma patients, only 5 patients were referred to an alcohol treatment program: one by a medical social worker, one by a resident, and three by psychiatry consultants. In this study population, staff recognition of intoxication was good (77%) when the blood alcohol level was > 0.1g/dl, but was poor (25%) with positive blood alcohol levels of < 0.1g/dl (Silver, 1990).

Screening Recommendations

A consensus panel from the Center for Substance Abuse Treatment, in their 1995 report, recommended alcohol and drug screening as "an essential first step" in understanding trauma patients' medical needs, noting a 1991 call from the American Society for Addiction Medicine and the AMA House of Delegates for blood alcohol screening on all hospitalized trauma patients (Rostenberg, 1995). In a position paper published in 2001, the Eastern Association for the Surgery of Trauma (EAST) recommended requiring alcohol and drug testing of all trauma patients on admission, use of interview screening tools for alcohol and drug abuse, reporting of substance abuse test findings to the patient, and referral for treatment as indicated (Soderstrom, 2001). In citing their perceptions of the reasons that physician fail to screen for alcohol abuse problems in their patients, the EAST group offered the following list:

- Surgeons are trained to focus on acute and critical care management of their patients, not on issues such as substance abuse
- Many physicians have an aversion to the behaviors of intoxicated patients
- Many sense that substance abusing patients are unwilling to undergo treatment for their addiction
- Surgeons assume that "cures" of addicts are rare
- Many institutions have limited resources to address substance abuse disorders

In summarizing their recommendations, the EAST group stated that physicians are obliged to address substance abuse because: it is a factor in all types of trauma, and among all groups; both acute and chronic substance abuse affects all phases of trauma care; and, treatment of substance abuse will reduce future injuries (Soderstrom, 2001).

HEAD INJURIES

An important subset of patients with traumatic injuries are those with head trauma. The earliest written account of head injury was found on a papyrus recovered from Thebes in 1862. That papyrus, thought to date back to 1600 BC, detailed 48 cases of in which surgery was performed. A number of those individuals undergoing surgery had head injuries (Beaumont, 2000).

Traumatic Brain Injury

In the US, about 500,000 traumatic brain injury patients require hospitalization each year, and about 50,000 suffer some form of permanent neurologic disability. The cost of care for a head injured patient is estimated to be $4.6 million, about twice the lifetime care cost of a person with cancer or heart disease. It is estimated that 70% of head injuries occur in those younger than 30, and that men are 3-4 times more likely to incur these injuries than women (Rostenberg, 1995). Motor vehicle accidents are the most common cause, followed by falls, pedestrian-vehicle accidents, and assaults (Schmidek, 2000). Nonfatal estimates, prepared by the CDC in 1991, suggested a total of 1.54 million cases with concussion, skull fracture, contusions, and hemorrhages that required professional attention, but were not hospitalized.

It is estimated that there are 24 patients with brain injury for every 6 hospitalized, and 6 hospitalized cases for each fatality (Kraus, 2000).

The study of head injury is complicated by the fact that there are no fewer than 10 International Classification of Disease (ICD) codes for those suffering head injury, and the classification is based on pathologic rather than clinical criteria (Jennett, 1996). Case definition can also be problematic in that some diagnoses, such as concussion, are made on purely clinical grounds without supporting objective data (Kraus, 2000).

Head Injury in Trauma Patients

Of the roughly 100,000 patients who die each year of a head injury, 70,000 die before ever reaching the hospital (Gennarelli, 1989). In one study of 49,143 patients reviewed by the Major Trauma Outcome Study, involving 95 hospitals between 1982 and 1986, 33% of those presenting with traumatic injury reported head injury as an accompanying injury to other trauma, and 6% had head injury alone. Though making up only 33% of the study population, head injured patients comprised 60% of the mortality, with a mortality rate three times that of the non-head injured (18.2% vs 6.1%) (Gennarelli, 1989). In a review of patients in the Traumatic Coma Data Bank from Jan 1984 to Sep 1987, of the 1,030 consecutive admissions with severe head injury, 284 were brain dead on admission. Of the 746 remaining, 36% had expired by 6 months post injury, 14% were vegetative, and only 7% showed a good outcome (Marshall, 1991). Because most who incur a traumatic brain injury are young and previously healthy, the impact to society in terms of family disruption, lost productivity, and medical costs is considerable (Zink, 1994).

Head Injury in the Military

One study of military head-injury cases reviewed all military hospital discharge records for 1992. 82% of head injured patients were male, with a mean age of 23.8 years. Intracranial injuries without skull fracture accounted for 72% of military admissions; and the most common causes of head injury were falls, followed by motor vehicle accidents, altercations, and sports injuries, in that order. Total cost of care for 5,568 admissions was $42 million (Ommaya, 1996).

ALCOHOL AND HEAD INJURY

A number of studies have reviewed alcohol use in conjunction with head injury. Of 100 patients admitted with concussion from March through May, 1980, 58% were assessed as being intoxicated on admission, and alcohol dependence was diagnosed in 43% (Brismar, 1983). In another study, 62% of 658 men and 27% of 260 women with head injury were found to have a positive blood alcohol test (Galbraith, 1976). In a population of 2,649 brain injured patients, 49% of the males tested for blood alcohol were positive, compared to 30% of females (Kraus, 1989). A review of 14,920 men presenting to the ER with traumatic injury revealed that intoxicated men had head injuries more often than sober ones (64.2% vs 17.7%) (Honkanen, 1991). A comprehensive study of 22,427 head injury cases drawn from the California Regional Trauma Registry revealed that 36% of skull fracture patients had a positive blood alcohol level, 32.2% had a negative level, and 31% were not tested. For other intracranial injury diagnoses, 33.9% were positive for blood alcohol, 30.2% negative, and

35.9% not tested (Treno, 1996). The mechanism of injury was reviewed with respect to alcohol consumption in a group of 2,649 brain-injured patients. Though only 44% of the population of injured patients had a blood alcohol level determined, of those that were tested, 66% of those involved in motor vehicle accidents had a positive blood alcohol level, as did 60% with assaults, 44% with falls, and 35% involved in firearms incidents (Kraus, 1989).

Risk Taking Behavior in Head Injury Patients

Just as risk-taking behavior was identified as a factor in alcohol and general injury cases, it is observed in head injury cases as well. 244 patients with loss of consciousness after head trauma had blood alcohol levels drawn, and were interviewed about seatbelt use. A positive blood alcohol level in this study was defined as being greater than 0.49 g/dl. Blood alcohol levels were positive in 41% of the men and 11% of the women, and only 10% of those with positive blood alcohol levels reported seatbelt use, compared to 56% of those with negative blood alcohol levels (Tom-Harald, 1982).

Alcohol Testing in Head Injury Patients

Frequency of alcohol testing appears to be no better in head injury patients than in the larger population of injured patients. In a study of 320 records from patients injured in motor vehicle accidents, only 42% of patients with head injury were tested for blood alcohol levels. None of the patients from this sample were referred for alcohol abuse evaluation or treatment, even though 66% of those tested for blood alcohol had a positive test. Three patients, with blood alcohol levels between 0.245 and 0.368%, were instructed at the time of discharge "not to drink and drive" (Chang, 1988).

Alcohol Dependence in Head Injury Patients

Diagnosis of alcohol dependency in a population of head injured patients may present an opportunity for treatment. In a study of 197 head injured survivors at a level 1 trauma center, 42% were legally intoxicated on admission. 45% of those with a positive blood alcohol level had a positive SMAST on admission, and 25% of those with a blood alcohol level of zero also had a positive SMAST. After hospital discharge, alcohol consumption declined when measured one month post discharge, but then increased to near baseline levels at one year post discharge (Dikmen, 1995). This period of decreased alcohol use may present a "window of opportunity" for an alcohol control intervention.

Alcohol and Head Injury in Military Populations

Only one study has addressed the issue of alcohol as it relates to head injury in a military population. In that study, 10% of patients admitted to an Army medical treatment facility with a diagnosis of head injury carried an additional alcohol-related diagnosis (McCarroll, 1990). There have been no studies to address the frequency of alcohol intake in a population of Air Force members with head injury, and this gap in knowledge is an important one. Are Air Force members as likely to present with intoxication and head injury as their civilian counterparts? Does the typical demographic of "young drunk man in a motor vehicle accident" (Zink, 1994), apply to the Air Force population?

Alcohol Use in Aircrew with Head Injury

A singularly pressing question relates to the occurrence of alcohol use in aircrew presenting with head injury, since both head injury and alcoholism can have a negative impact on the member's flying career, and therefore on the operational mission of a flying unit. Since 75% of intoxicated patients presenting with injury were found to have evidence of chronic alcoholism by SMAST (Short Michigan Alcohol Screening Test) (Rivara, 1993), and since only 7% of those presenting intoxicated in one study were referred to an alcohol treatment program at discharge (Silver, 1990), the possibility exists that the diagnosis of chronic alcoholism is being missed. If this experience is mirrored in head-injured aircrew members, precious treatment opportunities are being neglected.

MILITARY FITNESS FOR DUTY

All military members are obliged to adhere to certain medical standards in order to serve as a member of the armed forces. When affected by illness or injury, these standards are applied to assess the member's ability to return to duty, and to continue to serve as a military member. Certain military occupations require standards that are more rigorous than those generally applied to all military members. "Aircrew" is the term applied to those military members whose duties involve aerial flight. The specific occupations include pilots (including student pilots), navigators, flight surgeons, flight nurses, and enlisted aircrew members with duties aboard flying aircraft. Given the unique stresses of the aerospace environment, and the stresses imposed by the aircraft used in accomplishing the operational mission, injuries and illnesses in aircrew members can lead to disqualification from flying duty. Injuries or illnesses that do not meet the following criteria are potentially disqualifying:

- Not pose a risk of sudden incapacitation
- Pose minimal potential for subtle performance decrement, particularly with regard to the higher senses
- Be resolved or stable, and be expected to remain so under the stresses of the aviation environment
- If the possibility of progression or recurrence exists, the first symptoms or signs must be easily detectable and not pose a risk to the individual or the safety of others
- Cannot require exotic tests, regular invasive procedures, or frequent absences to monitor for stability or progression
- Must be compatible with the performance of sustained flying operations in austere environments

Medical Evaluation of Aircrew

Medical evaluation of aircrew is required when applying for initial flying duty, when returning to flying duty after a break in flying service, or when suffering an illness or injury that is felt by a flight surgeon to potentially impact the member's ability to perform the flying mission. Specific medical standards for military duty, including those specific to flying duty, are outlined in Air Force Instruction 48-123. Special evaluation requirements apply to aircrew sustaining a head injury, and are related to the severity of the injury. Oversight of the evaluation process of head-injured aircrew and deliberations that lead to a return to duty, or disqualification from further flying duties, lies with the Aeromedical Consult Service (ACS).

The Aeromedical Consult Service

The ACS is responsible for specialized aeromedical evaluation of aircrew members, when referred by a flight surgeon at the unit or higher headquarters level. The ACS evaluates the member and makes recommendations to the appropriate authorities regarding the referred member's medical qualification for flying duty. Certain medical conditions, such as those involving head injury, require ACS input prior to a member's return to flying duty. Thus, evaluation by the ACS is performed on all head-injured aircrew members that wish to return to flying duty after medical disqualification. This "common pipeline" through which head-injured aircrew must pass offers a unique opportunity to study this highly-selected population.

RATIONALE FOR ADDITIONAL STUDY

The body of literature referencing alcohol use and head injury does not specifically address alcohol use in head-injured aircrew. While it is difficult to prospectively study head injuries in alcohol-using aircrew members, given the relative rarity of head injuries, and the difficulty in defining the alcohol use patterns of aircrew members individually, it is possible to pursue a descriptive study of alcohol use in this population. Since head-injured aircrew members who wish to return to flying status must be evaluated by the ACS, the ACS evaluation files should reflect the sum total of aircrew members that survive their head injury and are being considered for a return to flying duties. Review of this population will add significantly to the body of knowledge addressing alcohol use and head injury in military members, and thus broaden the knowledge base regarding alcohol use and head injury in general.

PURPOSE OF THE PROPOSED STUDY

This study will describe the distribution of alcohol use in a population of Air Force aircrew referred to the Aeromedical Consult Service for evaluation of head injury.

METHODS AND PROCEDURES

STUDY DESIGN

This study is a descriptive study of the prevalence of alcohol use in head-injured aircrew.

POPULATION

Target Population

The target population is Air Force aircrew members.

Study Population

The study population is head-injured aircrew.

Study Sample

The study sample is head-injured aircrew presenting to the ACS for evaluation relative to their head injury during the time period of January, 1982 through August, 2002.

Rationale for This Study Sample

Head-injured aircrew members wishing to return to flying status must be evaluated and cleared by the ACS prior to their return to flying duty. This study sample should thus be representative of the study population. The study sample does not include those members that died as a result of their head injuries, or those that were medically retired without consideration of fitness for continued flying duty by the ACS, since data for those members is unavailable for review. It also does not include those with head injury too mild to be evaluated by the ACS. Since the level of injury requiring evaluation includes those with head injuries of mild severity, this group would likely only include those that did not seek medical attention after their injury.

VARIABLES/OPERATIONAL DEFINITIONS

- Age at the time of the head injury
- Gender: male, female, missing
- Race/Ethnicity: white, black, Hispanic, Asian, other
- Aircrew position: pilot, navigator, flight surgeon, enlisted aircrew, other
- Rank: Enlisted (E0-E4, E5-E6, E7-E9), 2Lt, 1Lt, Capt, Maj, Lt Col, Col
- Marital status: single, married, divorced, unknown
- Year of head injury
- Mechanism of head injury: aircraft accident, motor vehicle accident (MVA), sports/recreational injury, fall, pedestrian-vehicle accident, altercation, other
- Severity of head injury: mild, moderate, severe
- BAT taken at time of injury: yes, no
- BAT value at the time of presentation with injury, if taken
- Alcohol use as demonstrated by history of alcohol intake temporally related to the injury: yes, no, unknown
- Reported baseline (routine) alcohol use: abstinent, light, moderate, heavy

Severity of Head Injury

Air Force Instruction 48-123 classifies the severity of head injuries as follows:

- Severe: unconscious or amnestic for at least 24 hours; retained metallic or boney fragments; depressed skull fracture; traumatic or surgical laceration of the dura mater; focal neurologic signs; epidural, subdural, subarachnoid, or intracerebral hemorrhage; CSF otorrhea or rhinorrhea for more than 7 days; CNS infection within 6 months of injury
- Moderate: unconscious for 30 minutes or greater, but less than 24 hours; amnesia for one hour or greater, but less than 24 hours
- Mild: cases do not meet any of the criteria described above. Those cases with no loss of consciousness, amnesia, or abnormal findings do not require a waiver.

Baseline Alcohol Use

Baseline alcohol use refers to the routine alcohol consumption pattern practiced around the time of injury. In this study, abstinence is defined as consuming fewer than 12 drinks per year. Light drinkers consume up to three drinks per week. Moderate drinkers consume 3 to 14 drinks per week, but never over 4 drinks in any single drinking session. Heavy drinkers consume 15 or more drinks per week, or report any drinking sessions in which they consume 5 or more drinks.

METHOD OF DATA COLLECTION

Information was obtained from a dataset developed and maintained by the Neuropsychiatry Division of the ACS. This dataset was prepared from information contained in the ACS evaluation files on patients presenting for consultation dealing with a previous head injury. Evaluation files are prepared on aircrew presenting to the ACS for evaluation, and include: an aeromedical summary prepared by the referred member's attending flight surgeon, documents pertinent to past evaluations, sent to the ACS by the member's attending flight surgeon, reports from consultations obtained as a part of the member's evaluation at the ACS, laboratory and radiology reports obtained at the ACS, and the results of specialized aeromedical testing performed in the course of the member's evaluation. Aeromedical summaries and consultation reports are detailed reviews of pertinent clinical and behavioral information that emphasize the impact of the member's illness or injury on their ability to perform flying duties. In the specific case of head-injured patients, psychiatry and neuropsychology evaluations are generally obtained and specifically address substance use and abuse issues. This dataset includes the variables outlined above, but does not contain any individual identifiers, such as name, social security number, or case number.

ANALYSIS

Comparison of the Study Sample to other Air Force Populations

The study sample was compared to the demographic distribution of Air Force members, in general, and Air Force aircrew on duty Sep 2002, broken down as enlisted or officer. The demographic information about 2002 Air Force members was obtained from the Air Force Personnel Center (AFPC) via their demographics website, http://www.afpc.randolph.af.mil/demographics/. This website displays public domain information about Air Force personnel demographics, is publicly available for use without consent from AFPC, and the data contains no personal identifiers.

Description of Alcohol Use in the Study Sample

Alcohol use in the study sample was described using three variables: blood alcohol level (if taken), history of alcohol use prior to head injury (if available), and baseline alcohol use.

Assessment of Alcohol as a Contributing Factor to Head Injury

Alcohol was assessed as contributing to the head injury if the member had a positive blood alcohol level at the time of injury, or if the member reported alcohol use at the time of head injury. Alcohol was assessed as not contributing to the head injury if the member had a blood alcohol level of zero at the time of injury, or if they denied alcohol use at the time of injury (with either a blood alcohol level of zero, or no blood alcohol level performed). Where neither blood alcohol level nor history of alcohol use at the time of injury was available, the contribution of alcohol use to head injury was assessed as "unknown".

RESULTS

DESCRIPTION OF THE STUDY SAMPLE

99 head-injured aircrew members were evaluated by the ACS between 1 Jan 1982 and 5 Jun 2002. The initial evaluation of aeromedical fitness for student pilots or new aircrew members may involve consideration of head injuries that occurred even in childhood. Eight cases were excluded from consideration due to head injury occurring prior to age 18. Three were not included in the dataset because their evaluation record could not be located, thus they were not entered into the database. Thus, 88 cases remained in the dataset for consideration. 78 of the 88 aircrew members were officers, and 10 were enlisted.

Officer Demographics

Officer demographic data is displayed in Table 1. Out of a total officer corps of around 71,000 (2002 data), approximately 19,000 are aircrew members. The study sample is younger than either total aircrew or total officer corps, with significantly more members in the 20-24 year age range ($p < 0.001$ for aircrew, $p = 0.013$ for total officer corps [1]), and a median age of 27. Figure 1 displays the age distribution curve (by proportion for age groups) of all three groups.

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[1] All determinations of significance are done at the 95% level

All of the members of the study sample are male, compared to 95.8% males in total aircrew, and 82.1% male in total officer corps ($p < 0.001$ for both total aircrew and total officers). In addition, the study sample is almost entirely of white ethnicity ($p < 0.001$ for both total aircrew and total officers). Fewer study sample members are married, compared to total aircrew ($p = 0.025$), though the proportion of married members in the study sample does not differ significantly from the total officer corps ($p = 0.190$). The proportion of single members does not differ among the three groups.

Though the proportion of Second Lieutenants is higher in the total officer corps than in the study sample ($p = 0.019$), there is no difference in the proportions of other officer ranks. When the study sample is compared with total aircrew, there are more Majors in the total aircrew ($p = 0.046$), with no difference in proportion of other officer ranks.

Thus, overall the study sample is younger, with a greater proportion of white ethnicity and a greater proportion of males than either the population of total aircrew, or the total Air Force officer corps.

Table 1: Officer Demographics

	All AF Officers	%	AF Air Crew	%	Study sample (officers)	%
Year	2002		2002		1982-2002	
AGE						
denominator	71139		18859		78	
less than 20	2	0.0%	0	0.0%	3	3.8%
20-24	6509	9.1%	785	4.2%	16	20.5%
25-29	15783	22.2%	5219	27.7%	27	34.6%
30-34	15580	21.9%	4102	21.8%	11	14.1%
35-39	13793	19.4%	3972	21.1%	11	14.1%
40-44	10973	15.4%	3555	18.9%	6	7.7%
45-49	6020	8.5%	1078	5.7%	3	3.8%
over 49	2479	3.5%	148	0.8%	1	1.3%
GENDER						
denominator	71279		18862		78	
male	58519	82.1%	18061	95.8%	78	100.0%
female	12760	17.9%	801	4.2%	0	0.0%
RACE						
denominator	71145		18862		78	
white	59223	83.2%	17057	90.4%	77	98.7%
black	4765	6.7%	505	2.7%	0	0.0%
Hispanic	2005	2.8%	454	2.4%	1	1.3%
Asian	1944	2.7%	294	1.6%	0	0.0%
other	3208	4.5%	552	2.9%	0	0.0%
RANK						
denominator	70598		20100		78	
2Lt	10433	14.8%	565	2.8%	6	7.7%
1Lt	8733	12.4%	2684	13.4%	9	11.5%
Capt	21969	31.1%	6353	31.6%	23	29.5%
Maj	15535	22.0%	5355	26.6%	14	17.9%
Lt Col	10602	15.0%	3853	19.2%	16	20.5%
Col	3326	4.7%	1290	6.4%	7	9.0%
other*	0	0.0%	0	0.0%	3	3.8%
MARITAL STATUS						
denominator	71006		18862		78	
married	50575	71.2%	14397	76.3%	50	64.1%
single	16456	23.2%	3856	20.4%	14	17.9%
divorced	3018	4.3%	538	2.9%	1	1.3%
other	898	1.3%	15	0.1%	0	0.0%
unknown	59	0.1%	56	0.3%	13	16.7%

* Cadet (1), Warrant Officer (2)

Enlisted Demographics

Enlisted demographic data is displayed in Table 2. A sample size of only 10 renders statistical comparisons of the enlisted study sample to the other two groups suspect. Figure 2 displays the age distribution (by proportion for age groups), and the distribution appears to be similar for all three groups. The median age of the enlisted members in the study sample is 26.5 years. The study sample is all male, and all of white ethnicity, which is not the case for enlisted aircrew or the total enlisted force. Rank distribution suggests that the study sample is more heavily weighted to mid-level enlisted rank, and the number married appears to be the same among the three groups.

Table 2: Enlisted Demographics

	All AF Enlisted	%	AF Air Crew (enlisted)	%	Study sample (enlisted)	%
Year	2002		2002		1982-2002	
AGE						
denominator	292605		38483		10	
less than 20	25267	8.6%	2585	6.7%	0	0.0%
20-24	97970	33.5%	11890	30.9%	4	40.0%
25-29	54684	18.7%	7740	20.1%	3	30.0%
30-34	38142	13.0%	5502	14.3%	2	20.0%
35-39	46216	15.8%	6597	17.1%	1	10.0%
40-44	25501	8.7%	3531	9.2%	0	0.0%
45-49	4475	1.5%	602	1.6%	0	0.0%
over 49	335	0.1%	31	0.1%	0	0.0%
unknown	15	0.0%	5	0.0%	0	0.0%
GENDER						
denominator	292605		38483		10	
male	234567	80.2%	29576	76.9%	10	100.0%
female	58038	19.8%	8907	23.1%	0	0.0%
RACE						
denominator	292605		38483		10	
white	206492	70.6%	29209	75.9%	10	100.0%
black	53016	18.1%	5584	14.5%	0	0.0%
Hispanic	17745	6.1%	2067	5.4%	0	0.0%
Asian	9331	3.2%	894	2.3%	0	0.0%
other	6021	2.1%	729	1.9%	0	0.0%
RANK						
denominator	292605		38483		10	
E0-E4	134410	45.9%	15556	40.4%	1	10.0%
E5-E6	117939	40.3%	17120	44.5%	7	70.0%
E7-E9	40039	13.7%	5802	15.1%	2	20.0%
unknown	217	0.1%	5	0.0%	0	0.0%
MARITAL STATUS						
denominator	292605		38483		10	
married	163396	55.8%	21772	56.6%	6	60.0%
single	107913	36.9%	13645	35.5%	1	10.0%
divorced	19506	6.7%	2789	7.2%	2	20.0%
other	209	0.1%	35	0.1%	0	0.0%
unknown	1581	0.5%	242	0.6%	1	10.0%

Study Sample, Overall

Overall, a greater proportion of the study sample is of white ethnicity, with a greater proportion of males than either the enlisted aircrew population or the total enlisted force. In addition, there appears to be a greater representation of mid-level enlisted ranks in the study sample, compared to the other two groups.

Aircrew Position

As shown in Table 3, pilots made up the largest portion of the study sample, at 48.9%. Enlisted aircrew made up only 11.4% of the study sample, though the number of enlisted aircrew in the Air Force is more than twice that of the officer aircrew force.

Table 3: Aircrew responsibilities in the study sample

	Study sample	**%**
Aircrew position		
enlisted	10	11.4%
student	10	11.4%
pilot	43	48.9%
navigator	17	19.3%
flight surgeon	6	6.8%
other	2	2.3%

MECHANISM OF INJURY/SEVERITY

Mechanism and severity of head injury is displayed in Table 4. Motor vehicle accident (MVA) was the most frequent mechanism of injury, followed by recreational/sports injury. 14 cases were injured as a result of aircraft accidents. Severe injuries made up 42% of the study sample.

Table 4: Mechanism of Injury and Injury Severity

	Study sample	%
Mechanism of injury		
Aircraft accident	14	15.9%
Motor vehicle accident	32	36.4%
Pedestrian - auto accident	4	4.5%
Recreational/sports injury	17	19.3%
Fall	12	13.6%
Altercation	5	5.7%
Other	3	3.4%
Unknown	1	1.1%
Severity of head injury		
mild	27	30.7%
moderate	24	27.3%
severe	37	42.0%

BASELINE ALCOHOL CONSUMPTION

Alcohol use in the study sample is displayed in Table 5. Baseline (routine) alcohol use was unknown in only 3 of the 88 (3.4%) head injured aircrew members. Self-reported alcohol use met the criteria for moderate or heavy use in 43.2% of the study sample. When measured, blood alcohol levels were positive (exceeded zero) in 10 of 12 cases (88.3%).

Table 5: Baseline Alcohol Use

Baseline alcohol use		
	Study sample	%
abstains	19	21.6%
light	28	31.8%
moderate	25	28.4%
heavy	13	14.8%
unknown	3	3.4%

ALCOHOL USE AT THE TIME OF HEAD INJURY

Table 6 reveals data regarding alcohol use at the time of injury. The history of alcohol use at the time of injury was known in 25 of 88 (28.4%) of cases, and blood alcohol level was known in 12 of 88 (13.6%). Both blood alcohol level and history of alcohol use at the time of injury was known in 11 of 88 (12.5%). Table 7 shows blood alcohol concentration, when measured. Blood alcohol levels exceeded zero in 10 of 12 cases (88.3%).

Table 6: Correlation of History/Blood Alcohol Level

		History of Alcohol Use at Time of Injury			
		Y	N	Unk	totals
Blood Alcohol	Positive	9 (10.2%)	0 (0%)	1 (1.1%)	10 (11.4%)
	Negative	0 (0%)	2 (2.3%)	0 (0%)	2 (2.3%)
	Unknown	7 (8%)	7 (8%)	62 (70.5%)	76 (86.4%)
	totals	16 (18.2%)	9 (10.2%)	63 (71.6%)	88 (100%)

Table 7: Blood Alcohol Level

	Study sample	**%**
Blood alcohol level, if taken		
0%	2	16.7%
0.01 - 0.04%	1	8.3%
0.05 - 0.99%	0	0.0%
0.10 - 0.20%	3	25.0%
greater than 0.20%	6	50.0%

ALCOHOL CONTRIBUTION TO THE HEAD INJURY

Alcohol as a Contributing Factor

As displayed in Table 8, alcohol contribution was unknown in 70.5%. Where the contribution of alcohol to injury was known, it was felt to be a contributing factor in 17 of 26 cases (65.4%).

Table 8: Alcohol Contribution to Head Injury

Alcohol Contributed to HI		
	Study sample	**%**
Yes	17	19.3%
No	9	10.2%
Unk	62	70.5%

Alcohol Contribution Assessment by Date of Evaluation

The 20 year timeframe of the study was broken down into four groups to assess whether the frequency of ascertaining alcohol contribution to head injury changed over time. The groups were as follows: 1982-1986 (group 1), 1987-1991 (group 2), 1992-1996 (group 3), 1997-2002 (group 4). Of the 25 cases in group 1, alcohol contribution was known in 6 (25%). Of the 15 cases in group 2, alcohol contribution was known in 4 (26.7%). Of the 21 cases in group 3, alcohol contribution was know in 4 (19.1%). And of the 27 cases in group 4, alcohol contribution was known in 12 (44.4%). None of the differences between groups reached statistical significance, though certainly group 4 demonstrated a trend upward in compliance, compared to the other groups.

Alcohol Contribution and Baseline Alcohol Use

In the 9 cases in which alcohol was felt not to contribute to head injury, none reported moderate or heavy baseline alcohol use. In the 17 cases in which alcohol was felt to contribute to the head injury, 10 (58.9%) reported moderate or heavy baseline alcohol use. This difference is statistically significant ($p < 0.001$).

Correlation of Blood Alcohol Level and History of Alcohol Use at Time of Injury

As seen in Table 6, there was good correlation between the history of alcohol use at the time of injury and measured blood alcohol levels, when such data was available. Within this subset, in only one case was there no agreement between history and measured blood alcohol level. In that case, the history of alcohol use at the time of injury was unknown.

Severity of Head Injury and Alcohol Use as a Contributing Factor

In the cases in whom alcohol use at the time of injury was known, alcohol was felt to be a contributing factor in 1 of 3 cases (33.3%) with mild head injury, 5 of 10 cases (50%) with moderate head injury, and 11 of 13 cases (84.6%) with severe head injury. These differences were not statistically significant.

Mechanism of Injury and Alcohol as a Contributing Factor

In the 17 cases in which alcohol was felt to be a contributing factor, motor vehicle accident (MVA) was the mechanism of injury in 7 (41.2%), followed by altercation (23.5%), falls (17.6%), pedestrian-vehicle accident (11.8%), and sports/recreational injuries (5.9%). No patients with aircraft accident as the mechanism of injury had alcohol as a contributing factor.

DISCUSSION

STUDY SAMPLE

The study sample of 88 aircrew members was surprisingly small, given the twenty-year time span considered in this study. Under-reporting of cases is possible in the event of mild head injury, in which the injury was not felt to be severe enough to warrant removal from flying duties and further evaluation. This decision is made by the flight surgeon responsible for the care of the patient, within the guidelines of Air Force Instruction 48-123. Likewise, very severe injuries may not be represented in this study sample because the injury was fatal, or because the patient was so severely injured that he/she was medically retired, and no effort was made to return that patient to flying status. While this issue could bias the study group toward less severely injured patients, the selected group of patients has significant military impact, since they represent a group that could potentially return to flying duty and thus mitigate the operational impact of their loss.

The economic and operational impact of even a small number of cases could be substantial. It is commonly accepted that the cost of training a pilot approaches $2.5 million. Thus, the 43 pilots reflected in this study represent an Air Force investment of $107.5 million. The operational impact of lost aircrew cannot be measured in dollars, but is felt in lost capability. Battles lost for lack of trained aircrew can threaten the outcome of war, as evidenced by Japanese pilot losses in WWII and the impact of this reality on their ability to wage war.

Recognition and elimination of remediable risk factors for aircrew loss define Operational Risk Management (ORM), an Air Force process that is a routine part of daily operations. While a descriptive study design cannot be used to assess causality of alcohol as a risk factor in head injury, exploring the frequency with which alcohol use is felt to contribute to head injury is important in ORM, and may point the way for further study.

DEMOGRAPHICS

Ethnicity/Age/Gender

98.9% of the study sample was of white ethnicity, and all were male. The lone non-white case was Hispanic, and there were no blacks or other ethic groups represented. The study sample differed from total Air Force and aircrew demographics with regard to both ethnicity and gender.

In the case of the officers in the sample, those studied were younger than the overall aircrew or total officer force. In his study of a civilian population, Rostenberg found that head injury patients are generally younger than 30 years old. With a mean age of 29.6 years, the age of study sample is consistent with Rostenberg's findings. Rostenberg observed that 3-4 times the number of males suffer head injury as females, but the lack of female representation in the current study sample certainly distinguishes it from the population represented in Rostenberg's study (Rostenberg, 1995).

A study of head injury in a population hospitalized at military facilities reported a mean age of 23.8 years in head-injured patients, younger than the mean age of this study's population. However, only 60% of that study population was active-duty, and child dependents of active duty members were not excluded from consideration (Omaya, 1996). The current study sample appears to be more representative of active duty aircrew than Omaya's study population.

Rank

Rank distribution for officers in the study sample approximated that of total aircrew and total officer corps. For the enlisted aircrew, the 10 individuals studied had a rank distribution that favored mid-level rank. No conclusions can be drawn about the enlisted rank distribution as compared to the remainder of the total aircrew or total enlisted force, given the small sample size.

Marital Status

Marital status differed little between the study sample and overall Air Force manning, with 64% of the study sample described as being married. Marital status has not been commonly explored as a risk factor for head injury in the literature, though one study did find that only 24% of 197 patients presenting to a level 1 trauma center were married (Dikmen, 1995), and another described 35% of those presenting to the ER as being married (Cherpitel, 1995). The current study sample clearly exceeds the proportion married in these two studies, but the proportion married in the referent populations of the cited studies was not reported.

MECHANISM OF INJURY

In Gennarelli's review of 16,524 head injury patients, MVA was the leading cause of head injury, followed by falls, assaults, pedestrian accidents, motorcycle crashes, gunshot wounds, and stabbings (Gennarelli, 1989). In this study sample, MVA was also the most frequent mechanism for head injury. Recreational/sports injuries and aircraft accidents were not reflected in Gennarelli's data, but are not unexpected in this study sample given the occupational exposures and the prevalence of sports activities in an active duty population. Altercations were less frequent in the study sample than in Gennarelli's study group, but falls were represented approximately equally (15% in Gennarelli's sample, 13.6% in the current study).

SEVERITY OF INJURY

Severity of injury was defined by the criteria contained in AFI 48-123, and these definitions differ from those used in other studies. Kraus defined severity by Glasgow Coma Scale: those with a score of 8 or lower were defined as severe; those with a GCS of 9-13 were considered moderate if accompanied by a hospital stay of at least 48 hours and an abnormal CT scan, or if they had brain surgery; and all others were considered mild (Kraus, 1989). According to AFI criteria, many of those described by Kraus as moderate would be classified as severe by Air Force criteria.

817 of 2,646 (30.9%) were classified in Kraus' study as having moderate or severe injuries, compared to 42% in the current study sample having a severe injury. It is unlikely that this difference can be explained by a greater severity of Air Force head injuries, and is

more likely that the discrepancy is due to substantial differences in case definition between the two samples. The criteria used to define severity of injury are different in the two studies, and the Air Force definition of a "severe" head injury would likely include many classified as "moderate" in other studies.

BASELINE ALCOHOL CONSUMPTION

Baseline (routine) alcohol use was categorized into abstinent, light, moderate, and heavy categories using a variation of the quantity-frequency scheme utilized by Li in his 1994 review of drinking behavior in relation to cause of death in US adults (Li, 1994). While Li did not make the distinction, subjects in the current study that reported five or more drinks per drinking session were classified as heavy drinkers. Bray, in his comparison of military and civilian substance use, also classified five or more drinks in a single drinking session as evidence of heavy alcohol use (Bray, 1991). In contrast, Allen defined heavy alcohol use as 7 or more drinks per day (Allen, 1985), a much more stringent classification scheme. The lack of a single scale to quantify alcohol use complicates efforts to compare results obtained by different investigators.

Ross and Ross, in a questionnaire study of 1,169 pilots, found that 15.9% of professional pilots were heavy drinkers (more than five drinks per occasion two or more times monthly, or an average of two drinks daily) (Ross, 1988). Cases in the current study sample, drinking two drinks daily, were at the top of the scale as moderate drinkers, but any drinking five or more drinks per session would have been classified as heavy drinkers. The

16.3% proportion of heavy drinkers among pilots in the current study approximates that of the 15.9% of heavy-drinking professional pilots described by Ross.

ALCOHOL USE AT THE TIME OF INJURY

The status of alcohol use at the time of injury was known in only 28.4% of the study sample. Given the importance of alcohol as a potential contributing factor to injury, as evidenced by the American College of Surgeons' recommendation to inquire about alcohol use in all trauma patients, this low rate of discovery is particularly worrisome. While the present study compares favorably to Danielsson's finding that only 18.7% of trauma surgeons routinely screen all trauma patients for alcohol abuse (Danielsson, 1999), the need for an aeromedical evaluation to be singularly comprehensive demands greater attention to this issue.

It is interesting that baseline alcohol use data was available in 96.6% of the study sample, while information about alcohol use at the time of injury was available in only 28.4%. There seemed to be no reluctance to broach the subject of alcohol use with aircrew, but the completeness of the inquiry with respect to the time of injury was suboptimal and warrants a review of current procedures in place to ascertain the history of alcohol use at the time of injury.

The duration of time between head injury and aeromedical evaluation at the ACS could account for potential recall bias among those whose alcohol use at the time of injury is known. In 7 of 9 cases in which the assessment of alcohol as a contributing factor was "no", no blood alcohol level was available in the record to corroborate the history. In addition, since alcohol use in conjunction with an injury carries considerable stigma in the military, and could put military benefits at risk, there could be pressure for patients to under-report alcohol use.

It is not known how much of the information gained at the time of evaluation was obtained from the clinical interview, and how much from a review of old records. Availability and review of medical records prepared at the time of injury could reduce the risk of recall bias, and offer a greater opportunity to obtain and review blood alcohol levels performed at the time of injury.

Frequency of Alcohol Assessment by Date of Evaluation

Breaking the data down into four groups by date of evaluation, it was hoped that the number of cases in which alcohol use at the time of injury was defined would increase, given the growing body of literature stressing the need to determine alcohol use at the time of traumatic injury. While 44.4% of those presenting in the last five years were evaluated for alcohol use at the time of injury, that figure is not significantly different from those evaluated in previous years, and is still far below the optimal rate of assessment.

BLOOD ALCOHOL LEVEL TESTING AT THE TIME OF INJURY

Blood alcohol level information was available in only 13.6% of those evaluated. Blood alcohol level testing must be performed by the attending physician at the time of injury, and would thus be available for review only as a recorded item in the record. It is unlikely that a patient would recall their blood alcohol level as an item of history, thus this information would only be available through a review of the medical record. Without knowledge of how often the medical record prepared at the time of injury was available for review, it is not possible to assess whether the problem with blood alcohol assessment resided with availability of the old record, or diligence in pursuit of blood alcohol testing by the initial attending physician.

Soderstrom noted that only 72% of level I trauma centers had a policy requiring blood alcohol testing of trauma patients, and only 60.7% actually performed these assessments. The number of level III trauma centers with a blood alcohol testing policy fell to 47% (Soderstrom, 1994). Only 44% of 2,649 brain injury patients were tested for blood alcohol level in Kraus' study of level 1 trauma patients (Kraus, 1989). Thus there is room across the board for improvements in alcohol testing in medical care facilities that accept trauma patients for care.

ALCOHOL AS A CONTRIBUTING FACTOR TO HEAD INJURY

In 17 of the 88 cases (19.3%), alcohol was felt to be a contributing factor to the head injury. The proportion increased to 17 of 26 cases (65.4%) when those with an unknown alcohol history at the time of injury were excluded. In each case, historical evidence of alcohol use at the time of injury or a positive blood alcohol level (at any concentration) was taken as evidence of alcohol as a contributing factor.

Cherpitel, in a review of 17 international studies of alcohol use in trauma patients, discovered positive blood alcohol levels in 6-34% of the populations studied. These populations were not specifically composed of head injury patients (Cherpitel, 1993). Rivara described a positive blood alcohol level in 47% of 2657 trauma patients (Rivara, 1993). 57% of Kraus' brain-injured population had a positive blood alcohol level (Kraus, 1989), and Galbraith described a positive blood alcohol level in 62% of 658 head-injured males (Galbraith, 1976). These studies assessed alcohol contribution only in those in whom the alcohol use data was available at the time of evaluation. Using that same approach would yield the finding that 65.4% of the 26 in the current study sample, in whom alcohol use at the time of injury was known, had alcohol as a contributing factor. However, failing to consider the 62 cases in whom alcohol use at the time of injury is unknown introduces a potential selection bias that weakens the impact of that finding.

Baseline Alcohol Use

Among those in the study sample with alcohol as a contributing factor to their head injury, 10 of 17 (58.9%) reported either moderate or heavy baseline alcohol use. Dikmen, in his study of 197 head injury patients, found that over 40% had 3 or more drinks per sitting, at least 1-2 times weekly (Dikmen, 1995).

While the study sample was not of sufficient size to determine a statistically significant difference in baseline alcohol use between those in whom alcohol was felt to contribute to injury, and those where it did not, baseline alcohol use in those whose injury was not felt to have alcohol as a contributing factor was described as abstinence in 88.9% of the cases, with none describing moderate or heavy drinking. In those whose injury was felt to have alcohol as a contributing factor, baseline alcohol use was described as abstinence in only one case, and moderate or heavy baseline drinking in 58.8% of cases. This would certainly support the assumption that heavier baseline drinkers are more likely to have alcohol as a factor contributing to injury.

Correlation of Blood Alcohol Level and History

In 11 of the 12 cases where a blood alcohol level was determined, the history of alcohol use at the time of injury correlated with the blood alcohol level. In one case, the history of alcohol use at the time of injury was unknown. In no case did the history conflict with the blood alcohol level. Cherpitel, in a study of 247 injured patients, discovered that 17% had a positive blood alcohol level on presentation, but 25% self-reported alcohol use at the time of injury (Cherpitel, 1995). This discrepancy may reflect the time-lag between the time of injury and the time at which the blood alcohol level was drawn in the face of ongoing alcohol metabolism. It is well-recognized that a blood alcohol level is a poor tool for diagnosing alcoholism in ER patients, since it will fail to recognize those alcoholic patients who were not drinking at the particular time of their accident, or those with long waiting times in the ER.

Severity of Head Injury with Alcohol as a Contributing Factor

Alcohol was felt to contribute to head injury in only 1 of 3 with a mild head injury, but in 50% of those with a moderate head injury, and 84.6% of those with a severe injury. While the sample size is too small to permit meaningful significance testing, the trend strongly suggests that alcohol was more likely to contribute to injury in those with severe head injuries than in those with mild head injuries. In contrast, Kraus found that mildly injured patients in his study of 1,155 brain injured patients were more likely to have a positive blood alcohol level than those with moderate or severe injury (Kraus, 1989). He opined that the difference in his study was due to selection bias caused by differential rates of blood alcohol level testing in the different severity groups.

Mechanism with Alcohol as a Contributing Factor

In the cases in which alcohol was felt to be a contributing factor to head injury, MVA remained the most likely mechanism of injury (38.9%). Sports/recreational injuries, which were the second most-likely mechanism of injury in the overall study sample of 88 at 19.3%, represented only one case of the 17 with alcohol as a contributing factor. Aircraft accidents, the third most likely mechanism of injury in the overall study sample, were not represented in the subgroup in which alcohol was felt to contribute to the head injury. Given the 12 hour "bottle to throttle" rule which prohibits flying within 12 hours of the consumption of alcohol, this finding could represent either a real finding, or be erroneous by means of reporting bias.

Kraus, in his review of alcohol and head injury, showed that 67% of those with MVA as a mechanism of injury has a positive blood alcohol level at the time of presentation for evaluation (Kraus, 1989). He also found a positive blood alcohol level in 60% of assault patients, 44% of fall patients, and 42% of all other causes when blood alcohol data was available. In the current study sample, 58.3% of MVA patients in whom alcohol use at the time of injury was assessed had alcohol as a contributing factor, as well as 68% of the falls, and all of the altercations, pedestrian accidents, and the sports/recreational injury. Smith, in his metaanalysis of fatal nontraffic injuries, found that 63.3% of falls had a positive blood alcohol level, as well as 40.7% of homicides in which beatings/bludgeoning was the mechanism of injury (Smith, 1999).

LIMITATIONS

Selection bias is the main limitation of the present study. The first selection bias occurred when individuals were or were not evaluated by the ACS. Those with very mild injuries, and those with very severe injuries were excluded, pushing the population toward the "middle ground" of severity. If, for instance, all of those with fatal injuries had high blood alcohol levels and had been included in the dataset, it would significantly strengthen concern about the association of alcohol with head injury.

With alcohol use at the time of injury known in just 28.4% of the study sample, a second level of potential selection bias was introduced. 65.4% of those whose alcohol status was known were positive for alcohol at the time of their injury. If alcohol users were more likely to have their use identified in history or the record, compared to those who did not use alcohol at the time of injury, then the figure of 65.4% is erroneously inflated.

Classification bias also limits the current study, particularly in attempting to compare the findings of this study to other works. The lack of a clear and consistent scale with which to measure baseline alcohol use makes study comparisons difficult. In addition, classification of the severity of head injury varies from study to study. While the Air Force is consistent in its definition of head injury severity through AFI 48-123, these definitions do not match those of civilian investigators performing other studies.

Recall bias could influence the accuracy of alcohol consumption data, both as baseline and as event-related alcohol use. While the literature suggests that self-reported alcohol use is a valid measurement, there are factors that could result in under-reporting of alcohol use in aircrew. First, alcoholism is a stigmatizing disease, particularly in the military culture. Second, the use of alcohol during an injury-producing event puts military benefits at risk and may lead to under-reporting.

Lastly, completeness of the dataset must always be in question when cases are referred in from 81 different bases by 500 different flight surgeons. While consistency in referral patterns is always the goal, there is no way to confirm that case collection in this study was complete.

Mechanisms to Address These Limitations in Future Studies

Future studies of alcohol use in a head-injured aircrew population would be most aided by completeness in data reporting. Every head-injured patient presenting to the ACS should have alcohol use at the time of injury addressed during the case history, and corroborating information should be gleaned from the medical record prepared at the time of injury. Supplementing the database with those severely injured could be accomplished by reporting Medical Board information, which addresses medical retirement, to the ACS, and by releasing information on fatal injuries from Mortuary Affairs to the ACS.

Prospective entry of cases into the database as they are evaluated could allow the calculation of risk if a control population of non-head-injured age/sex/race-matched ACS cases are selected and followed with the head injury cases.

CONCLUSION

In order to determine the contribution of alcohol to a head injury, one must first ascertain data relating to alcohol consumption at the time of injury. Alcohol use at the time of injury was known in just 28.4% of this study sample, introducing a selection bias that severely limits the interpretation of the results. While alcohol as a contributing factor was documented in 64.5% of those in whom alcohol use information was available, this proportion is of limited use without knowing the alcohol use data for the other 62 cases in the study sample.

What is evident is that in 17 of 88 patients presenting to the ACS for evaluation of head injury, alcohol was felt to have contributed to their injuries. The finding that a minimum of 19.3% of cases, most with severe head injuries, had alcohol as a contributing factor should be a source of concern to those addressing Force Protection and Operational Risk Management issues.

Future studies should focus on completeness of data reporting, on ensuring the inclusion of all aircrew head injury cases, and on considering a study design that will permit a true assessment of risk.

ETHICAL ISSUES

Since the dataset did not contain any individual identifiers, the information contained cannot be tracked back to any individual aircrew member. This dataset was not available for review in the public domain, and permission for its use was obtained from the Chief of the ACS (authorization attached in Appendix). Use of the data contained in the dataset was exempt from Institutional Review Board evaluation, citing the following regulation:

> 32CFR219.101.b.4 lists the following as an exemption from IRB review:
> (4) Research, involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Documentation of exemption by the Brooks Air Force Base Institutional Review Board is attached in the Appendix.

The data disk was maintained in a locked file cabinet, along with any paper data produced. Data stored on the computer was in a password-protected folder that was not shared on a network. No one had access to either digital or printed study-related data except for the primary investigator and the thesis review committee.

FIGURE 1: Age Distribution of Officers by Age Group (Proportion)

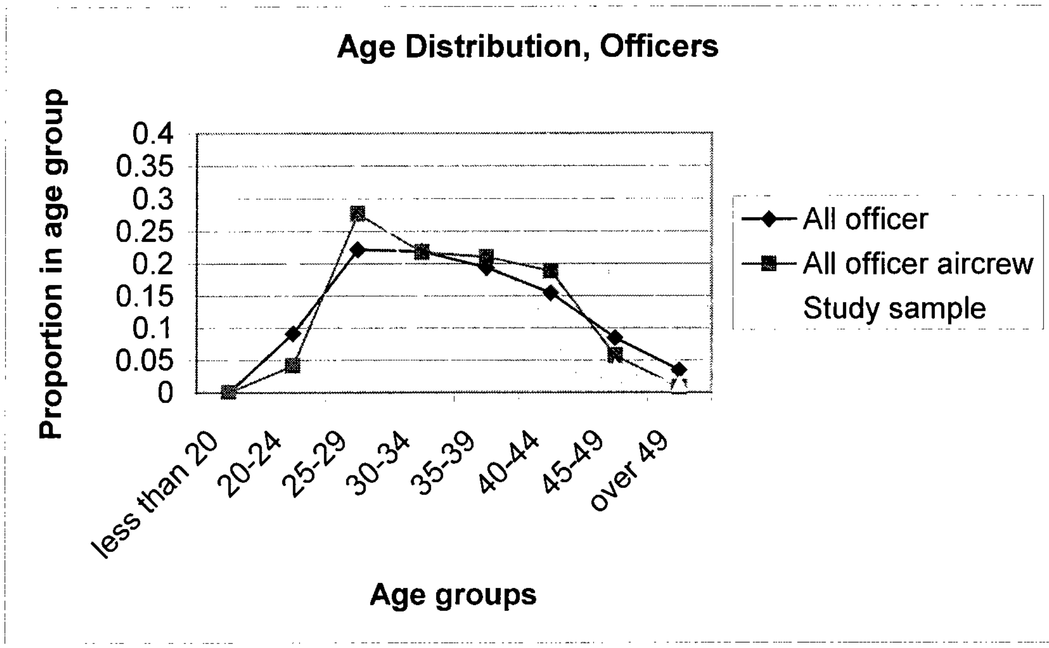
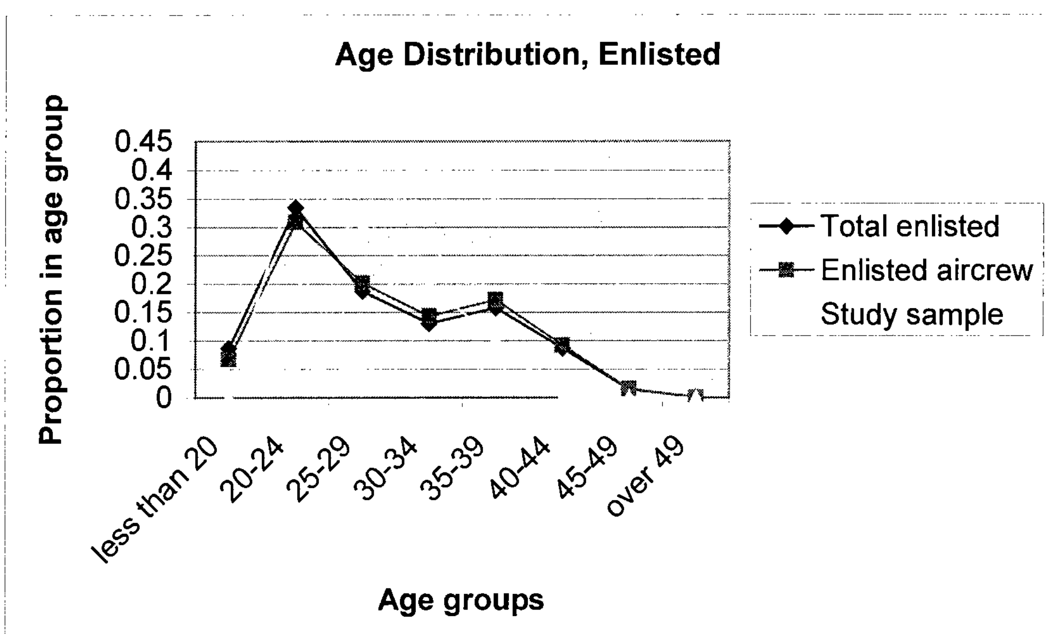


FIGURE 2: Age Distribution of Enlisted by Age Group (Proportion)



APPENDIX 1: Thesis Proposal Approval

THE UNIVERSITY *of* TEXAS
HEALTH SCIENCE CENTER AT HOUSTON
SCHOOL *of* PUBLIC HEALTH

Research Services Center
Phone 713.500.9055
Fax 713.500.9145

MEMORANDUM

TO: Patrick R. Storms

FROM: R. Sue Day, PhD
Associate Dean for Research

RE: Thesis Proposal

DATE: November 26, 2002

TITLE: Alcohol in Head-Injured Aircrew Evaluated by the Aeromedical Consult Service, 1982-2002

Your proposal has been reviewed and approved by the UT School of Public Health Research Services Center. Your proposal is exempt from review by the University of Texas Health Science Center at Houston Committee for the Protection of Human Subjects. You may proceed with your research.

CC: Dr. Jimmy Perkins
Sema Spigner, Student Affairs

Note: Other committee member(s) include Dr. Alfonso H. Holguin

APPENDIX 2: Dataset Use Approval

DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
BROOKS AIR FORCE BASE TEXAS

24 October 2002

MEMORANDUM FOR 12 ADS/SGGF
ATTENTION: LT COL PATRICK STORMS

FROM: USAFSAM/FEC

SUBJECT: Approval to Use Clinical Sciences Division Data

You are hereby authorized to use the Alcohol in Head Injury Dataset in conjunction with your thesis research project, "Alcohol in head-injured aircrew evaluated by the Aeromedical Consult Service, 1980-2002." This dataset contains no personal identifiers, and the database from which it is derived is used for clinical evaluation purposes, thus no IRB review is needed in reference to the source database.

DANIEL L. VAN SYOC
Col, USAF, MC, CFS
Chief, Clinical Sciences Division

APPENDIX 3: IRB Exemption Notice

DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
BROOKS AIR FORCE BASE TEXAS

OCT 29 2002

MEMORANDUM FOR AFIT/CI
ATTN: LT COL PATRICK STORMS

FROM: USAFSAM/GE

SUBJECT: Approval of Exempt Protocol **(#F-BR-2003-0007-E)**

1. Col Marden, Chair of the Brooks Institutional Review Board, and Col Cowles, the 311 HSW Authorizing Institutional Official (AIO) have reviewed and approved your project for your Master's thesis titled, **"Alcohol in Head-Injured Aircrew Evaluated by the Aeromedical Consult Service, 1980 - 2002"** for exemption. Approval is also required by your sponsoring civilian institution prior to commencing your study.

2. A periodic report will be due annually (Sep 03), and/or upon completion of the study whichever is soonest.

3. You may begin your research at your discretion.

Jane E. Marquardt
JANE E. MARQUARDT
Protocol Administrator

Attachments:
1. Optional Form 310
2. Col Marden's Letter, dtd 18 Oct 02
3. Exempt Protocol

APPENDIX 4: IRB Exemption Form

OMB No. 0990-0263
Approved for use through 07/31/2005

Protection of Human Subjects
Assurance Identification/IRB Certification/Declaration of Exemption
(Common Rule)

Policy: Research activities involving human subjects may not be conducted or supported by the Departments and Agencies adopting the Common Rule (56FR28003, June 18, 1991) unless the activities are exempt from or approved in accordance with the Common Rule. See section 101(b) of the Common Rule for exemptions. Institutions submitting applications or proposals for support must submit certification of appropriate Institutional Review Board (IRB) review and approval to the Department or Agency in accordance with the Common Rule.

Institutions must have an assurance of compliance that applies to the research to be conducted and should submit certification of IRB review and approval with each application or proposal unless otherwise advised by the Department or Agency.

1. Request Type	2. Type of Mechanism	3. Name of Federal Department or Agency and, if known, Application or Proposal Identification No.
[] ORIGINAL [] CONTINUATION [x] EXEMPTION	[] GRANT [] CONTRACT [] FELLOWSHIP [] COOPERATIVE AGREEMENT [x] OTHER: AFIT	USAF, #F-BR-2003-0007-E

4. Title of Application or Activity	5. Name of Principal Investigator, Program Director, Fellow, or Other
Alcohol in Head0Injured Aircrew Evaluated by the Aeromedical Consult Service, 1980 - 2002	Lt Col P. Storms

6. Assurance Status of this Project *(Respond to one of the following)*

[ ] This Assurance, on file with Department of Health and Human Services, covers this activity:
Assurance Identification No.________, the expiration date______ IRB Registration No. ______

[ ] This Assurance, on file with *(agency/dept)*________, covers this activity.
Assurance No.______, the expiration date______ IRB Registration/Identification No.______ *(if applicable)*

[ ] No assurance has been filed for this institution. This institution declares that it will provide an Assurance and Certification of IRB review and approval upon request.

[x] Exemption Status: Human subjects are involved, but this activity qualifies for exemption under Section 101(b), paragraph (4).

7. Certification of IRB Review (Respond to one of the following IF you have an Assurance on file)

[x] This activity has been reviewed and approved by the IRB in accordance with the Common Rule and any other governing regulations.
by: [ ] Full IRB Review on (date of IRB meeting)______ or [x] Expedited Review on (date) 18 Oct 02
[ ] If less than one year approval, provide expiration date ______

[ ] This activity contains multiple projects, some of which have not been reviewed. The IRB has granted approval on condition that all projects covered by the Common Rule will be reviewed and approved before they are initiated and that appropriate further certification will be submitted.

8. Comments

9. The official signing below certifies that the information provided above is correct and that, as required, future reviews will be performed until study closure and certification will be provided.	10. Name and Address of Institution
11. Phone No. *(with area code)* (210) 536-3995 12. Fax No. *(with area code)* (210) 536-2898 13. Email: stuart.cowles@brooks.af.mil	USAFSAM/GE 2601 Louis Bauer Drive Brooks AFB, TX 78235-5130
14. Name of Official STUART R. COWLES, Col, USAF, MSC	15. Title Vice Commander 311th Human Systems Wing
16. Signature Stuart R Cowles	17. Date OCT 21 2002

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APPENDIX 5: Col Marden Approval, Brooks IRB

18 Oct 2002

MEMORANDUM FOR: LT COL PATRICK STORMS

FROM: 311TH HSW/SA

SUBJECT: Alcohol in Head-Injured Aircrew Evaluated by the Aeromedical Consultation Service 1980-2002 (Your letter 3 Oct, 2002)

1. I have reviewed your request for exemption from IRB oversight for the above project. As I understand it, you will an existing data set at the Aeromedical Consultation Service that contains no personal identifiers.

2. Based on your description, this effort is considered exempt in accordance with 32 CFR 219 para 101 b(4) with the caveat that you publish the data in aggregate form in such a manner that no individual can be identified through "triangulation" on demographic data.

3. Your request is approved contingent on approval by the IRB of your sponsoring civilian institution. When received, please provide the Protocol Administrator, Mrs. Marquardt a copy of the approval. This memo, along with the approval of the civilian institution's IRB, will be placed into the minutes of the next meeting of the Brooks Institutional Review Board.

4. If you have questions, please feel free to call me at 4-4466.

HARRY E. MARDEN, JR,
Col, USAF, MC, CFS
Chair, Brooks IRB

APPENDIX 6: Dataset, Part 1

Date of eval	DOB	YOB	Yr of Injury	E vs O	Rank	Gender	Race
14-Dec-01	22-Nov-54	1954	2001	O	Col	male	White
06-Apr-83	11-Mar-43	1943	1970	O	Maj	male	White
30-Jan-02	06-May-63	1963	1994	E	SSgt	male	White
02-Mar-83	27-May-59	1959	1982	O	Lt Col	male	White
23-Sep-93	04-May-66	1966	1992	O	1Lt	male	White
18-Feb-82	23-May-36	1936	1954	O	Lt Col	male	Hispanic
24-Feb-82	19-Feb-59	1959	1981	O	2Lt	male	White
14-Jan-87	06-Jan-48	1948	1983	O	Maj	male	White
12-Jan-96	30-May-70	1970	1995	O	1Lt	male	White
16-Oct-01	21-Jan-69	1969	1989	E	SPC	male	White
31-Mar-94	02-Jun-63	1963	1992	E	SSgt	male	White
27-Mar-02	11-Feb-76	1976	2001	O	1Lt	male	White
26-May-97	09-Mar-46	1946	1991	O	WO	male	White
21-Feb-85	30-Dec-45	1945	1972	O	Capt	male	White
14-Oct-93	31-Jul-53	1953	1984	E	CMSgt	male	White
06-Jan-98	08-Aug-65	1965	1990	O	1Lt	male	White
02-Dec-88	22-Dec-61	1961	1986	O	Capt	male	White
16-Aug-96	21-Jul-62	1962	1990	O	Maj	male	White
03-Apr-02	19-Oct-63	1963	2000	O	Maj	male	White
16-Aug-95	22-Jun-51	1951	1982	O	Lt Col	male	White
10-Oct-85	25-May-46	1946	1972	O	Maj	male	White
30-Aug-93	17-Aug-54	1954	1977	O	Lt Col	male	White
23-Sep-82	18-Jan-48	1948	1982	O	1Lt	male	White
05-Mar-86	14-Jul-34	1934	1967	O	Col	male	White
04-May-92	24-Sep-53	1953	1989	O	Maj	male	White
16-Mar-01	17-Aug-73	1973	2000	O	Capt	male	White
21-Feb-86	05-Oct-44	1944	1971	O	Lt Col	male	White
02-Apr-91	09-May-55	1955	1989	O	Maj	male	White
05-Jun-02	18-Feb-64	1964	2001	E	MSgt	male	White
07-Apr-94	18-Dec-37	1937	1968	O	Col	male	White
12-Jan-83	16-Dec-55	1955	1982	O	Capt	male	White
27-Jul-90	13-Feb-48	1948	1983	O	Lt Col	male	White
04-Dec-89	07-Apr-31	1931	1967	O	Maj	male	White
21-Sep-90	27-Sep-49	1949	1989	O	Lt Col	male	White
26-Feb-92	12-Mar-45	1945	1971	O	Col	male	White
21-Jul-92	26-Jan-34	1934	1958	O	Lt Col	male	White
23-Jul-99	08-Jan-66	1966	1998	O	Capt	male	White
02-Sep-00	03-Nov-57	1957	2000	O	Lt Col	male	White
28-Sep-82	22-Mar-51	1951	1980	O	Maj	male	White

APPENDIX 7: Dataset, Part 2

Date of eval	Marital status	Position	HI Severity
14-Dec-01	Married	flight surgeon	Mild
06-Apr-83	Married	pilot	Mild
30-Jan-02	Married	enlisted	Mild
02-Mar-83	Single	student	Mild
23-Sep-93	Married	pilot	Moderate
18-Feb-82	unk	pilot	Moderate
24-Feb-82	unk	student	Moderate
14-Jan-87	Married	navigator	Moderate
12-Jan-96	Married	pilot	Moderate
16-Oct-01	Married	enlisted	Moderate
31-Mar-94	Married	enlisted	Moderate
27-Mar-02	Married	pilot	Moderate
26-May-97	Married	pilot	Severe
21-Feb-85	Married	navigator	Severe
14-Oct-93	Unknown	enlisted	Severe
06-Jan-98	unk	pilot	Severe
02-Dec-88	Married	pilot	Severe
16-Aug-96	Single	pilot	Severe
03-Apr-02	Married	flight surgeon	Severe
16-Aug-95	Married	navigator	Mild
10-Oct-85	Married	pilot	Mild
30-Aug-93	Married	navigator	Mild
23-Sep-82	Married	other	Mild
05-Mar-86	Married	pilot	Moderate
04-May-92	Married	pilot	Moderate
16-Mar-01	Single	pilot	Moderate
21-Feb-86	Married	pilot	Moderate
02-Apr-91	Married	pilot	Moderate
05-Jun-02	Divorced	enlisted	Severe
07-Apr-94	Married	pilot	Severe
12-Jan-83	Married	navigator	Severe
27-Jul-90	Married	navigator	Severe
04-Dec-89	Married	pilot	Mild
21-Sep-90	Married	pilot	Mild
26-Feb-92	Married	pilot	Mild
21-Jul-92	Married	pilot	Mild
23-Jul-99	Single	navigator	Mild
02-Sep-00	Married	navigator	Mild
28-Sep-82	unk	flight surgeon	Mild

APPENDIX 8: Dataset, Part 3

Date of eval	BAT recorded?	BAT	Hx EtOH use proximate?	EtOH related?	Baseline use
14-Dec-01	FALSE		No	No	abstains
06-Apr-83	FALSE		Unk	Unk	abstains
30-Jan-02	TRUE	0.22	Yes	Yes	abstains
02-Mar-83	FALSE		Unk	Unk	abstains
23-Sep-93	FALSE		No	No	abstains
18-Feb-82	FALSE		Unk	Unk	abstains
24-Feb-82	TRUE	0	No	No	abstains
14-Jan-87	TRUE	0	No	No	abstains
12-Jan-96	FALSE		No	No	abstains
16-Oct-01	FALSE		No	No	abstains
31-Mar-94	FALSE		Unk	Unk	abstains
27-Mar-02	FALSE		Unk	Unk	abstains
26-May-97	FALSE		No	No	abstains
21-Feb-85	FALSE		Unk	Unk	abstains
14-Oct-93	FALSE		Unk	Unk	abstains
06-Jan-98	FALSE		No	No	abstains
02-Dec-88	FALSE		Unk	Unk	abstains
16-Aug-96	FALSE		Unk	Unk	abstains
03-Apr-02	FALSE		Unk	Unk	abstains
16-Aug-95	FALSE		Unk	Unk	heavy
10-Oct-85	FALSE		Unk	Unk	heavy
30-Aug-93	FALSE		Unk	Unk	heavy
23-Sep-82	FALSE		Unk	Unk	heavy
05-Mar-86	FALSE		Unk	Unk	heavy
04-May-92	FALSE		Unk	Unk	heavy
16-Mar-01	FALSE		Yes	Yes	heavy
21-Feb-86	FALSE		Unk	Unk	heavy
02-Apr-91	TRUE	0.22	Yes	Yes	heavy
05-Jun-02	TRUE	0.17	Yes	Yes	heavy
07-Apr-94	FALSE		Unk	Unk	heavy
12-Jan-83	FALSE		Yes	Yes	heavy
27-Jul-90	FALSE		Unk	Unk	heavy
04-Dec-89	FALSE		Unk	Unk	light
21-Sep-90	FALSE		Unk	Unk	light
26-Feb-92	FALSE		Unk	Unk	light
21-Jul-92	FALSE		Unk	Unk	light
23-Jul-99	FALSE		Unk	Unk	light
02-Sep-00	FALSE		Unk	Unk	light
28-Sep-82	FALSE		No	No	light

APPENDIX 9: Dataset, Part 4

Date of eval	DOB	YOB	Yr of Injury	E vs O	Rank	Gender	Race
09-Aug-91	23-Nov-59	1959	1982	O	Capt	male	White
28-Oct-93	10-Jun-51	1951	1971	O	Capt	male	White
30-Apr-87	07-Mar-55	1955	1982	O	Capt	male	White
14-Feb-90	30-Jun-63	1963	1989	O	2Lt	male	White
12-Sep-94	14-Apr-44	1944	1987	O	Col	male	White
06-Feb-01	09-Jun-62	1962	1984	O	Maj	male	White
31-Jan-01	28-Aug-73	1973	2000	O	2Lt	male	White
03-May-83	31-Jan-47	1947	1972	O	Capt	male	White
17-Jul-84	04-Feb-36	1936	1974	O	Lt Col	male	White
05-Sep-85	30-Nov-46	1946	1983	O	Capt	male	White
23-Jan-02	11-Jun-77	1977	2001	E	SSgt	male	White
08-May-92	12-Oct-49	1949	1987	O	Lt Col	male	White
21-Apr-98	01-Aug-52	1952	1986	O	Col	male	White
20-Jan-00	28-Dec-63	1963	1998	O	Maj	male	White
02-May-97	09-Jan-62	1962	1996	O	Capt	male	White
06-Mar-00	02-Apr-74	1974	1999	O	1Lt	male	White
14-May-97	10-Sep-66	1966	1994	E	SSgt	male	White
02-Sep-97	27-Jun-70	1970	1990	E	SSgt	male	White
28-Mar-84	09-Apr-29	1929	1983	O	Col	male	White
31-Mar-88	03-Mar-62	1962	1983	O	1Lt	male	White
21-Nov-01	04-Jul-77	1977	2001	E	SSgt	male	White
03-Jun-97	27-Nov-50	1950	1975	O	Lt Col	male	White
25-May-01	02-Dec-57	1957	2000	O	Maj	male	White
16-Oct-85	22-Apr-37	1937	1979	O	Lt Col	male	White
23-Jan-86	12-Dec-43	1943	1981	O	Maj	male	White
04-Jun-92	08-Mar-57	1957	1981	O	Capt	male	White
06-Jun-90	13-May-60	1960	1983	O	Capt	male	White
14-Jul-83	21-Aug-55	1955	1981	O	Capt	male	White
15-Oct-86	24-Feb-37	1937	1967	O	Lt Col	male	White
30-Nov-92	27-Oct-48	1948	1992	O	WO	male	White
15-Jun-90	04-Jan-68	1968	1987	O	2Lt	male	White
31-Oct-85	23-Nov-64	1964	1983	O	Cadet	male	White
02-Nov-88	29-Jul-60	1960	1986	O	Capt	male	White
07-Nov-83	31-Oct-50	1950	1981	O	Capt	male	White
15-Apr-96	18-Aug-62	1962	1991	O	Capt	male	White
04-Jun-02	21-Sep-76	1976	2001	O	1Lt	male	White
09-Feb-82	21-May-58	1958	1981	O	2Lt	male	White
09-Nov-82	16-Jan-44	1944	1972	O	Lt Col	male	White
08-Aug-91	27-May-60	1960	1986	O	Capt	male	White
07-Oct-94	15-Dec-63	1963	1989	O	Capt	male	White

APPENDIX 10: Dataset, Part 5

Date of eval	Marital status	Position	HI Severity	Mechanism
09-Aug-91	Married	navigator	Mild	MVA
28-Oct-93	Married	pilot	Mild	other
30-Apr-87	Married	navigator	Mild	Sports/recreational
14-Feb-90	Married	student	Mild	Sports/recreational
12-Sep-94	Married	pilot	Mild	Sports/recreational
06-Feb-01	unk	pilot	Mild	unk
31-Jan-01	Single	student	Moderate	Altercation
03-May-83	unk	pilot	Moderate	Fall
17-Jul-84	Married	pilot	Moderate	MVA
05-Sep-85	Married	pilot	Moderate	MVA
23-Jan-02	Married	enlisted	Moderate	Sports/recreational
08-May-92	Married	pilot	Severe	Fall
21-Apr-98	Married	flight surgeon	Severe	Fall
20-Jan-00	Single	navigator	Severe	Fall
02-May-97	Married	pilot	Severe	Fall
06-Mar-00	Single	navigator	Severe	MVA
14-May-97	Single	enlisted	Severe	MVA
02-Sep-97	Married	enlisted	Severe	other
28-Mar-84	Married	flight surgeon	Severe	Ped-vehicle accident
31-Mar-88	Married	student	Severe	Sports/recreational
21-Nov-01	Married	enlisted	Severe	Sports/recreational
03-Jun-97	Married	navigator	Mild	Aircraft accident
25-May-01	Married	navigator	Mild	Fall
16-Oct-85	Single	navigator	Mild	MVA
23-Jan-86	unk	pilot	Mild	MVA
04-Jun-92	Married	flight surgeon	Mild	other
06-Jun-90	Married	pilot	Mild	Sports/recreational
14-Jul-83	Divorced	pilot	Moderate	Altercation
15-Oct-86	unk	pilot	Moderate	MVA
30-Nov-92	Married	pilot	Moderate	MVA
15-Jun-90	Single	student	Moderate	Ped-vehicle accident
31-Oct-85	Single	student	Moderate	Sports/recreational
02-Nov-88	unk	pilot	Moderate	Sports/recreational
07-Nov-83	unk	pilot	Severe	Altercation
15-Apr-96	Married	pilot	Severe	Fall
04-Jun-02	Single	pilot	Severe	Fall
09-Feb-82	Single	student	Severe	MVA
09-Nov-82	Married	pilot	Severe	MVA
08-Aug-91	Married	pilot	Severe	MVA
07-Oct-94	Single	navigator	Severe	MVA

APPENDIX 11: Dataset, Part 6

Date of eval	BAT recorded?	BAT	Hx EtOH use proximate?	EtOH related?	Baseline use
09-Aug-91	FALSE		Unk	Unk	light
28-Oct-93	FALSE		Unk	Unk	light
30-Apr-87	FALSE		Unk	Unk	light
14-Feb-90	FALSE		Unk	Unk	light
12-Sep-94	FALSE		Unk	Unk	light
06-Feb-01	FALSE		Unk	Unk	light
31-Jan-01	TRUE	0.36	Yes	Yes	light
03-May-83	FALSE		Unk	Unk	light
17-Jul-84	FALSE		Unk	Unk	light
05-Sep-85	FALSE		Unk	Unk	light
23-Jan-02	FALSE		Unk	Unk	light
08-May-92	FALSE		Unk	Unk	light
21-Apr-98	FALSE		Unk	Unk	light
20-Jan-00	FALSE		Unk	Unk	light
02-May-97	TRUE	0.277	Yes	Yes	light
06-Mar-00	FALSE		Unk	Unk	light
14-May-97	TRUE	0.14	Yes	Yes	light
02-Sep-97	FALSE		Unk	Unk	light
28-Mar-84	FALSE		Unk	Unk	light
31-Mar-88	FALSE		Unk	Unk	light
21-Nov-01	TRUE	0.209	Yes	Yes	light
03-Jun-97	FALSE		Unk	Unk	moderate
25-May-01	FALSE		Unk	Unk	moderate
16-Oct-85	FALSE		Unk	Unk	moderate
23-Jan-86	FALSE		Unk	Unk	moderate
04-Jun-92	FALSE		Unk	Unk	moderate
06-Jun-90	FALSE		Unk	Unk	moderate
14-Jul-83	FALSE		Yes	Yes	moderate
15-Oct-86	FALSE		Unk	Unk	moderate
30-Nov-92	FALSE		Unk	Unk	moderate
15-Jun-90	FALSE		Yes	Yes	moderate
31-Oct-85	FALSE		Unk	Unk	moderate
02-Nov-88	FALSE		Unk	Unk	moderate
07-Nov-83	FALSE		Unk	Unk	moderate
15-Apr-96	FALSE		Yes	Yes	moderate
04-Jun-02	FALSE		Yes	Yes	moderate
09-Feb-82	FALSE		Unk	Unk	moderate
09-Nov-82	FALSE		Unk	Unk	moderate
08-Aug-91	FALSE		Unk	Unk	moderate
07-Oct-94	FALSE		Unk	Unk	moderate

APPENDIX 12: Dataset, Part 7

Date of eval	DOB	YOB	Yr of Injury	E vs O	Rank	Gender	Race
15-Feb-02	04-Sep-71	1971	1996	E	SSgt	male	White
16-Jan-85	06-Aug-61	1961	1984	O	2Lt	male	White
12-Mar-91	16-Jun-62	1962	1983	O	Capt	male	White
03-Aug-92	24-Apr-62	1962	1986	O	Capt	male	White
13-Jan-00	21-Apr-70	1970	1994	O	Capt	male	White
15-May-02	01-Dec-66	1966	2001	O	Maj	male	White
23-May-94	13-Dec-60	1960	1993	O	Capt	male	White
25-Oct-82	11-Nov-32	1932	1978	O	Lt Col	male	White
11-Oct-94	21-May-68	1968	1990	O	1Lt	male	White

Date of eval	Marital status	Position	HI Severity	Mechanism
15-Feb-02	Divorced	enlisted	Severe	MVA
16-Jan-85	Single	pilot	Severe	MVA
12-Mar-91	Married	student	Severe	MVA
03-Aug-92	Married	pilot	Severe	Ped-vehicle accident
13-Jan-00	Married	other	Severe	Sports/recreational
15-May-02	Married	pilot	Severe	Sports/recreational
23-May-94	unk	pilot	Severe	MVA
25-Oct-82	unk	navigator	Severe	MVA
11-Oct-94	Unknown	student	Severe	MVA

Date of eval	BAT recorded?	BAT	Hx EtOH use proximate?	EtOH related?	Baseline use
15-Feb-02	FALSE		Unk	Unk	moderate
16-Jan-85	TRUE	0.257	Yes	Yes	moderate
12-Mar-91	TRUE	0.18	Yes	Yes	moderate
03-Aug-92	FALSE		Unk	Unk	moderate
13-Jan-00	FALSE		Unk	Unk	moderate
15-May-02	FALSE		Unk	Unk	moderate
23-May-94	FALSE		Unk	Unk	unknown
25-Oct-82	FALSE		Yes	Yes	unknown
11-Oct-94	TRUE	0.03	Unk	Yes	unknown

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VITA

PII Redacted

Dr. Patrick Storms [redacted], the third of four children to [redacted]. He was raised in Port Arthur, Texas and obtained his undergraduate education at Lamar University, graduating with a B.S. in Biology in 1978. He went on to attend medical school at Baylor College of Medicine and graduated with honors, earning his M.D. in 1981. His postgraduate training consisted of an Internal Medicine residency at Baylor University Medical Center (Dallas, Texas) from 1981 to 1984, followed by a Gastroenterology fellowship at the University of Texas Southwestern Medical Center at Dallas from 1984 to 1986. Board certified in both Internal Medicine and Gastroenterology, he joined the Medical Arts Clinic of Corsicana, Texas in 1986. In 1988 he relocated to Beaumont, Texas to establish Southeast Texas Gastroenterology Associates, and he remained in private practice there until 1995, when he answered his country's call and joined the United States Air Force. His military duties began at Wilford Hall Medical Center, followed by assignment to Langley Air Force Base, Virginia, in October, 1996. In July, 2000 he was assigned to the Air Force Personnel Center as Chief of Physician Utilization, and served there until entering the Residency in Aerospace Medicine program in July, 2002. Dr. Storms is married to [redacted] and has three children: [redacted]

This thesis was typed by Patrick Storms.