

CHAPTER 12

PSYCHOLOGICAL ASSESSMENT

INTRODUCTION

Background

Emotional illnesses or psychological abnormalities are not generally recognized as primary clinical endpoints following exposure to chlorophenols, phenoxy herbicides, and dioxin. "Neurobehavioral effects" occasionally ascribed to such exposures have been, in fact, predominantly neurological symptoms for which causation is not disputed (see Chapter 11). Higher central nervous system (CNS) functioning, in terms of cognitive skills, personality, and reactivity, may be temporarily or permanently impaired depending on the exposure and the ability to measure accurately the psychological changes.

Animal studies provide little insight into possible human psychological problems. Animal signs of lethargy, stupor, poor coordination, lack of feeding, and agitation have been observed in multiple studies involving many species. These signs have generally been attributed to the "wasting syndrome" or multiorgan toxicity, rather than primary CNS toxicity.¹ A study of "behavioral" effects in rats following single and weekly doses of 2,4-D showed that the central effects of decreased coordination and lever-pressing behavior were transient and reversible.²⁻⁹ Transient myotonia was the most consistently observed effect, while the results for other specific effects were contradictory. One experiment did measure increased levels of acetylcholinesterase in rat muscle with 2,4-D exposure, which was accompanied by interference with distal motor activities.⁹ Further, no latent CNS impairment was detected after a d-amphetamine challenge.

Human studies and case reports have occasionally noted psychological disorders or symptom complexes following exposure to herbicides and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD or dioxin). Complaints included headache, anxiety, malaise, depression, abnormal anger, mood changes, sleep disturbances, decreased libido, and impotence. Scientific confirmation of these symptoms by psychological testing is difficult and exclusion of other plausible causes such as age or preexisting psychological abnormalities is often impossible. Most studies have merely recorded complaints and have not pursued their validation by indepth functional testing.

Early studies of industrial chemical workers first provided the suggestion of psychological effects. Followup studies from the Nitro, West Virginia, accident in 1949 showed "nervousness," fatigue, irritability, cold intolerance, and decreased libido in many of the workers with chloracne, but most of these symptoms subsided over a 4-year period.^{10,11} Two followup studies of expanded (but slightly different) plant cohorts in 1979, noted reports of sexual dysfunction and decreased libido.^{12,13} One of these studies noted that these observations (and insomnia) were significantly increased in individuals with chloracne.¹² Neither of these followup efforts conducted neurobehavioral tests to validate the reported symptoms.

Other industrially based studies reported symptoms of fatigue;¹⁴⁻²⁰ decreased libido;¹⁴ impotence;¹⁴ sleep disturbances;^{15,18-20} reduced emotional responses;¹⁵ sensory deficits of smell, taste, and hearing;¹⁶ reading difficulties;¹⁶ memory loss;¹⁸ and emotional disorders.^{19,20} Symptoms of depression and anxiety have been associated with disfiguring chloracne. One study found a relationship between chloracne and hypomania as determined from the Minnesota Multiphasic Personality Inventory (MMPI),²¹ and another noted that two of three chemists involved in the synthesis of TCDD developed marked personality changes.²² Although data interpretation problems exist, a Czechoslovakian 10-year followup study cited eight cases of severe dementia in exposed workers and reported that symptoms of anxiety and depression decreased over the followup period.²⁰

A contemporary cross-sectional morbidity study of a mobile-home park, environmentally contaminated with dioxin, showed subclinical hepatic, hematologic, immunologic, and psychological changes in exposed residents.²³ Significant abnormalities were recorded in the exposed group for the tension/anxiety and anger/hostility scales of the Profile of Mood States Inventory, as well as the vocabulary subtest of the Wechsler Adult Intelligence Scale (WAIS). However, functional testing by the Halstead-Reitan Battery (HRB) did not reveal significant group differences. There was no way to differentiate between the primary effects of exposure and the secondary effects of publicity.

In contrast to industrial cohorts, the study of chemically related psychological problems in veterans has proved more difficult because of the confounding effects of combat stress and the post-traumatic stress disorder (PTSD), and the uncertainty of exposure. Of almost 100,000 Vietnam veterans registered in the Veterans Administration's Agent Orange Registry in 1983, 18 percent complained of "nervousness" and 10 percent cited personality disorders.²⁴ A psychiatric review of 132 veterans included in the Registry, most of whom had been referred for treatment, disclosed a symptom hierarchy of sleep disorders (53%), mood depression (36%), suicidal thoughts (35%), and irritability (31%).²⁵ Fifty-three percent of these veterans received the PTSD diagnosis.

In 1980, the American Psychiatric Association established the term "post-traumatic stress disorder" to define a neurosis caused by extreme psychic trauma, e.g., natural disaster, war, imprisonment, or torture.²⁶ PTSD comprises the symptoms of anxiety, "powder keg" anger, depression, irritability, restlessness, recurrent intrusive dreams, flashbacks, and sleeplessness. Quiescent PTSD may be acutely reactivated in some individuals by specific triggering events (e.g., visiting the Vietnam Memorial).²⁷ The disorder is equally applicable to civilians following emotionally traumatic experiences. The onset of PTSD may immediately follow the traumatic event or it may occur years afterward. The older terms "shell shock," "combat fatigue," and "anxiety reaction" generally referred to the more immediate symptoms following the trauma of war, although components of PTSD are now recognized in veterans of earlier wars.

The prevalence of PTSD in Vietnam veterans is unknown, and even the qualitative assessments of "common" or "rare" are debatable.^{28,29} A 7-month incidence of legal and emotional maladjustments in returning Vietnam veterans occurred at the rate of 23 percent and did not differ significantly from comparable rates in nonveterans.³⁰ Though a concise definition of PTSD exists,

there is controversy as to the best means of diagnosis. Some investigators prefer a full and thorough clinical interview²⁸ while others favor empiric symptom scales.²² Each method serves a different, but highly related, purpose: clinical diagnosis in individuals versus an epidemiologic and statistical contrast of groups.

Risk factors for the development of PTSD may include emotional predisposition, social/ethnic background, parental factors, race, and combat intensity ranging from slight involvement to participation in atrocities.^{28,32,33} Parallel conditions to PTSD (or perhaps unrecognized components of PTSD) encompass alcoholism, drug abuse, lawlessness, (arrests and felony convictions), personality disorders, and frank psychosis.^{28,32-34}

A number of studies have attempted to investigate the relationship between PTSD and herbicide exposure in Vietnam veterans. As with studies investigating other health effects in this group, the most difficult problem is the determination of exposure. Among the methods used have been self-reporting of exposure, use of chloracne symptoms as a definitive indicator of exposure (both self-reported and medically diagnosed), and various attempts to relate the location of a veteran to use of herbicides. All of these methods are at present controversial and of unproven validity. Self-reporting has been shown to be highly inaccurate for most applications, and for this application in particular. Use of chloracne as an indicator has been the main method of choice. One study using 6 Vietnam veterans with current mild cases of chloracne in the malar and postauricular area and 25 control subjects selected from the same sample group found significant evidence of organic psychological deficits in the exposed subjects based on the results of a neuropsychological battery.³⁵ This study included the influence of level of combat experience with all of the control group having experienced heavy combat, while two of the exposed group experienced only light combat.

A case study of a single veteran exposed to Agent Orange, based on self-reporting of exposure and the presence of chloracne, found motor and sensory nerve conduction velocities normal and reflexes normal but muscle function revealed fibrillations, polyphasic potentials, and general muscle instability.³⁶ The use of chloracne as an indicator of exposure, however, has been questioned in that the use of any physical symptom as a marker does not prove that symptom is a result of Vietnam-herbicide exposure and not the result of other physical or psychological sources.³⁷ Another study of 15 Vietnam veterans exposed for 15 months or less (no criteria for exposure is discussed) who claimed symptoms of sensory neuropathy showed no significant differences in nerve conduction velocities or latencies.³⁸

A newer method of determining exposure in Vietnam veterans has been to use a probabilistic approach. One study utilized data based on self-reported locations of service in Vietnam and Department of Defense records on locations where herbicides were used to develop probabilities for exposure.³⁹ Based on the resulting probability distribution, a group of 100 randomly selected Vietnam veterans were assessed for psychological problems and for self-reporting bias in symptoms. It was found that by using the probabilistic approach, no significant differences in psychological problems were seen between the two groups; however, very significant differences were seen using self-reported exposures. While the authors of the study indicated they probably overpredicted exposures because of a lack of data relating time of

service to service in and where herbicides were used, they did conclude that self-reported exposures are highly unreliable, but the belief in exposure may be of great significance in relation to psychological symptoms.

Another much larger study using this probabilistic approach randomly selected 6,810 American Legionnaires who served during the Vietnam War. The group was divided into those who served in Southeast Asia (SEA) and those who served elsewhere during that same time. Those serving in SEA were considered the possibly exposed group (including 102 known handlers of herbicides), and those who served elsewhere were considered unexposed. The probability of exposure was based on the time and location of service of each veteran and the time(s) of herbicide use in each area as identified from recently released data from the US Army Joint Services Environmental Support Group.³⁹ The level of combat experience was evaluated along with a number of social and behavioral effects. The results of the study showed that though herbicide exposure could not independently predict reported psychosocial outcomes, it did significantly predict the outcomes when used as a cross-product with combat, indicating that a synergistic effect may be occurring.⁴⁰ Reported outcomes were not verified by records review or psychological testing.

These reports all used methods to determine exposure that have been challenged.⁴¹

Baseline Summary Results

An extensive battery of psychological parameters was assessed on all participants during the 1982 Baseline questionnaire and physical examination. The expected high degree of concordance between education (college, high school) and military rank (officer, enlisted) was observed and validated the use of education as the sole covariate representing socioeconomic status for most analyses.

There were no questionnaire differences for past history of emotional or psychological illnesses between the Ranch Hand and Comparison groups. For the psychological indices of fatigue, anger, erosion, anxiety, and severity of depression (as determined by a modification of the Diagnostic Interview Schedule⁴²), no group differences were detected among the college-educated Ranch Hands. However, for the high school-educated stratum, Ranch Hands demonstrated significantly more fatigue, anger, erosion, and anxiety. An unadjusted analysis of reported depression showed significantly more depression in the Ranch Hands, as did the isolation index adjusted for educational level. Exposure index analyses from the Ranch Hand questionnaire data did not suggest a relationship between exposure and psychological abnormality.

At the time of the physical examination, additional self-reported data were collected with the Cornell Index and the MMPI. The CNS functional testing was conducted by a modified HRB, and intelligence was measured by the WAIS.

The Cornell Index showed a significant increase in psychophysiologic symptoms in the high school-educated Ranch Hands. Six of 10 parameters of the Cornell Index were abnormal in the Ranch Hands (e.g., fear, startle,

psychosomatic) as contrasted to the Original Comparisons, and all abnormal responses/parameters were inversely related to education to a statistically significant degree. MMPI results in the high school-educated participants showed differences in the scales of denial, hypochondria, masculinity/femininity, and mania/hypomania as contrasted to the college-educated group. Only the social introversion scale was significant in the college-educated participants. The effect of education was influential ($p < 0.01$) in all scales of the MMPI. Race was not a significant covariate. None of the self-reported data, including those from the in-home questionnaire, were adjusted for possible group differences in PTSD or combat experience/intensity.

Performance testing by the HRB showed no neuropsychiatric impairment in the Ranch Hands in contrast to the results of the self-administered MMPI and Cornell Index. In fact, Ranch Hand overreporting in several parameters was suggested, but was not proved. The effect of education on the Halstead-Reitan testing was strong ($p < 0.0001$). WAIS intelligence scores revealed very close group similarities in the full-scale and verbal and performance scales. As expected, the intelligence quotient (IQ) of college graduates was significantly higher than the IQ of high-school graduates. Exposure index analyses of the HRB and WAIS data were negative and disclosed no patterns that suggested a herbicide effect.

1985 Followup Study Summary Results

Two of the psychological tests (MMPI, HRB) conducted at the 1982 Baseline examination were repeated at the first followup examination in 1985. Repetitive testing was accomplished for purposes of clinical validation, establishment of comparable longitudinal parameters, and comparable covariate adjustments by concurrently derived PTSD and combat experience indices.

Questions from the Diagnostic Interview Schedule were deleted from the followup questionnaire and were replaced by questions on combat experience in Vietnam. An updated history of mental and emotional disorders was obtained on all participants. An indicator of PTSD was derived from a new MMPI subscale³¹ and was used for covariate adjustments of non-MMPI psychological data. The WAIS IQ assessment was deleted, but all parameters of the MMPI and HRB were retained. The Cornell Medical Index (CMI)⁴³ was substituted for the Cornell Index in the 1985 psychological assessment.

The dependent variables and covariates of the 1985 followup examination were similar to those analyzed at the Baseline. Longitudinal analyses of the MMPI scales of denial and depression considered the change of psychological test indices between groups.

Questionnaire data (verified by medical record reviews) for the lifetime events of psychotic illness, alcohol dependence, anxiety, or other neuroses disclosed no significant differences between groups for these conditions.

Analyses of the 1985 followup psychological examination emphasized 14 scales from the MMPI, 3 parameters of the CMI, and the HRB impairment index.

The similarity of the group distribution for the 14 MMPI variables, each stratified by the 3 occupational categories, was examined, and only 2 of the

42 tests approached statistical significance. The group distributions of the total CMI score were similarly contrasted, with separate analyses performed with stratification by the five covariates of age, race, occupation, education, and current drinking status. For one stratum of each of these covariates, a significant difference in the distribution of the Ranch Hand and Comparison scores was found. In all cases for the CMI, the Ranch Hand mean was greater than the Comparison mean.

The unadjusted analyses showed a significant difference for the MMPI scales of denial ($p < 0.001$) and masculinity/femininity ($p = 0.017$), the total CMI ($p < 0.001$), and the Section A-H area subscore ($p = 0.003$). A borderline significant difference was observed for the MMPI scales of hysteria ($p = 0.067$) and social introversion ($p = 0.069$). Comparisons had a greater percentage of abnormal scores for the denial and masculinity/femininity scales, whereas Ranch Hands showed adverse findings for the other four variables. The overall MMPI results have been interpreted in light of the significant increased denial in the Comparison group.

The covariates of age, education, lifetime alcohol history, current alcohol use, and occupation had pronounced effects on the psychological variables, with a significant association or a borderline significant association with at least two-thirds of the 18 psychological variables. Many dependent variables were affected by age in an expected pattern. Very few variables exhibited this pattern of consistency with lifetime alcohol history. The intermediate category of greater than 0 to 50 drink-years often had the smallest proportion of abnormalities. The PTSD variable, derived from a subset of the MMPI, was strongly associated with the CMI measures, but not with the HRB Impairment Index. Race and the Vietnam combat index (used for the MMPI subscales) had significant associations with a lesser amount of the psychological variables (6 of 18 variables and 3 of 14 variables, for race and combat index, respectively).

The adjusted analyses were generally quite similar to the unadjusted analyses with respect to group differences, although a direct comparison of these analyses was often clouded by the presence of a substantial number of interactions (six group-by-covariate interactions were significant, and three interactions approached significance [$0.05 < p < 0.10$]). The MMPI scales of denial and masculinity/femininity were statistically significant in both the adjusted and unadjusted analyses, where Comparisons showed an adverse effect over Ranch Hands. The A-H subscore of the CMI (suggesting diffuse medical problems) was also significant, where the Ranch Hands had higher mean scores than the Comparisons, suggesting that the Ranch Hands had more illness. Education was often involved in significant group interactions, with high school-educated Ranch Hands demonstrating a higher percentage of abnormal scores than high school-educated Comparisons. No group differences were observed in the college-educated stratum. The M-R subscore of the CMI, a broad indicator of emotional health, was not statistically different between the two groups.

The HRB impairment index, a measure of CNS functional integrity, did not differ significantly between the Ranch Hand and Comparison groups. Strong covariates in the adjusted analysis were age, race, and education.

Because of alternate statistical models and slightly different psychological testing parameters, a direct contrast between the psychological results of the Baseline and 1985 followup examinations was not always possible. However, several broad patterns were observed: (1) the discordance between distributional tests and results from traditional statistical models of the MMPI variables was noted with data from both examinations; (2) there was a narrowing of group differences at the 1985 followup examination for most subjective variables, either by a decrease in Ranch Hand reporting, or by an increase in Comparison reporting; and (3) as at the Baseline, functional CNS testing, as measured by the HRB impairment index, showed no group differences, and did not support an organic basis for differences in self-reported symptomatology. The longitudinal analysis of two MMPI scales, depression and denial, showed a significant reversal of depression seen at Baseline in the high school-educated Ranch Hands.

The determination of PTSD in both Air Force cohorts by a relatively new MMPI scale showed a prevalence rate of less than 1 percent. This low rate is strongly influenced by characteristics of the study population (e.g., age, education, and officer ratio).

Unadjusted exposure index analyses did not reveal any patterns consistent with a dose-response relationship. For the adjusted exposure analyses, approximately one-third presented exposure interactions with the covariates of race, education, and age, but no consistent pattern could be identified.

In conclusion, significant test results were present in both groups or were noted in specific subgroups of a covariate. Educational level, age, and alcohol use showed strong effects on the psychological scales and scores in this psychological assessment. Testing of the CNS by the HRB demonstrated an almost identical prevalence of abnormality in both groups.

Parameters of the 1987 Psychological Assessment

Dependent Variables

Questionnaire and physical examination data were used in the 1987 psychological assessment.

Questionnaire Data

At the 1987 followup face-to-face interview, each participant was asked whether he had a mental or emotional disorder since the date of his last interview. Reported disorders for which treatment was obtained were subsequently verified by reviews of medical records. Information on verified psychological disorders from the 1987 followup was combined with verified disorders from the Baseline and 1985 followup studies, and a series of dependent variables regarding verified history of psychological disorders was created. In particular, the verified histories of psychoses, alcohol dependence, drug dependence, anxiety, and other neuroses were studied. Participants with a verified pre-SEA history of a psychological disorder were excluded from the analyses pertaining to the disorder.

Each participant was also asked a series of questions regarding sleep problems.⁴⁴ Each participant was asked whether he had a current or past problem with the following 12 sleep disorders: (1) trouble falling asleep, (2) waking up during the night, (3) waking up too early and can't go back to sleep, (4) waking up unrefreshed, (5) involuntarily falling asleep during the day, (6) great or disabling fatigue during the day, (7) frightening dreams, (8) talking in sleep, (9) sleepwalking, (10) abnormal movement or activity during the night, (11) sleep problems requiring medication, and (12) snore loudly in all sleeping positions. Each of these conditions was considered to be a problem if the participant responded yes to having either a current or past problem. In addition, a participant was considered as having insomnia currently or in the past if he responded yes to any of the first three conditions.⁴⁴ Also, an overall sleep disorder index was constructed, where a sleep disorder was defined as yes if a participant responded affirmatively to any of these conditions, either currently or in the past. Each of the 12 conditions, along with insomnia and the sleep disorder index, was dichotomized and analyzed.

Each participant was asked the average number of hours he slept per night. This dependent variable was analyzed in its continuous form. In addition, summary statistics were tabulated on amount of sleep by group for participants with a sleep disorder.

No participants were excluded for medical reasons from the analyses of these variables.

Physical Examination Data

Two new psychological instruments, the Symptom Check List-90-Revised (SCL-90-R) and the Millon Clinical Multiaxial Inventory (MCMI), were used in the 1987 followup. Descriptions of the SCL-90-R and MCMI variables are provided at the beginning of Appendix I. No participants were excluded from the analysis for medical reasons.

SCL-90-R

The SCL-90-R is a multidimensional self-reported symptom inventory designed to measure symptomatic psychological distress in terms of nine primary symptom dimensions and three global indices of distress.⁴⁵ Each participant was asked to respond to 90 questions in terms of a 5-point scale: not at all (0), a little bit (1), moderately (2), quite a bit (3), and extremely (4). Responses to 83 of the 90 questions were grouped into the nine primary symptom categories, and a raw score for a participant for a category was determined by adding the scores of the answered questions in that category and dividing by the number of answered questions in that category. The raw scores were then converted to T-scores (reference scores for a given population norm) for analysis. These nine categories were anxiety, depression, hostility, interpersonal sensitivity, obsessive-compulsive behavior, paranoid ideation, phobic anxiety, psychoticism, and somatization.

Three global indices, based on the responses to all 90 questions, were also analyzed: the global severity index (GSI), the positive symptom total

(PST), and the positive symptom distress index (PSDI). The GSI was defined as the sum of the scores of all answered questions divided by the number of answered questions on the entire test. This index combines information on the number of symptoms and the intensity of distress. The PST was the number of questions to which the participant responded positively (i.e., 1, 2, 3, or 4). The PSDI was determined by adding the scores of all answered questions and dividing by the PST. This index describes the intensity of the positive symptoms. Each of these indices was also converted to a T-score.

The T-scores from the nine primary symptom categories were classified as normal or abnormal, with abnormal being defined as a T-score of at least 63. Less than 10 percent of the scores for each category were judged to be abnormal, based on this criterion.

MCMII

The MCMII⁴⁶ is a self-administered test consisting of 175 items and divided into 20 scales. Each of its 20 scales was constructed as an operational measure of a syndrome derived from a theory of personality and psychopathology. The MCMII was not designed to be a general personality instrument to be used for "normal" populations or for purposes other than diagnostic screening or clinical assessment. The 20 scales are organized into three broad categories to reflect distinctions between basic personality patterns, pathological personality disorders, and clinical symptom syndromes.

Basic Personality Patterns. Eight scales from the MCMII focus on everyday ways of functioning that characterize patients even when they are not suffering acute symptom states. These scales reflect relatively enduring and pervasive traits that typify styles of behaving, perceiving, thinking, feeling, and relating to others. These eight scales are schizoid (asocial), avoidant, dependent (submissive), histrionic (gregarious), narcissistic, antisocial (aggressive), compulsive (conforming), and passive-aggressive (negativistic).

Pathological Personality Disorders. Three MCMII scales describe patients who clearly evidence chronic or periodically severe pathology in the overall structure of personality. These scales are schizotypal (schizoid), borderline (cycloid), and paranoid.

Clinical Symptom Syndromes. Nine scales from the MCMII measure reactive disorders, often precipitated by external events, that are of substantially briefer duration than the personality disorders. Six scales--anxiety, somatoform, hypomanic, dysthymic, alcohol abuse, and drug abuse--represent disorders of moderate severity. The other three scales--psychotic thinking, psychotic depression, and psychotic delusions--reflect disorders of marked severity.

Raw scores were derived for each of these scales and were converted to base rate (BR) scores based on known personality and syndrome prevalence data. The BR scores for each of these 20 scales were analyzed as continuous variables. High scores indicated greater emotional illness or psychological abnormality than low scores.

Transformations were applied to certain MCMI variables. In particular, a natural logarithm transformation was applied to the schizoid and avoidant scores. This transformation was performed after adding 1.0 to the avoidant scores because some participants had a score of 0. A square root transformation was used with the dependent, passive-aggressive, and hypomania scores, and a square transformation was applied to the histrionic and compulsive scores. All statistics have been converted back to the original units for presentation.

Covariates

Covariates examined in the psychological assessment, both in pairwise associations with dependent variables and in adjusted statistical analyses, included the matching variables of age and race, education level (high school, college), current alcohol use (drinks/day), and lifetime alcohol history (drink-years). Due to the high association ($p < 0.001$) between occupation and education (officers are often college-educated; enlisted personnel are often high-school educated), only education was used in adjusted statistical analyses to reduce estimation problems that would be introduced if both covariates were used. Occupation was used as a stratification covariate in exposure index analyses.

A covariate reflecting PTSD, based on a subset of 49 questions³¹ from the MMPI administered at the 1985 followup examination, was used in the analysis of all dependent variables. This covariate was dichotomized as yes/no using greater than 30 affirmative responses as a positive indicator of PTSD. Participants at the 1987 followup examination who did not attend the 1985 followup examination had missing information for this covariate.

Age, lifetime alcohol history, and current alcohol use were used in the continuous form for modeling purposes for most general linear models and logistic regression analyses. These covariates were discretized for presentation purposes (e.g., dependent variable-covariate associations and interaction summaries) and occasionally for adjusted analyses. The variables for which these covariates were discretized in adjusted analyses are presented below.

- Age: Sleep Disorder Index, SCL-90-R Anxiety Score, SCL-90-R Interpersonal Sensitivity Score, SCL-90-R Obsessive-Compulsive Behavior Score, SCL-90-R Phobic Anxiety Score, SCL-90-R Psychoticism Score, MCMI Dependent Score, MCMI Schizotypal Score, MCMI Borderline Score, MCMI Psychotic Delusion Score.
- Current Alcohol Use: MCMI Dependent Score, MCMI Histrionic Score, MCMI Psychotic Delusion Score.
- Lifetime Alcohol History: SCL-90-R Depression, SCL-90-R Phobic Anxiety, SCL-90-R Somatization, MCMI Avoidant Score, MCMI Schizotypal Score.

The lifetime alcohol history and current alcohol use covariates were based on self-reported information from the questionnaire. For lifetime alcohol history, the respondent's average daily alcoholic consumption was

determined for various drinking stages throughout his lifetime, and an estimate of the corresponding total number of drink-years (1 drink-year=365 drinks) was derived. The current alcohol use covariate was based on the average drinks per day for the month prior to completing the questionnaire.

In discussing the alcohol-related covariates, the terms nondrinkers, moderate, and heavy drinkers are used to describe the lifetime alcohol history of the participants; for current alcohol use, light replaces nondrinkers. These distinctions correspond to the three drinking categories in Table 12-1 for lifetime drinking history and current alcohol use.

Relation to Baseline and 1985 Followup Studies

The dependent variables dealing with a history of mental or emotional disorders were analyzed for the Baseline and 1985 followup studies. However, the variables concerned with sleep disorders, the SCL-90-R, and the MCMI were new to the 1987 followup study.

Statistical Methods

The basic statistical analysis methods used in the psychological assessment are as described in Chapter 7. Table 12-1 summarizes the statistical analyses performed for the 1987 psychological assessment. The first part of this table describes the dependent variables, and the second part provides a further description of the candidate covariates. In the interest of space, abbreviations are used extensively in the body of the table and are defined in footnotes.

Although no participants were excluded for medical reasons in the psychological assessment, dependent variable and covariate data were missing for many variables. The number of participants with missing data is provided in Table 12-2 by group and variable. Of the 262 individuals with missing test scores for the SCL-90-R, 258 answered "not at all" to all of the questions on the examination; therefore, the test was unable to be scored for these subjects.

RESULTS

Ranch Hand and Comparison Group Contrast

Questionnaire Variables: Verified Psychological Disorders

The results of the unadjusted analyses of the verified psychological disorders are presented in Table 12-3. Adjusted analysis were not done.

TABLE 12-1.

Statistical Analysis for the Psychological Assessment

Dependent Variables

Variable (Units)	Data Source	Data Form	Cutpoints	Candidate Covariates	Statistical Analyses
Psychoses	Q-V	D	No Yes	--	UC: FT
Alcohol Dependence	Q-V	D	No Yes	--	UC: FT
Drug Dependence	Q-V	D	No Yes	--	UC: FT
Anxiety	Q-V	D	No Yes	--	UC: FT
Other Neuroses	Q-V	D	No Yes	--	UC: FT
Trouble Falling Asleep	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Waking Up During the Night	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Waking Up Too Early and Can't Go Back to Sleep	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Waking Up Unrefreshed	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Involuntarily Falling Asleep During the Day	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR

TABLE 12-1. (continued)

Statistical Analysis for the Psychological Assessment

Dependent Variables

Variable (Units)	Data Source	Data Form	Cutpoints	Candidate Covariates	Statistical Analyses
Great or Disabling Fatigue During the Day	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Frightening Dreams	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Talking in Sleep	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Sleepwalking	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Abnormal Movement/Activity During the Night	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Sleep Problems Requiring Medication	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Snore Loudly in All Sleeping Positions	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR

TABLE 12-1. (continued)

Statistical Analysis for the Psychological Assessment

Dependent Variables

Variable (Units)	Data Source	Data Form	Cutpoints	Candidate Covariates	Statistical Analyses
Insomnia	Q-SR	D	No Yes	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Overall Sleep Disorder Index	Q-SR	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
Average Sleep Each Night (hours)	Q-SR	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
SCL-90-R Anxiety	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
SCL-90-R Depression	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
SCL-90-R Hostility	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
SCL-90-R Interpersonal Sensitivity	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR

TABLE 12-1. (continued)

Statistical Analysis for the Psychological Assessment

Dependent Variables

Variable (Units)	Data Source	Data Form	Cutpoints	Candidate Covariates	Statistical Analyses
SCL-90-R Obsessive- Compulsive Behavior	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
SCL-90-R Paranoid Ideation	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
SCL-90-R Phobic Anxiety	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
SCL-90-R Psychoticism	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
SCL-90-R Somatization	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
SCL-90-R GSI	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
SCL-90-R PSDI	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR

TABLE 12-1. (continued)

Statistical Analysis for the Psychological Assessment

Dependent Variables

Variable (Units)	Data Source	Data Form	Cutpoints	Candidate Covariates	Statistical Analyses
SCL-90-R PST	PE	D	Normal Abnormal	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: FT AC: LR CA: CS, FT UE: CS, FT AE: LR
MCMII Schizoid Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMII Avoidant Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMII Dependent Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMII Histrionic Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMII Narcissistic Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMII Antisocial Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM

TABLE 12-1. (continued)

Statistical Analysis for the Psychological Assessment

Dependent Variables

Variable (Units)	Data Source	Data Form	Cutpoints	Candidate Covariates	Statistical Analyses
MCMJ Compulsive Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMJ Passive- Aggressive Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMJ Schizotypal Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMJ Borderline Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMJ Paranoid Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMJ Anxiety Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMJ Somatoform Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM

TABLE 12-1. (continued)

Statistical Analysis for the Psychological Assessment

Dependent Variables

Variable (Units)	Data Source	Data Form	Cutpoints	Candidate Covariates	Statistical Analyses
MCMH Hypomania Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMH Dysthymia Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMH Alcohol Abuse Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMH Drug Abuse Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMH Psychotic Thinking Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMH Psychotic Depression Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM
MCMH Psychotic Delusion Score	PE	C	--	AGE, RACE, OCC, EDUC, DRKYR, ALC, PTSD	UC: TT AC: GLM CA: CC, GLM, TT UE: GLM, TT AE: GLM

TABLE 12-1. (continued)
Statistical Analysis for the Psychological Assessment

Covariates

Variable (Abbreviation)	Data Source	Data Form	Cutpoints
Age (AGE)	MIL	D/C	Born \geq 1942 Born 1923-1941 Born \leq 1922
Race (RACE)	MIL	D	Nonblack Black
Occupation (OCC)	MIL	D	Officer Enlisted Flyer Enlisted Groundcrew
Education (EDUC)	Q-SR	D	High School College
Lifetime Alcohol History (DRKYR) (drink-years)	Q-SR	D/C	0 >0-40 >40
Current Alcohol Use (ALC) (drinks/day)	Q-SR	D/C	0-1 >1-4 >4
Presence of PTSD	Q-SR (1985)	D	No Yes

Abbreviations:

Data Source: MIL--Air Force military records
PE--1987 SCRF psychological examination
Q-SR--1987 NORC questionnaire (self-reported)
Q-SR (1985)--1985 NORC questionnaire (self-reported)
Q-V--1987 NORC questionnaire (verified)

Data Form: D--Discrete analysis only
C--Continuous analysis only
D/C--Appropriate form for analysis (either discrete or continuous)

TABLE 12-1. (continued)

Statistical Analysis for the Psychological Assessment

Abbreviations (continued):

Statistical Analyses: UC--Unadjusted core analyses
AC--Adjusted core analyses
CA--Dependent variable-covariate associations
UE--Unadjusted exposure index analyses
AE--Adjusted exposure index analyses

Statistical Methods: CC--Pearson's product moment correlation
coefficient
CS--Chi-square contingency table test
FT--Fisher's exact test
GLM--General linear models analysis
LR--Logistic regression analysis
TT--Two-sample t-test

TABLE 12-2.

Number of Participants Excluded and With Missing Data
for the Psychological Assessment by Group

Variable	Analysis Use	Group		Total
		Ranch Hand	Comparison	
Frightening Dreams	DEP	3	3	6
Talking in Sleep	DEP	1	1	2
Overall Sleep Disorder Index	DEP	3	3	6
Average Sleep Each Night	DEP	0	1	1
12 SCL-90-R Variables	DEP	115	147	262
20 MCMI Variables	DEP	3	3	6
Education	COV	8	6	14
Lifetime Alcohol History	COV	10	3	13
Current Alcohol Use	COV	5	1	6
Presence of PTSD	COV	36	80	116
Pre-SEA Alcohol Dependence	EXC	0	1	1
Pre-SEA Anxiety	EXC	4	3	7
Pre-SEA Other Neuroses	EXC	13	12	25

Abbreviations: DEP--Dependent variable (missing data)
COV--Covariate (missing data)
EXC--Exclusion

TABLE 12-3.

Unadjusted Analysis for Verified Psychological Disorders by Group

Variable	Statistic	Group				Est. Relative Risk (95% C.I.)	p-Value
		Ranch Hand		Comparison			
Psychoses	n	995		1,299		0.87 (0.50,1.50)	0.712
	Number/%						
	Yes	22	2.2%	33	2.5%		
	No	973	97.8%	1,266	97.5%		
Alcohol Dependence	n	995		1,298		1.37 (0.99,1.89)	0.068
	Number/%						
	Yes	81	8.1%	79	6.1%		
	No	914	91.9%	1,219	93.9%		
Drug Dependence	n	995		1,299		0.26 (0.03,2.23)	0.368
	Number/%						
	Yes	1	0.1%	5	0.4%		
	No	994	99.9%	1,294	99.6%		
Anxiety	n	991		1,296		1.09 (0.87,1.37)	0.476
	Number/%						
	Yes	160	16.1%	194	15.0%		
	No	831	83.9%	1,102	85.0%		
Other Neuroses	n	982		1,287		1.19 (1.00,1.41)	0.056
	Number/%						
	Yes	399	40.6%	471	36.6%		
	No	583	59.4%	816	63.4%		

12-22

Psychoses

Based on the unadjusted analysis of psychoses, there was no significant difference between the Ranch Hands and the Comparisons ($p=0.712$).

Alcohol Dependence

A higher percentage of the Ranch Hands than the Comparisons had an alcohol dependence (8.1% vs. 6.1%), and the two groups were marginally significantly different based on the unadjusted analysis (Est. RR: 1.37, 95% C.I.: [0.99,1.89], $p=0.068$).

Drug Dependence

Five Comparisons and one Ranch Hand had a drug dependence. This difference was not statistically significant ($p=0.368$).

Anxiety

The results of the unadjusted analysis of anxiety did not detect a significant difference between the two groups ($p=0.476$).

Other Neuroses

The unadjusted analysis of other neuroses revealed a marginally significant difference ($p=0.056$) between the percentage of Ranch Hands with other neuroses (40.6%) and the percentage of Comparisons (36.6%). The estimated relative risk between groups was 1.19 (95% C.I.: [1.00,1.41]).

Questionnaire Variables: Reported Sleep Disorders

The results of the unadjusted and adjusted analyses of the reported sleep disorders of the psychological assessment are presented in Tables 12-4 and 12-5, respectively. The dependent variable-covariate associations are provided in Table I-1 of Appendix I. Table I-2 of Appendix I contains the group-by-covariate interactions.

Trouble Falling Asleep

No difference between the Ranch Hands and Comparisons was detected in the unadjusted analysis ($p=0.352$) for trouble falling asleep.

Based on combined Ranch Hand and Comparison data, the covariate tests of association with trouble falling asleep showed that age ($p=0.002$), education ($p=0.001$), lifetime alcohol history ($p=0.001$), and PTSD ($p<0.001$) were significant. Of the participants who were born in or after 1942, 13.9 percent reported experiencing trouble falling asleep, as compared with 9.3 percent of those born between 1923 and 1941 and 8.3 percent of those born in or before

TABLE 12-4.

Unadjusted Analysis for Psychological Sleep Disorder Variables by Group

Variable	Statistic	Group				Est. Relative Risk (95% C.I.)	p-Value
		Ranch Hand		Comparison			
Trouble Falling Asleep	n	995		1,299		0.87 (0.67,1.14)	0.352
	Number/%						
	Yes	104	10.5%	153	11.8%		
	No	891	89.5%	1,146	88.2%		
Waking Up During the Night	n	995		1,299		0.92 (0.73,1.17)	0.532
	Number/%						
	Yes	137	13.8%	192	14.8%		
	No	858	86.2%	1,107	85.2%		
Waking Up Too Early and Can't Go Back to Sleep	n	995		1,299		1.07 (0.82,1.39)	0.666
	Number/%						
	Yes	113	11.4%	139	10.7%		
	No	882	88.6%	1,160	89.3%		
Waking Up Unrefreshed	n	995		1,299		1.14 (0.86,1.51)	0.402
	Number/%						
	Yes	100	10.1%	116	8.9%		
	No	895	89.9%	1,183	91.1%		
Involuntarily Falling Asleep During the Day	n	995		1,299		1.12 (0.74,1.71)	0.658
	Number/%						
	Yes	42	4.2%	49	3.8%		
	No	953	95.8%	1,250	96.2%		
Great or Disabling Fatigue During the Day	n	995		1,299		1.80 (1.10,2.96)	0.026
	Number/%						
	Yes	38	3.8%	28	2.2%		
	No	957	96.2%	1,271	97.8%		

TABLE 12-4. (continued)

Unadjusted Analysis for Psychological Sleep Disorder Variables by Group

Variable	Statistic	Group		Est. Relative Risk (95% C.I.)	p-Value		
		Ranch Hand	Comparison				
Frightening Dreams	n	992		1,296		1.27 (0.85,1.89)	0.282
	Number/%						
	Yes	50	5.0%	52	4.0%		
	No	942	95.0%	1,244	96.0%		
Talking in Sleep	n	994		1,298		1.60 (1.04,2.45)	0.041
	Number/%						
	Yes	48	4.8%	40	3.1%		
	No	946	95.2%	1,258	96.9%		
Sleep-walking	n	995		1,299		1.51 (0.83,2.77)	0.232
	Number/%						
	Yes	23	2.3%	20	1.5%		
	No	972	97.7%	1,279	98.5%		
Abnormal Movement/Activity During the Night	n	995		1,299		1.16 (0.74,1.81)	0.604
	Number/%						
	Yes	37	3.7%	42	3.2%		
	No	958	96.3%	1,257	96.8%		
Sleep Problems Requiring Medication	n	995		1,299		1.43 (0.81,2.50)	0.272
	Number/%						
	Yes	26	2.6%	24	1.8%		
	No	969	97.4%	1,275	98.2%		
Snore Loudly in All Sleeping Positions	n	995		1,299		1.12 (0.82,1.55)	0.520
	Number/%						
	Yes	76	7.6%	89	6.9%		
	No	919	92.4%	1,210	93.1%		

TABLE 12-4. (continued)

Unadjusted Analysis for Psychological Sleep Disorder Variables by Group

Variable	Statistic	Group		Est. Relative Risk (95% C.I.)	p-Value
		Ranch Hand	Comparison		
Insomnia	n	995			
	Number/%	1,299			
	Yes	234 23.5%	313 24.1%	0.97 (0.80,1.18)	0.786
No	761 76.5%	986 75.9%			
Overall Sleep Disorder Index	n	992			
	Number/%	1,296			
	Abnormal	350 35.3%	439 33.9%	1.06 (0.90,1.27)	0.510
Normal	642 64.7%	857 66.1%			
Average Sleep Each Night	n	995			
	Mean	1,298			
	95% C.I.	6.91 (6.84,6.98)	6.95 (6.89,7.00)	--	0.421

--Estimated relative risk not applicable for continuous analysis of a variable.

TABLE 12-5.

Adjusted Analysis for Psychological Sleep Disorder Variables by Group

Variable	Statistic	Group		Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
		Ranch Hand	Comparison			
Trouble Falling Asleep	n	943	1,210	0.81 (0.61,1.08)	0.144	EDUC (p=0.016) PTSD (p<0.001) AGE*DRKYR (p=0.004) DRKYR*ALC (p=0.027)
Waking Up During the Night	n	950	1,216	****	****	GRP*AGE (p=0.009) DRKYR (p<0.001) AGE*RACE (p=0.043) ALC*PTSD (p=0.011)
Waking Up Too Early and Can't Go Back to Sleep	n	943	1,210	1.02 (0.77,1.34)**	0.911**	GRP*PTSD (p=0.042) EDUC*PTSD (p=0.001) PTSD*DRKYR (p=0.015) PTSD*ALC (p=0.030)
Waking Up Unrefreshed	n	950	1,216	1.07 (0.79,1.44)	0.663	DRKYR (p<0.001) PTSD (p<0.001) AGE*ALC (p=0.001)
Involuntarily Falling Asleep During the Day	n	943	1,210	1.09 (0.69,1.70)	0.722	DRKYR (p<0.001) RACE*PTSD (p=0.010) RACE*EDUC (p=0.011) ALC*PTSD (p=0.003)
Great or Disabling Fatigue During the Day	n	943	1,210	1.65 (0.97,2.81)	0.065	EDUC (p=0.003) PTSD (p<0.001) RACE*DRKYR (p=0.040) RACE*ALC (p=0.029)

12-27

TABLE 12-5. (continued)

Adjusted Analysis for Psychological Sleep Disorder Variables by Group

Variable	Statistic	Group		Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
		Ranch Hand	Comparison			
Frightening Dreams	n	947	1,213	1.23 (0.80,1.90)	0.346	DRKYR (p<0.001) PTSD (p<0.001) RACE*AGE (p=0.012)
Talking in Sleep	n	942	1,209	****	****	GRP*PTSD (p=0.009) EDUC (p=0.006) PTSD*AGE (p=0.001) PTSD*DRKYR (p=0.002)
Sleep-walking	n	977	1,290	1.48 (0.78,2.80)	0.234	AGE*DRKYR (p=0.034) EDUC*DRKYR (p=0.033)
Abnormal Movement/Activity During the Night	n	952	1,213	1.16 (0.71,1.88)**	0.558**	GRP*EDUC (p=0.039) AGE (p=0.003) PTSD (p<0.001)
Sleep Problems Requiring Medication	n	943	1,210	1.02 (0.55,1.89)	0.955	EDUC (p=0.026) DRKYR (p=0.024) PTSD (p<0.001)
Snore Loudly in All Sleeping Positions	n	943	1,210	1.05 (0.75,1.48)	0.766	EDUC*DRKYR (p<0.001) ALC*PTSD (p=0.016)
Insomnia	n	943	1,210	0.96 (0.78,1.18)**	0.711**	GRP*AGE (p=0.027) PTSD (p<0.001) AGE*EDUC (p=0.004) DRKYR*ALC (p=0.034)

12-28

TABLE 12-5. (continued)

Adjusted Analysis for Psychological Sleep Disorder Variables by Group

Variable	Statistic	Group		Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
		Ranch Hand	Comparison			
Overall Sleep Disorder Index	n	940	1,207	1.06 (0.88,1.27)**	0.534**	GRP*DRKYR (p=0.011) Age (p=0.049) PTSD (p<0.001) EDUC*DRKYR (p=0.024) DRKYR*ALC (p=0.027)
Average Sleep Each Night	n Adj. Mean 95% C.I.	948 6.39 (6.13,6.66)	1,212 6.42 (6.16,6.69)	--	0.509	AGE (p<0.001) RACE (p<0.001) EDUC (p=0.014) ALC*PTSD (p=0.018)

--Adjusted relative risk not applicable for continuous analysis of a variable.

***Group-by-covariate interaction (p<0.01)--adjusted relative risk, confidence interval, and p-value not presented.

**Group-by-covariate interaction (0.01<p<0.05)--adjusted relative risk, confidence interval, and p-value derived from a model fitted after deletion of this interaction.

1922. More high school-educated participants reported having experienced this sleep disorder than the college-educated participants (13.3% vs. 9.0%). The percentage of participants who had trouble falling asleep increased with alcohol consumption based on lifetime alcohol history (6.8% for nondrinkers, 10.3% for moderate drinkers, and 15.5% for heavy drinkers). The prevalence rate for the participants with PTSD was 81.3 percent, as contrasted with 10.7 percent of the participants without PTSD.

The adjusted analysis of trouble falling asleep did not detect a difference between the Ranch Hands and the Comparisons ($p=0.144$). Education ($p=0.016$), PTSD ($p<0.001$), age-by-lifetime alcohol history ($p=0.004$), and lifetime alcohol history-by-current alcohol use ($p=0.027$) were significant effects in the adjusted model.

Waking Up During the Night

Based on the unadjusted analysis, no group difference was identified ($p=0.532$) for waking up during the night.

The percentage of participants who reported that they wake up during the night was significantly associated with lifetime alcohol history, current alcohol use, and PTSD ($p<0.001$, $p=0.011$, and $p<0.001$, respectively). The associations with age and race were borderline significant ($p=0.053$ and $p=0.061$, respectively). Of the participants who were born in or before 1922, 22.6 percent responded yes to waking up during the night, as compared to 14.7 percent of those born between 1923 and 1941 and 13.2 percent of those born in or after 1942. A higher percentage of the nonblack participants reported waking up during the night than Black participants (14.7% vs. 8.8%). Based on lifetime alcohol history, the highest percentage of participants who reported this sleep disorder was among the heavy drinkers (21.1%) followed by the moderate drinkers (12.6%) and the nondrinkers (9.8%). A similar pattern was found for current alcohol use. The percentages of participants who reported waking up during the night were 18.9, 18.6, and 13.2 for the heavy drinkers, moderate drinkers, and light drinkers, respectively. Only 14.0 percent of the participants without PTSD reported experiencing this sleep disorder, as compared to 75.0 percent of the participants with PTSD.

In the adjusted analysis of waking up during the night, the group-by-age interaction was significant ($p=0.009$). Lifetime alcohol history ($p<0.001$), age-by-race ($p=0.043$), and current alcohol use-by-PTSD ($p=0.011$) were also significant. Stratifying by age identified no significant differences for those born in or after 1942 and for those born between 1923 and 1941 ($p=0.475$ and $p=0.281$, respectively). A borderline significant difference was found between the two groups for those born in or before 1922 (Adj. RR: 0.35, 95% C.I.: [0.11, 1.13], $p=0.078$). Of the Comparisons who were born in or before 1922, 29.2 percent reported that they wake up during the night, as compared to 14.3 percent of the Ranch Hands of the same age category.

Waking Up Too Early and Can't Go Back to Sleep

The results of the unadjusted analysis did not reveal a significant difference between the two groups ($p=0.666$) for waking up too early and can't go back to sleep.

The covariate associations with the sleep disorder of waking up too early and unable to go back to sleep indicated that education ($p=0.006$), lifetime alcohol history ($p=0.001$), current alcohol use ($p=0.050$), and PTSD ($p<0.001$) were significant. A higher percentage of the high school-educated participants reported having experienced this sleep disorder than college-educated participants (12.8% vs. 9.1%). The prevalence rate increased with alcohol consumption based on both lifetime alcohol history and current alcohol use. Based on lifetime alcohol history, the percentage of participants reporting this sleep disorder was 7.8 for nondrinkers, 9.9 for moderate drinkers, and 15.5 for heavy drinkers. Similarly for current alcohol use, the percentage of the light drinkers was 10.2, as compared to 13.6 percent of the moderate drinkers and 16.2 percent of the heavy drinkers. Of the participants with PTSD, 62.5 percent reported that they wake up too early and are unable to go back to sleep, whereas only 10.5 percent of the participants without PTSD reported having this sleep disorder.

In the adjusted analysis there were four significant interactions, all of which involved PTSD: group ($p=0.042$), education ($p=0.001$), lifetime alcohol history ($p=0.015$), and current alcohol use ($p=0.030$). Investigating the group-by-PTSD interaction revealed that a greater percentage of Comparisons with PTSD reported having this sleep disorder than Ranch Hands with PTSD and a greater percentage of Ranch Hands without PTSD reported having this sleep disorder than Comparisons without PTSD; however, these differences were not significant ($p=0.999$ and $p=0.804$, respectively). Without the group-by-PTSD interaction in the model, no difference between the two groups was found ($p=0.911$).

Waking Up Unrefreshed

No difference between the Ranch Hands and the Comparisons was identified in the unadjusted analysis of the percentage of participants who reported that they woke up unrefreshed ($p=0.402$).

Using pooled group data, age, education, and PTSD were significantly associated with the percentage of participants who reported that they wake up unrefreshed ($p=0.004$, $p=0.009$, and $p<0.001$, respectively). The association with lifetime alcohol history was borderline significant ($p=0.066$). The highest percentage of participants who reported waking up unrefreshed was among those born in or after 1942 (11.7%), followed by those born between 1923 and 1941 (8.0%) and those born in or before 1922 (4.8%). A higher percentage of the high school-educated participants reported this sleep disorder than college-educated participants (11.0% vs. 7.7%). The prevalence rate increased with alcohol consumption based on lifetime alcohol history (6.3% for nondrinkers, 9.0% for moderate drinkers, and 11.6% for heavy drinkers). Only 8.7 percent of the participants without PTSD reported this sleep disorder, as contrasted with 87.5 percent of those with PTSD.

The results of the adjusted analysis revealed no significant difference between the Ranch Hands and the Comparisons ($p=0.663$). Lifetime alcohol history and PTSD were significant covariates ($p<0.001$ for both), and age-by-current alcohol use was a significant interaction ($p=0.001$).

Involuntarily Falling Asleep During the Day

The percentage of Ranch Hands and Comparisons who reported that they involuntarily fall asleep during the day was not found to be significantly different in the unadjusted analysis ($p=0.658$).

Of the six covariate tests of association, the only significant association detected was for PTSD ($p<0.001$). Of the participants with PTSD, 31.3 percent reported that they involuntarily fall asleep during the day, as compared to 3.8 percent of the participants without PTSD.

No difference between the two groups was detected in the adjusted analysis ($p=0.722$). Lifetime alcohol history ($p<0.001$), race-by-education ($p=0.011$), race-by-PTSD ($p=0.010$), and current alcohol use-by-PTSD ($p=0.003$) were significant terms in the model.

Great or Disabling Fatigue During the Day

Significantly more Ranch Hands than Comparisons reported that they experienced great or disabling fatigue during the day based on the unadjusted analysis (3.8% vs. 2.2%; Est. RR: 1.80, 95% C.I.: [1.10,2.96], $p=0.026$).

The results of the tests of association with great or disabling fatigue during the day showed that education and PTSD were significant ($p<0.001$ for both). The association with lifetime alcohol history was borderline significant ($p=0.083$). The prevalence rate was higher for the participants who were high school educated (4.3% for high school educated vs. 1.4% for college educated). The prevalence rate increased with alcohol consumption based on lifetime alcohol history (2.0% for nondrinkers, 2.5% for moderate drinkers, and 4.3% for heavy drinkers). Of the participants with PTSD, 37.5 percent reported having this sleep disorder, as compared to 2.7 percent of the participants without PTSD.

After adjusting for covariates, the difference between the two groups was borderline significant (Adj. RR: 1.65, 95% C.I.: [0.97,2.81], $p=0.065$). Education and PTSD were significant covariates in the model ($p=0.003$ and $p<0.001$, respectively). The significant interactions were race-by-lifetime alcohol history and race-by-current alcohol use ($p=0.040$ and $p=0.029$, respectively).

Frightening Dreams

Based on the unadjusted analysis, no group difference was detected ($p=0.282$) in experiencing frightening dreams.

The covariate tests showed that the associations with education, lifetime alcohol history, and PTSD were significant ($p=0.038$, $p<0.001$, and $p<0.001$, respectively). The association with current alcohol was borderline significant ($p=0.095$). Of the participants with a high school education, 5.3 percent reported that they have frightening dreams, as compared to 3.5 percent of those with a college education. The prevalence rate increased with alcohol consumption for lifetime alcohol history and current alcohol use. Based on

lifetime alcohol history, 3.4 percent of the nondrinkers, 3.5 percent of the moderate drinkers, and 7.9 percent of heavy drinkers reported that they had frightening dreams. Similarly for current alcohol use, the percentages reporting frightening dreams were 4.0, 5.8, and 8.1 for light drinkers, moderate drinkers, and heavy drinkers, respectively. Only 3.9 percent of the participants without PTSD reported that they had frightening dreams, as compared with 66.7 percent of those with PTSD.

No difference between the Ranch Hands and Comparisons was detected in the adjusted analysis ($p=0.346$). Lifetime alcohol use, PTSD, and age-by-race were significant terms in the model ($p<0.001$, $p<0.001$, and $p=0.012$, respectively).

Talking in Sleep

The results of the unadjusted analysis revealed that significantly more Ranch Hands reported that they talked in their sleep than Comparisons (4.8% vs. 3.1%, $p=0.041$). The estimated relative risk was 1.60 (95% C.I.: [1.04, 2.45]).

Using combined Ranch Hand and Comparison data, the covariate tests revealed significant associations for age, education, and PTSD ($p=0.001$, $p<0.001$, and $p=0.005$, respectively). The talking in sleep-lifetime alcohol history test of association was borderline significant ($p=0.090$). The prevalence rate was highest for those born in or after 1942 (5.5%), followed by those born in or before 1922 (3.6%) and those born between 1923 and 1941 (2.6%). More participants with a high school education reported talking in their sleep than those with a college education (5.2% vs. 2.5%). The prevalence rate was increased with alcohol consumption based on lifetime alcohol history (2.9% for nondrinkers, 3.4% for moderate drinkers, and 5.4% for heavy drinkers). For PTSD, 25.0 percent of the participants with PTSD reported that they talked in their sleep, compared to 3.7 percent of those without PTSD.

The adjusted analysis of talking in sleep identified a significant group-by-PTSD interaction ($p=0.009$). Education was a significant covariate ($p=0.006$), and age and lifetime alcohol history interactions with PTSD were also significant terms in the model ($p=0.001$ and $p=0.002$, respectively). Investigating the group-by-PTSD interaction revealed no significant difference between the Ranch Hands with PTSD and the Comparisons with PTSD ($p=0.999$). The difference between the Ranch Hands and Comparisons without PTSD was borderline significant ($p=0.089$). Of the participants without PTSD, 4.5 percent of the Ranch Hands and 3.1 percent of the Comparisons reported that they talk in their sleep (Adj. RR: 1.48, 95% C.I.: [0.94, 2.34]).

Sleepwalking

No significant difference was detected between the two groups based on the unadjusted analysis of sleepwalking ($p=0.232$).

Of the six covariate tests of association with sleepwalking, only the association with age was significant ($p=0.001$). The participants born in or after 1942 had the highest prevalence rate (3.1%). Of the participants born between 1923 and 1941, 1.0 percent reported that they walk in their sleep. No

(0.0%) participants born in or before 1922 reported having this sleep disorder.

In the adjusted analysis of sleepwalking, no significant difference between the Ranch Hands and Comparisons was identified ($p=0.234$). The age-by-lifetime alcohol history and education-by-lifetime alcohol history interactions were significant terms in the model ($p=0.034$ and $p=0.033$, respectively).

Abnormal Movement/Activity During the Night

Based on the number of Ranch Hands and Comparisons who reported abnormal movement/activity during the night, no significant difference between the two groups was found in the unadjusted analysis ($p=0.604$).

The results of the covariate tests identified three significant dependent variable-covariate associations: age ($p=0.020$), education ($p=0.005$), and PTSD ($p<0.001$). The prevalence rate of abnormal movement or activity during the night decreased with age (4.7% for those born in or after 1942, 2.6% for those born between 1923 and 1941, and 2.4% for those born in or before 1922). A higher percentage of the high school-educated participants reported having this sleep disorder than the college-educated participants (4.5% vs. 2.3%). Half (50.0%) of the participants with PTSD reported that they have abnormal movement or activity during the night, as compared to 3.1% of the participants without PTSD.

In the adjusted analysis, the interaction between group and education was significant ($p=0.039$). Age and PTSD were significant covariates ($p=0.003$ and $p<0.001$, respectively). No significant differences were found after stratifying by education ($p=0.106$ for high school and $p=0.177$ for college). Without the interaction in the model, no difference between the two groups was detected ($p=0.558$).

Sleep Problems Requiring Medication

In the unadjusted analysis of sleep problems requiring medication, no significant difference between the Ranch Hands and Comparisons was identified ($p=0.272$).

The covariate tests revealed four significant associations: education ($p=0.010$), lifetime alcohol history ($p<0.001$), current alcohol use ($p=0.018$), and PTSD ($p<0.001$). The prevalence rate was higher for the high school-educated participants than those with a college education (3.0% vs. 1.3%). Based on lifetime alcohol history, the highest percentage of participants who reported having sleep problems that required medication was among the heavy drinkers (4.4%), followed by the nondrinkers (2.0%) and the moderate drinkers (1.5%). The prevalence rate increased with current alcohol use (1.9% for light drinkers, 2.5% for moderate drinkers, and 6.8% for heavy drinkers). For PTSD, 1.8 percent of the participants without PTSD and 56.3 percent of the participants with PTSD reported having sleep problems that required medication.

Based on the adjusted analysis, no significant difference between the two groups was detected ($p=0.955$). The significant covariates in the model were education, lifetime alcohol history, and PTSD ($p=0.026$, $p=0.024$, and $p<0.001$, respectively).

Snore Loudly in All Sleeping Positions

No significant difference in loud snoring was detected between the two groups based on the unadjusted analysis ($p=0.520$).

This sleep disorder was found to be significantly associated with lifetime alcohol history and PTSD ($p=0.035$ and $p=0.009$, respectively). The prevalence rate increased with alcohol consumption based on lifetime alcohol history (4.9% for nondrinkers, 6.5% for moderate drinkers, and 9.5% for heavy drinkers). A higher percentage of participants with PTSD reported that they snore loudly in all sleeping positions than those without PTSD (31.3% vs. 7.1%).

The results of the adjusted analysis found no significant difference between the two groups ($p=0.766$). There were two significant interactions in the model: education-by-lifetime alcohol history and current alcohol use-by-PTSD ($p<0.001$ and $p=0.016$, respectively).

Insomnia

No difference between the Ranch Hands and Comparisons was found based on the unadjusted analysis of participants classified as having insomnia (a composite variable based on reports of trouble falling asleep, waking up during the night, or waking up early and being unable to go back to sleep; $p=0.786$).

The results of the covariate tests identified significant associations for education ($p=0.005$), lifetime alcohol history ($p<0.001$), and PTSD ($p<0.001$), and a borderline significant association for current alcohol use ($p=0.083$). A higher percentage of the high school-educated participants were classified as having insomnia than those with a college education (26.3% vs. 21.2%). The prevalence rate increased with alcohol consumption based on lifetime alcohol history and current alcohol use. For lifetime alcohol history, the percentages of participants classified as having insomnia were 17.1, 22.0, and 32.1 for nondrinkers, moderate drinkers, and heavy drinkers, respectively. For the light, moderate, and heavy drinkers based on current alcohol use, the percentages were 22.9, 27.6, and 28.4, respectively. A higher percentage of participants with PTSD was classified as having insomnia than participants without PTSD (87.5% vs. 23.5%).

The results of the adjusted analysis showed that there was a significant group-by-age interaction ($p=0.027$). PTSD ($p<0.001$), age-by-education ($p=0.004$), and lifetime alcohol history-by-current alcohol use ($p=0.034$) were significant terms in the model. Stratifying by age found that significantly more Comparisons born in or before 1922 were classified as having insomnia than Ranch Hands of the same age category (41.7% vs. 17.1%; Adj. RR: 0.25, 95% C.I.: [0.08,0.74], $p=0.012$). No differences were detected in the other

two age categories ($p=0.547$ for those born in or after 1942 and $p=0.813$ for those born between 1923 and 1941). Without the group-by-age interaction in the model, the two groups were not found to be significantly different ($p=0.711$).

Overall Sleep Disorder Index

Based on the unadjusted analysis of the overall sleep disorder index, a composite variable of the 12 individual sleep disorders, no significant difference between the two groups was detected ($p=0.510$).

In the covariate tests, education, lifetime alcohol history, and PTSD were found to have significant associations with the overall sleep disorder index ($p<0.001$ for all). The association with age was borderline significant ($p=0.076$). The highest percentage of participants who reported having a sleep disorder was among the participants born in or after 1942 (37.0%), followed by those born in or before 1922 (36.9%) and those born between 1923 and 1941 (32.4%). A higher percentage of the high school-educated participants reported having a sleep disorder than those with a college education (38.3% vs. 30.4%). The prevalence rate of reported sleep disorders was found to be increasing with alcohol consumption based on both the lifetime alcohol history and current alcohol use. The percentages for lifetime alcohol history were 26.3 for nondrinkers, 32.4 for moderate drinkers, and 43.8 for heavy drinkers. All (100.0%) of the participants with PTSD reported having one or more of the 12 sleep disorders. The prevalence rate for the participants without PTSD was 34.2 percent.

In the adjusted analysis of the overall sleep disorder index, there was a significant group-by-lifetime alcohol history interaction ($p=0.011$). Age ($P=0.049$) and PTSD ($p<0.001$) were significant covariates. Two other interactions involving lifetime alcohol history, education-by-lifetime alcohol history and lifetime alcohol history-by-current alcohol use, were also significant ($p=0.024$ and $p=0.027$, respectively). Further investigation of the group-by-lifetime alcohol history revealed no significant group differences ($p=0.249$ for nondrinkers, $p=0.241$ for moderate drinkers, and $p=0.168$ for heavy drinkers). Without the interaction involving group in the model, no difference between the Ranch Hands and the Comparisons was found ($p=0.534$).

Average Sleep Each Night

Based on the unadjusted analysis of the average number of hours of sleep each night, there was no significant difference between the Ranch Hands and Comparisons ($p=0.421$). Of participants with some type of sleep disorder, there was no significant difference between the group means (Ranch Hands: 6.63 hours, Comparisons: 6.72 hours; $p=0.345$).

The results of the covariate tests showed that the average sleep each night was significantly associated with age, race, and education ($p<0.001$, $p<0.001$, and $p=0.001$, respectively). Age was positively correlated with the average sleep each night ($r=0.090$). The nonblack participants had a higher mean than the Black participants (6.96 hours vs. 6.41 hours). The participants with a college education had a mean of 7.00 hours, as compared to a mean of 6.86 hours for the participants with a high school education.

No significant difference was found between the two groups on the average sleep each night based on the adjusted analysis ($p=0.509$). The significant terms in the adjusted model were age ($p<0.001$), race ($p<0.001$), education ($p=0.014$), and current alcohol use-by-PTSD ($p=0.018$).

Physical Examination Variables: SCL-90-R

The results of the unadjusted analyses of the 12 variables of the SCL-90-R are presented in Table 12-6. Table 12-7 contains the results of the adjusted analyses. The covariate associations and group-by-covariate interactions are summarized in Tables I-1 and I-2, respectively, of Appendix I.

Anxiety

No significant difference was detected between the two groups based on the unadjusted analysis of the SCL-90-R anxiety variable ($p=0.149$).

Based on combined Ranch Hand and Comparison data, the covariate tests with anxiety showed that age ($p=0.027$), education ($p<0.001$), lifetime alcohol history ($p=0.008$), current alcohol use ($p=0.016$), and PTSD ($p<0.001$) were significant. For age, 8.3 percent of those born in or after 1942 were classified as abnormal, as compared to 5.3 percent of those born between 1923 and 1941 and 6.9 percent of those born in or before 1922. The high school-educated participants had a higher percentage of abnormalities than those with a college education (9.1% vs. 4.0%). For lifetime alcohol history, the highest percentage of abnormalities was among the heavy drinkers (9.8%), followed by the nondrinkers (6.2%) and the moderate drinkers (5.7%). The percentage of abnormalities increased with current alcohol use (5.9% for light drinkers, 9.0% for moderate drinkers, and 12.5% for heavy drinkers). Of the participants with PTSD, 93.8 percent were classified as abnormal, as compared to 5.9 percent of the participants without PTSD.

Based on the adjusted analysis of anxiety, no difference between the Ranch Hands and Comparisons was found ($p=0.361$). Education, PTSD, and age-by-current alcohol use were significant terms in the model ($p<0.001$, $p<0.001$, and $p=0.020$, respectively).

Depression

The results of the unadjusted analysis of depression from the SCL-90-R revealed a borderline significant difference between the two groups, with 9.8 percent abnormalities in the Ranch Hands, as compared to 7.6 percent abnormalities in the Comparisons (Est. RR: 1.33, 95% C.I.: [0.97, 1.81], $p=0.090$).

Depression-covariate analyses revealed that age ($p=0.028$), education ($p<0.001$), lifetime alcohol history ($p=0.007$), and PTSD ($p<0.001$) were significantly associated with the dependent variable. The lowest percentage of abnormalities was for those born between 1923 and 1941 (7.0%). The percentages of abnormalities were 8.3 and 10.4 for those born in or before 1922 and for those born in or after 1942, respectively. The college-educated

TABLE 12-6.

Unadjusted Analysis for SCL-90-R Psychological Variables by Group

Variable	Statistic	Group				Est. Relative Risk (95% C.I.)	p-Value
		Ranch Hand		Comparison			
Anxiety	n	880		1,152		1.31 (0.93,1.86)	0.149
	Number/%						
	Abnormal	67	7.6%	68	5.9%		
	Normal	813	92.4%	1,084	94.1%		
Depression	n	880		1,152		1.33 (0.97,1.81)	0.090
	Number/%						
	Abnormal	86	9.8%	87	7.6%		
	Normal	794	90.2%	1,065	92.4%		
Hostility	n	880		1,152		1.14 (0.76,1.72)	0.584
	Number/%						
	Abnormal	46	5.2%	53	4.6%		
	Normal	834	94.8%	1,099	95.4%		
Interpersonal Sensitivity	n	880		1,152		1.03 (0.72,1.47)	0.948
	Number/%						
	Abnormal	58	6.6%	74	6.4%		
	Normal	822	93.4%	1,078	93.6%		
Obsessive-Compulsive Behavior	n	880		1,152		1.11 (0.80,1.53)	0.580
	Number/%						
	Abnormal	74	8.4%	88	7.6%		
	Normal	806	91.6%	1,064	92.4%		
Paranoid Ideation	n	880		1,152		1.23 (0.79,1.91)	0.420
	Number/%						
	Abnormal	40	4.5%	43	3.7%		
	Normal	840	95.5%	1,109	96.3%		

12-38

TABLE 12-6. (continued)

Unadjusted Analysis for SCL-90-R Psychological Variables by Group

Variable	Statistic	Group		Est. Relative Risk (95% C.I.)	p-Value	
		Ranch Hand	Comparison			
Phobic Anxiety	n	880		1,152		
	Number/%					
	Abnormal	61	6.9%	81	7.0%	0.99 (0.70,1.39)
Normal	819	93.1%	1,071	93.0%	0.999	
Psychoticism	n	880		1,152		
	Number/%					
	Abnormal	82	9.3%	99	8.6%	1.09 (0.80,1.49)
	Normal	798	90.7%	1,053	91.4%	
Somatization	n	880		1,152		
	Number/%					
	Abnormal	94	10.7%	95	8.2%	1.33 (0.99,1.80)
Normal	786	89.3%	1,057	91.8%	0.073	
GSI	n	880		1,152		
	Number/%					
	Abnormal	78	8.9%	77	6.7%	1.36 (0.98,1.89)
Normal	802	91.1%	1,075	93.3%	0.081	
PSDI	n	880		1,152		
	Number/%					
	Abnormal	88	10.0%	105	9.1%	1.11 (0.82,1.49)
Normal	792	90.0%	1,047	90.9%	0.548	
PST	n	880		1,152		
	Number/%					
	Abnormal	73	8.3%	78	6.8%	1.25 (0.89,1.74)
Normal	807	91.7%	1,074	93.2%	0.226	

TABLE 12-7.

Adjusted Analysis for SCL-90-R Psychological Variables by Group

Variable	Statistic	Group		Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
		Ranch Hand	Comparison			
Anxiety	n	839	1,074	1.20 (0.81,1.77)	0.361	EDUC (p<0.001) PTSD (p<0.001) AGE*ALC (p=0.020)
Depression	n	834	1,072	1.17 (0.83,1.65)	0.379	EDUC (p<0.001) PTSD (p<0.001) AGE*RACE (p=0.012) RACE*DRKYR (p=0.044)
Hostility	n	834	1,072	****	****	GRP*PTSD (p=0.009) AGE*PTSD (p=0.033) RACE*PTSD (p=0.010) EDUC*PTSD (p<0.001) DRKYR*PTSD (p=0.021) ALC*PTSD (p=0.015)
Interpersonal Sensitivity	n	834	1,072	0.90 (0.61,1.33)	0.586	AGE (p=0.004) EDUC (p<0.001) DRKYR (p=0.010) PTSD (p<0.001)
Obsessive-Compulsive Behavior	n	834	1,072	1.07 (0.76,1.51)	0.704	AGE (p=0.018) EDUC (p<0.001) DRKYR (p=0.041) PTSD (p<0.001)
Paranoid Ideation	n	834	1,072	0.99 (0.61,1.61)	0.964	DRKYR (p=0.004) PTSD (p<0.001) AGE*EDUC (p=0.017)

12-40

TABLE 12-7. (continued)

Adjusted Analysis for SCL-90-R Psychological Variables by Group

Variable	Statistic	Group		Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
		Ranch Hand	Comparison			
Phobic Anxiety	n	834	1,072	0.87 (0.59,1.27)	0.460	DRKYR (p=0.032) PTSD (p<0.001) AGE*EDUC (p=0.033)
Psychoticism	n	843	1,075	1.01 (0.72,1.40)	0.968	PTSD (p<0.001) RACE*EDUC (p=0.005)
Somatization	n	843	1,075	1.21 (0.88,1.67)**	0.236**	GRP*EDUC (p=0.026) PTSD (p<0.001) AGE*EDUC (p=0.032)
GSI	n	834	1,072	1.20 (0.84,1.73)	0.314	AGE (p=0.001) EDUC (p<0.001) DRKYR (p=0.009) PTSD (p<0.001)
PSDI	n	843	1,075	0.97 (0.71,1.32)**	0.840**	GRP*RACE (p=0.046) EDUC (p=0.035) PTSD (p<0.001)
PST	n	834	1,072	1.13 (0.78,1.62)	0.524	AGE (p=0.003) EDUC (p=0.001) DRKYR (p=0.014) PTSD (p<0.001)

12-41

****Exposure index-by-covariate interaction (p<0.01)--adjusted relative risk, confidence interval, and p-value not presented.

**Exposure index-by-covariate interaction (0.01<p<0.05)--adjusted relative risk, confidence interval, and p-value derived from a model fitted after deletion of this interaction.

participants had a lower percentage of abnormalities than the participants with a high school education (5.9% vs. 11.0%). Based on lifetime alcohol history, the lowest percentage of abnormalities was among the moderate drinkers (7.1%), followed by the nondrinkers (10.7%) and the heavy drinkers (11.5%). All (100.0%) of the participants with PTSD were classified as abnormal on depression, as compared to 7.7 percent of those without PTSD.

After adjusting for covariates, no significant difference between the two groups was detected ($p=0.379$). The significant terms in the model were: education ($p<0.001$), PTSD ($p<0.001$), age-by-race ($p=0.012$), and race-by-lifetime alcohol history ($p=0.044$).

Hostility

The unadjusted analysis of the SCL-90-R hostility scale did not detect a significant difference between the two groups ($p=0.584$).

The covariate tests showed that age ($p<0.001$), education ($p=0.001$), lifetime alcohol history ($p=0.001$), and PTSD ($p<0.001$) were significantly associated with hostility. The association with current alcohol use was borderline significant ($p=0.086$). The percentage of abnormalities decreased with age (7.3% for those born in or after 1942, 3.2% for those born between 1923 and 1941, and 1.4% for those born in or before 1922). A higher percentage of abnormalities was found among the high school-educated participants than the college educated (6.5% vs. 3.1%). The percentage of abnormalities increased with alcohol consumption based on both the lifetime alcohol history and current alcohol use. For lifetime alcohol history, the percentages of abnormalities were 2.8, 4.1, and 8.1 for nondrinkers, moderate drinkers, and heavy drinkers, respectively. Based on current alcohol use, 4.4 percent of the light drinkers were classified as abnormal, as contrasted with 6.2 percent of the moderate drinkers and 9.4 percent of the heavy drinkers. Of the participants with PTSD, 81.3 percent were classified as abnormal, as compared to 4.3 percent of the participants without PTSD.

In the adjusted analysis of hostility, all two-factor interactions involving PTSD were significant: group ($p=0.009$), age ($p=0.033$), race ($p=0.010$), education ($p<0.001$), lifetime alcohol history ($p=0.021$), and current alcohol use ($p=0.015$). Investigating the group-by-PTSD interaction revealed that the Comparisons with PTSD had a higher percentage of abnormalities than the Ranch Hands with PTSD, and the Ranch Hands without PTSD had a higher percentage of abnormalities than the Comparisons without PTSD. However, these differences were not statistically significant ($p=0.869$ and $p=0.690$, respectively).

Interpersonal Sensitivity

For the interpersonal sensitivity scale of the SCL-90-R, no significant difference between the Ranch Hands and Comparisons was identified in the unadjusted analysis ($p=0.948$).

Age ($p<0.001$), education ($p<0.001$), lifetime alcohol history ($p=0.016$), and PTSD ($p<0.001$) were significant covariates in the tests of association

with interpersonal sensitivity. For age, the highest percentage of abnormalities was for those born in or after 1942 (8.9%), followed by those born in or before 1922 (8.3%) and those born between 1923 and 1941 (4.5%). The percentage of abnormalities for the high school-educated participants was 9.5 percent, as compared to 3.3 percent for the college-educated participants. The percentage of abnormalities increased with alcohol consumption based on lifetime alcohol history (5.1% for nondrinkers, 5.8% for moderate drinkers, and 9.4% for heavy drinkers). Only 5.8 percent of the participants without PTSD were classified as abnormal based on interpersonal sensitivity, as compared to 81.3 percent of the participants with PTSD.

Based on the adjusted analysis of interpersonal sensitivity, the Ranch Hands and the Comparisons were not statistically different ($p=0.586$). Age ($p=0.004$), education ($p<0.001$), lifetime alcohol history ($p=0.010$), and PTSD ($p<0.001$) were significant covariates in the model.

Obsessive-Compulsive Behavior

Based on the unadjusted analysis of the obsessive-compulsive behavior variable from the SCL-90-R, no significant group difference was detected ($p=0.580$).

The covariate tests revealed that obsessive-compulsive behavior was significantly associated with age ($p=0.006$), education ($p<0.001$), lifetime alcohol history ($p=0.020$), and PTSD ($p<0.001$). The lowest percentage of abnormalities was among the participants born between 1923 and 1941 (6.2%). For the participants born in or before 1922, 9.7 percent were classified as abnormal, as compared to 10.1 percent of those born in or after 1942. The percentage of abnormalities was higher for the high school-educated participants than for those with a college education (11.1% vs. 4.8%). For lifetime alcohol history, the highest percentage of abnormalities was among the heavy drinkers (11.1%), followed by the nondrinkers (7.3%) and the moderate drinkers (7.1%). Participants with PTSD and without PTSD had 81.3 percent and 7.4 percent abnormalities, respectively.

No significant difference between the two groups was identified based on the adjusted analysis ($p=0.704$). The significant covariates in the model were age ($p=0.018$), education ($p<0.001$), lifetime alcohol history ($p=0.041$), and PTSD ($p<0.001$).

Paranoid Ideation

The results of the unadjusted analysis of paranoid ideation from the SCL-90-R did not show a significant difference between the Ranch Hands and Comparisons ($p=0.420$).

Using combined Ranch Hand and Comparison data, age ($p=0.003$), education ($p=0.022$), lifetime alcohol history ($p=0.024$), and PTSD ($p<0.001$) were found to be significantly associated with paranoid ideation. The percentage of abnormalities decreased with age (5.8% for those born in or after 1942, 2.9% for those born between 1923 and 1941, and 1.4% for those born in or before 1922). A higher percentage of abnormalities was found among the high school-educated participants than those with a college education (5.1% vs. 3.0%).

The percentage of abnormalities increased with alcohol consumption based on lifetime alcohol history (2.2% for nondrinkers, 3.6% for moderate drinkers, and 6.2% for heavy drinkers). Seventy-five percent of the participants with PTSD were classified as abnormal based on paranoid ideation scale as compared to 3.5 percent of the participants without PTSD.

The two groups did not differ significantly on paranoid ideation based on the adjusted analysis ($p=0.964$). Lifetime alcohol history, PTSD, and age-by-education were significant terms in the adjusted model ($p=0.004$, $p<0.001$, and $p=0.017$, respectively).

Phobic Anxiety

No significant group difference was found in the unadjusted analysis of phobic anxiety from the SCL-90-R ($p=0.999$).

The covariate tests showed that phobic anxiety was significantly associated with age ($p<0.001$), education ($p<0.001$), lifetime alcohol history ($p=0.019$), and PTSD ($p<0.001$). The participants born in or after 1942 had the highest percentage of abnormalities (9.8%) when compared to the participants born between 1923 and 1941 (4.7%) and those born in or before 1922 (6.9%). A higher percentage of abnormalities was found among the high school-educated participants than those with a college education (9.0% vs. 4.9%). Based on the lifetime alcohol history, the highest percentage of phobic anxiety abnormalities was for the nondrinkers (10.1%), followed by the heavy drinkers (9.0%) and the moderate drinkers (5.9%). Participants with PTSD had a higher percentage of abnormalities than participants without PTSD (75.0% vs. 6.3%).

The adjusted analysis of phobic anxiety did not detect a significant difference between the Ranch Hands and the Comparisons ($p=0.460$). Lifetime alcohol history, PTSD, and age-by-education were significant terms in the model ($p=0.032$, $p<0.001$, and $p=0.033$, respectively).

Psychoticism

Based on the unadjusted analysis of the SCL-90-R psychoticism variable, no difference between the two groups was detected ($p=0.624$).

Of the six covariate tests, five were significantly associated with psychoticism: age ($p=0.008$), education ($p<0.001$), lifetime alcohol history ($p=0.016$), current alcohol use ($p=0.020$), and PTSD ($p<0.001$). The highest percentage of abnormalities was among the participants born in or after 1942 (11.1%), followed by those born in or before 1922 (9.7%) and those born between 1923 and 1941 (7.1%). Of the high school-educated participants, 12.1 percent were classified as abnormal, compared to 5.6 percent of the college-educated participants. For lifetime alcohol history, the highest percentage of abnormalities was among the heavy drinkers (12.2%), followed by the nondrinkers (9.6%) and the moderate drinkers (7.8%). A similar pattern of abnormalities was found for current alcohol use (18.8% for heavy drinkers, 8.6% for light drinkers, and 8.5% for moderate drinkers). The percentages of abnormalities for the participants with and without PTSD were 93.8 and 8.2, respectively.

No difference was found between the two groups based on the adjusted analysis of psychoticism ($p=0.968$). PTSD and race-by-education were significant terms in the model ($p<0.001$ and $p=0.005$, respectively).

Somatization

A borderline significant difference between the two groups was identified in the unadjusted analysis of somatization from the SCL-90-R (Est. RR: 1.33, 95% C.I.: [0.99,1.80], $p=0.073$). For this variable, 10.7 percent of the Ranch Hands were classified as abnormal, as compared to 8.2 percent of the Comparisons.

Education, lifetime alcohol history, and PTSD were found to be significantly associated with somatization ($p<0.001$, $p=0.042$, and $p<0.001$, respectively). The participants with a high school education had a higher percentage of abnormalities than those with a college education (12.6% vs. 5.9%). For lifetime alcohol history, the highest percentage of abnormalities was among the nondrinkers (12.4%), followed by the heavy drinkers (11.3%) and the moderate drinkers (8.2%). Of the participants with PTSD, 87.5 percent were classified as abnormal based on the somatization scale, as compared to 8.7 percent of the participants without PTSD.

In the adjusted analysis of somatization, there was a significant group-by-education interaction ($p=0.026$). PTSD and age-by-education were also significant terms in the model ($p<0.001$ and $p=0.032$, respectively). Stratifying by education revealed that the high school-educated Ranch Hands had a higher percentage of abnormalities than the Comparisons with a high school education (15.5% vs. 9.8%; Adj. RR: 1.57, 95% C.I.: [1.06,2.33], $p=0.025$). For those with a college education, no difference between the two groups was detected ($p=0.256$). Without the group-by-education interaction in the model, there was no significant difference between the two groups ($p=0.236$).

GSI

A borderline significant difference in severity of psychological distress between the two groups was detected in the unadjusted analysis on the GSI of the SCL-90-R (Est. RR: 1.36, 95% C.I.: [0.98,1.89], $p=0.081$). More Ranch Hands than Comparisons were classified as abnormal on the GSI (8.9% vs. 6.7%).

The results of the covariate tests with the GSI revealed significant associations for age ($p=0.001$), education ($p<0.001$), lifetime alcohol history ($p=0.030$), and PTSD ($p<0.001$). The association with current alcohol use was borderline significant ($p=0.086$). The percentage of abnormalities on the GSI decreased with age (10.2% for those born in or after 1942, 5.7% for those born between 1923 and 1941, and 5.6% for those born in or before 1922). The high school-educated participants had a higher percentage of abnormalities than the college-educated participants (10.8% vs. 4.3%). Based on lifetime alcohol history, the highest percentage of abnormalities was among the heavy drinkers (10.4%), followed by the nondrinkers (7.3%) and the moderate drinkers (6.7%). The percentage of abnormalities increased with current alcohol use (7.1% for light drinkers, 8.8% for moderate drinkers, and 14.1% for heavy drinkers). The percentage of abnormalities for the participants with PTSD was 93.8 percent, as compared to 6.8 percent for participants without PTSD.

The adjusted analysis of the GSI did not identify a significant difference between the Ranch Hands and the Comparisons ($p=0.314$). The significant covariates in the model were age ($p=0.001$), education ($p<0.001$), lifetime alcohol history ($p=0.009$), and PTSD ($p<0.001$).

PSDI

No significant group difference in the intensity of psychological distress was identified for the PSDI of the SCL-90-R in the unadjusted analysis ($p=0.548$).

The PSDI covariate tests showed that education, lifetime alcohol history, and PTSD were significant ($p=0.018$, $p=0.042$, and $p<0.001$, respectively). A higher percentage of the high school-educated participants were classified as abnormal on the PSDI than those with a college education (11.1% vs. 7.9%). For lifetime alcohol history, the highest percentage of abnormalities was among the nondrinkers (14.6%), followed by the heavy drinkers (9.6%) and the moderate drinkers (8.7%). Of the participants with PTSD, 75.0 percent were classified as abnormal based on the PSDI, as compared to 9.1 percent of the participants without PTSD.

In the adjusted analysis of the PSDI, there was a significant group-by-race interaction ($p=0.046$). Education and PTSD were significant covariates ($p=0.035$ and $p<0.001$, respectively). After stratifying by race, a borderline significant difference between the Black Ranch Hands and Black Comparisons was identified with 15.7 percent abnormalities among the Black Comparisons, as contrasted with 4.2 percent abnormalities in the Black Ranch Hands (Adj. RR: 0.25, 95% C.I.: [0.05, 1.18], $p=0.079$). No difference between the nonblack Ranch Hands and Comparisons was detected ($p=0.761$). Without the group-by-race interaction in the model, there was no significant difference between the two groups ($p=0.840$).

PST

The unadjusted results of the SCL-90-R PST did not detect a significant difference in the total number of reported symptoms between the Ranch Hands and the Comparisons ($p=0.226$).

Using pooled group data, the covariate tests showed that five of the six covariates were significantly associated with the PST: age ($p<0.001$), education ($p<0.001$), lifetime alcohol history ($p=0.009$), current alcohol use ($p=0.024$), and PTSD ($p<0.001$). For age, the highest percentage of abnormalities was among the participants born in or after 1942 (10.2%), followed by those born in or before 1922 (5.6%) and those born between 1923 and 1941 (5.4%). The high school-educated participants had a higher percentage of abnormalities than those with a college education (9.9% vs. 4.8%). For lifetime alcohol history, the highest percentage of abnormalities was among the heavy drinkers (10.7%), followed by the nondrinkers (6.7%) and the moderate drinkers (6.4%). Based on current alcohol use, the percentage of abnormalities increased with alcohol consumption (6.9% for light drinkers, 8.5% for moderate drinkers, and 15.6% for heavy drinkers). The percentages of abnormalities for the participants with and without PTSD were 93.8 and 6.7, respectively.

The Ranch Hands and the Comparisons did not differ significantly based on the adjusted analysis of the PST ($p=0.524$). The significant covariates in the model were: age ($p=0.003$), education ($p=0.001$), lifetime alcohol history ($p=0.014$), and PTSD ($p<0.001$).

Physical Examination Variables: MCMI

The results of the unadjusted and adjusted analyses of the MCMI are presented in Tables 12-8 and 12-9, respectively. Dependent variable-covariate associations are provided in Table I-1 of Appendix I. Table I-2 of Appendix I contains the group-by-covariate interactions.

Schizoid Score

The unadjusted analysis of the MCMI schizoid score did not detect a significant difference between the two groups ($p=0.408$).

The covariate tests showed that the schizoid score was significantly associated with age ($p=0.012$), education ($p<0.001$), lifetime alcohol history ($p=0.024$), and PTSD ($p<0.001$). Age was negatively correlated with the schizoid score ($r=-0.053$). The mean score of the high school-educated participants was higher than the mean score for those with a college education (26.3 vs. 22.6). The schizoid score was positively correlated with lifetime alcohol history ($r=0.047$). The mean score of the participants with PTSD exceeded that of the participants without PTSD (83.0 vs. 24.1).

Based on the adjusted analysis, the two groups did not differ significantly on the schizoid score ($p=0.788$). Education, PTSD, and age-by-lifetime alcohol history were significant terms in the model ($p<0.001$, $p<0.001$, and $p=0.029$, respectively).

Avoidant Score

Based on the unadjusted analysis of the avoidant score of the MCMI, no significant difference was found between the Ranch Hands and the Comparisons ($p=0.812$).

The covariate tests revealed significant associations with all of the covariates except race: age ($p=0.014$), education ($p<0.001$), lifetime alcohol history ($p<0.001$), current alcohol use ($p=0.010$), and PTSD ($p<0.001$). The avoidant score was negatively correlated with age ($r=-0.051$). The participants with a high school education had a higher mean score than the college-educated participants (19.3 vs. 14.3). For lifetime alcohol history, the heavy drinkers had the highest mean score (19.3), followed by the nondrinkers (17.6) and the moderate drinkers (15.8). The avoidant score was positively correlated with current alcohol use ($r=0.054$). The mean score of the participants with PTSD was 89.2, as compared to a mean score of 16.3 for participants without PTSD.

TABLE 12-8.

Unadjusted Analysis for MCMI Psychological Variables by Group

Variable	Statistic	Group		p-Value
		Ranch Hand	Comparison	
Schizoid Score	n Mean ^a 95% C.I. ^a	992 24.7 (23.8, 25.6)	1,296 24.2 (23.4, 24.9)	0.408
Avoidant Score	n Mean ^b 95% C.I. ^b	992 16.8 (15.9, 17.7)	1,296 16.6 (15.8, 17.5)	0.812
Dependent Score	n Mean ^c 95% C.I. ^c	992 40.4 (39.1, 41.6)	1,296 42.0 (40.9, 43.2)	0.048
Histrionic Score	n Mean ^d 95% C.I. ^d	992 63.3 (62.5, 64.2)	1,296 63.9 (63.2, 64.7)	0.318
Narcissistic Score	n Mean 95% C.I.	992 64.6 (63.6, 65.5)	1,296 63.4 (62.6, 64.3)	0.090
Antisocial Score	n Mean 95% C.I.	992 61.9 (60.7, 63.1)	1,296 59.1 (58.1, 60.2)	<0.001
Compulsive Score	n Mean ^d 95% C.I. ^d	992 68.3 (67.8, 68.9)	1,296 68.6 (68.1, 69.1)	0.408
Passive-Aggressive Score	n Mean ^c 95% C.I. ^c	992 19.6 (18.6, 20.6)	1,296 18.7 (17.9, 19.5)	0.170
Schizotypal Score	n Mean 95% C.I.	992 34.3 (33.2, 35.5)	1,296 34.4 (33.4, 35.4)	0.949
Borderline Score	n Mean 95% C.I.	992 32.7 (31.6, 33.7)	1,296 33.4 (32.5, 34.4)	0.278
Paranoid Score	n Mean 95% C.I.	992 53.2 (52.3, 54.2)	1,296 51.5 (50.7, 52.4)	0.011

TABLE 12-8. (continued)

Unadjusted Analysis for MCMI Psychological Variables by Group

Variable	Statistic	Group		p-Value
		Ranch Hand	Comparison	
Anxiety Score	n	992	1,296	0.200
	Mean	46.5	47.6	
	95% C.I.	(45.1,47.8)	(46.5,48.8)	
Somatoform Score	n	992	1,296	0.370
	Mean	50.9	51.5	
	95% C.I.	(49.8,52.0)	(50.6,52.5)	
Hypomania Score	n	992	1,296	0.736
	Mean ^c	21.4	21.1	
	95% C.I. ^c	(19.9,23.0)	(19.8,22.4)	
Dysthymia Score	n	992	1,296	0.242
	Mean	49.4	50.5	
	95% C.I.	(48.0,50.8)	(49.3,51.7)	
Alcohol Abuse Score	n	992	1,296	0.376
	Mean	31.5	30.8	
	95% C.I.	(30.4,32.5)	(29.9,31.7)	
Drug Abuse Score	n	992	1,296	0.353
	Mean	47.9	47.1	
	95% C.I.	(46.6,49.1)	(46.0,48.2)	
Psychotic Thinking Score	n	992	1,296	0.952
	Mean	32.1	32.1	
	95% C.I.	(30.9,33.4)	(31.0,33.2)	
Psychotic Depression Score	n	992	1,296	0.797
	Mean	23.5	23.3	
	95% C.I.	(22.2,24.8)	(22.2,24.4)	
Psychotic Delusion Score	n	992	1,296	0.061
	Mean	43.8	42.2	
	95% C.I.	(42.6,45.1)	(41.1,43.3)	

^aTransformed from natural logarithm scale.

^bTransformed from natural logarithm (X+1) scale.

^cTransformed from square root scale.

^dTransformed from square scale.

TABLE 12-9.

Adjusted Analysis for MCHI Psychological Variables by Group

Variable	Statistic	Group		p-Value	Covariate Remarks
		Ranch Hand	Comparison		
Schizoid Score	n Adj. Mean ^a 95% C.I. ^a	942 44.2 (38.4,50.9)	1,208 43.9 (38.1,50.6)	0.788	EDUC (p<0.001) PTSD (p<0.001) AGE*DRKYR (p=0.029)
Avoidant Score	n Adj. Mean ^b 95% C.I. ^b	942 **** ****	1,208 **** ****	****	GRP*EDUC (p=0.005) AGE (p=0.037) DRKYR (p<0.001) PTSD (p<0.001)
Dependent Score	n Adj. Mean** ^c 95% C.I.** ^c	947 46.2 (40.7,52.0)	1,209 48.3 (42.7,54.3)	0.020**	GRP*RACE (p=0.018) AGE (p=0.046) EDUC (p<0.001) ALC (p<0.001) PTSD (p=0.027)
Histrionic Score	n Adj. Mean** ^d 95% C.I.** ^d	947 62.4 (54.8,69.2)	1,209 62.7 (55.1,69.4)	0.607**	GRP*RACE (p=0.040) AGE (p=0.037) EDUC (p<0.001) ALC (p=0.006) RACE*PTSD (p=0.024)
Narcissistic Score	n Adj. Mean 95% C.I.	942 57.5 (53.4,61.7)	1,208 55.9 (51.8,60.1)	0.015	RACE (p<0.001) EDUC (p<0.001) DRKYR*PTSD (p=0.003)
Antisocial Score	n Adj. Mean 95% C.I.	983 61.9 (60.7,63.1)	1,294 59.1 (58.1,60.2)	0.001	DRKYR (p=0.002) AGE*ALC (p=0.021)

TABLE 12-9. (continued)

Adjusted Analysis for MCMI Psychological Variables by Group

Variable	Statistic	Group		p-Value	Covariate Remarks
		Ranch Hand	Comparison		
Compulsive Score	n	942	1,208	0.791**	GRP*ALC (p=0.047) GRP*PTSD (p=0.034) RACE (p=0.041) AGE*EDUC (p=0.004) DRKYR*ALC (p=0.020)
	Adj. Mean** ^d	58.6	58.8		
	95% C.I.** ^d	(56.1,61.1)	(56.2,61.2)		
Passive-Aggressive Score	n	942	1,208	0.270**	GRP*EDUC (p=0.017) AGE (p<0.001) PTSD (p<0.001) EDUC*DRKYR (p=0.031)
	Adj. Mean** ^c	46.6	45.5		
	95% C.I.** ^c	(41.2,52.3)	(40.2,51.2)		
Schizotypal Score	n	942	1,208	0.446**	GRP*DRKYR (p=0.044) AGE (p=0.010) EDUC (p<0.001) PTSD (p<0.001)
	Adj. Mean**	51.7	52.3		
	95% C.I.**	(46.8,56.5)	(47.4,57.1)		
Borderline Score	n	942	1,208	0.050**	GRP*RACE (p=0.014) AGE (p=0.005) EDUC (p<0.001) DRKYR (p<0.001) PTSD (p<0.001)
	Adj. Mean**	51.1	52.6		
	95% C.I.**	(46.8,55.5)	(48.2,56.9)		
Paranoid Score	n	984	1,290	0.014	RACE (p=0.002) EDUC (p<0.001)
	Adj. Mean	55.0	53.4		
	95% C.I.	(53.5,56.6)	(52.0,54.9)		
Anxiety Score	n	951	1,210	****	GRP*RACE (p=0.010) PTSD (p<0.001) AGE*EDUC (p=0.003)
	Adj. Mean	****	****		
	95% C.I.	****	****		

12-51

TABLE 12-9. (continued)

Adjusted Analysis for MCMI Psychological Variables by Group

Variable	Statistic	Group		p-Value	Covariate Remarks
		Ranch Hand	Comparison		
Somatoform Score	n	947	1,209	0.321	ALC (p=0.013) AGE*EDUC (p=0.002) RACE*PTSD (p=0.035)
	Adj. Mean	68.6	69.4		
	95% C.I.	(59.9,77.4)	(60.7,78.1)		
Hypomania Score	n	942	1,208	0.646	AGE (p=0.022) EDUC (p=0.004) DRKYR (p<0.001) PTSD (p=0.034) RACE*ALC (p=0.020)
	Adj. Mean ^c	30.7	30.1		
	95% C.I. ^c	(23.5,38.7)	(23.0,38.1)		
Dysthymia Score	n	951	1,210	0.166	EDUC (p=0.014) PTSD (p<0.001)
	Adj. Mean	68.6	70.0		
	95% C.I.	(63.2,74.1)	(64.5,75.5)		
Alcohol Abuse Score	n	942	1,208	0.475**	GRP*RACE (p=0.027) GRP*PTSD (p=0.038) EDUC (p<0.001) ALC (p=0.019) AGE*DRKYR (p=0.008)
	Adj. Mean**	49.6	49.1		
	95% C.I.**	(45.5,53.7)	(45.0,53.2)		
Drug Abuse Score	n	942	1,208	0.131	AGE (p=0.007) EDUC (p=0.040) DRKYR (p<0.001) RACE*PTSD (p=0.035)
	Adj. Mean	65.3	64.1		
	95% C.I.	(55.4,75.3)	(54.2,74.0)		
Psychotic Thinking Score	n	942	1,208	0.443	AGE (p=0.005) EDUC (p<0.001) DRKYR (p<0.001) PTSD (p<0.001)
	Adj. Mean	49.7	50.4		
	95% C.I.	(44.8,54.7)	(45.5,55.3)		

12-52

TABLE 12-9. (continued)

Adjusted Analysis for MCHI Psychological Variables by Group

Variable	Statistic	Group		p-Value	Covariate Remarks
		Ranch Hand	Comparison		
Psychotic Depression Score	n Adj. Mean 95% C.I.	942 **** ****	1,208 **** ****	****	GRP*EDUC (p=0.010) AGE (p=0.049) DRKYR (p<0.001) PTSD (p<0.001)
Psychotic Delusion Score	n Adj. Mean 95% C.I.	947 50.9 (45.4,56.5)	1,209 49.3 (43.8,54.8)	0.062	RACE (p=0.015) PTSD (p=0.036) EDUC*ALC (p=0.045)

^aTransformed from natural logarithm scale.

^bTransformed from natural logarithm (X+1) scale.

****Group-by-covariate interaction (p<0.01)--adjusted mean, confidence interval, and p-value not presented.

^cTransformed from square root scale.

**Group-by-covariate interaction (0.01<p<0.05)--adjusted mean, confidence interval, and p-value derived from a model fitted after deletion of this interaction.

^dTransformed from square scale.

In the adjusted analysis, there was a significant group-by-education interaction ($p=0.005$). The covariates that made a significant contribution to the model were age, lifetime alcohol history, and PTSD ($p=0.037$, $p<0.001$, $p<0.001$, respectively). After stratifying by education, the results showed that the college-educated Comparisons had a significantly higher adjusted mean score than the Ranch Hands with a college education (35.0 vs. 31.0, $p=0.022$). For those with a high school education, the Ranch Hands had an adjusted mean score of 45.6, as contrasted with an adjusted mean score of 41.9 for the Comparisons; this difference was borderline significant ($p=0.099$).

Dependent Score

The results of the unadjusted analysis showed that the Comparisons had a significantly higher mean dependent score on the MCMI than the Ranch Hands (42.0 vs. 40.4, $p=0.048$).

Based on pooled group data, the dependent score was significantly associated with age, education, and current alcohol use ($p=0.003$, $p<0.001$, and $p<0.001$, respectively). The participants born in or before 1922 had the highest mean score (45.9), followed by those born in or after 1942 (42.5) and those born between 1923 and 1941 (40.1). The mean score for the high school-educated participants was higher than the mean score for the participants with a college education (44.0 vs. 38.6). The mean dependent scores were 42.1, 37.5, and 43.6 for the light, moderate, and heavy drinkers, respectively.

In the adjusted analysis, there was a significant group-by-race interaction ($p=0.018$). The significant covariates in the model were: age ($p=0.046$), education ($p<0.001$), current alcohol use ($p<0.001$), and PTSD ($p=0.027$). Stratifying by race revealed that the nonblack Comparisons had a higher adjusted mean dependent score than the nonblack Ranch Hands (48.5 vs. 45.9, $p=0.005$). The difference between the adjusted mean scores for the Black Ranch Hands and Black Comparisons was borderline significant (52.4 and 45.8, respectively; $p=0.086$). Without the group-by-race interaction in the model, the Comparisons had a significantly higher adjusted mean score than the Ranch Hands (48.3 vs. 46.2, $p=0.020$).

Histrionic Score

In the unadjusted analysis of the MCMI histrionic score, the two groups did not differ significantly ($p=0.318$).

The covariate tests with the histrionic score found significant associations with race ($p=0.002$), education ($p<0.001$), current alcohol use ($p=0.004$), and PTSD ($p<0.001$). The mean score for the Blacks exceeded the mean score for the nonblacks (67.2 vs. 63.4). For education, the participants with a high school education had a mean score of 61.4 as compared to a mean score of 65.9 for the participants with a college education. Based on current alcohol use, the highest mean score was for the moderate drinkers (65.7), followed by the light drinkers (63.3) and the heavy drinkers (61.9). The participants without PTSD had a mean score of 63.9, as compared to a mean score of 41.2 for the participants with PTSD.

The results of the adjusted analysis showed that the group-by-race interaction was significant ($p=0.040$). Age ($p=0.037$), education ($p<0.001$), current alcohol use ($p=0.006$), and race-by-PTSD ($p=0.024$) were also significant terms in the model. Stratifying by race identified a borderline significant difference between the adjusted mean scores of the Black Ranch Hands and Comparisons (74.5 and 70.5, respectively; $p=0.062$). No difference was detected for nonblacks ($p=0.313$). Without the group-by-race interaction in the model, no significant difference between the two groups was found ($p=0.607$).

Narcissistic Score

The results of the unadjusted analysis of the narcissistic score of the MCMI showed that the mean score of the Ranch Hands was marginally significantly higher than the mean score of the Comparisons (64.6 vs. 63.4, respectively; $p=0.090$).

Using combined Ranch Hand and Comparison data, race, education, and PTSD were found to be significantly associated with the narcissistic score ($p<0.001$ for all). The mean score for Blacks exceeded the mean score of the nonblacks (69.2 vs. 63.6). The college-educated participants had a higher mean score than those with a high school education (65.3 vs. 62.6). The mean scores of the participants with and without PTSD were 40.1 and 64.1, respectively.

In the adjusted analysis, the Ranch Hands had a significantly higher adjusted mean score than the Comparisons (57.5 vs. 55.9, $p=0.015$). Race, education, and lifetime alcohol history-by-PTSD were significant terms in the model ($p<0.001$, $p<0.001$, and $p=0.003$, respectively).

Antisocial Score

Based on the unadjusted analysis, the Ranch Hands had a significantly higher mean antisocial score on the MCMI than the Comparisons (61.9 vs. 59.1, $p<0.001$).

The covariate tests identified a significant association between the antisocial score and lifetime alcohol history ($p<0.001$). The associations with education and current alcohol use were borderline significant ($p=0.063$ and $p=0.066$, respectively). For education, the mean score for the high school-educated participants was higher than the mean score for those with a college education (61.0 vs. 59.5). Lifetime alcohol history and current alcohol use were found to be positively correlated with the antisocial score ($r=0.075$ and $r=0.039$, respectively).

The results of the adjusted analysis also showed that the Ranch Hands differed significantly from the Comparisons, with the Ranch Hands having a higher adjusted mean antisocial score (61.9 vs. 59.1, $p=0.001$). Lifetime alcohol history and age-by-current alcohol use were significant terms in the model ($p=0.002$ and $p=0.021$, respectively).

Compulsive Score

Based on the unadjusted analysis of the MCMI compulsive score, no significant difference between the two groups was detected ($p=0.408$).

The results of the covariate tests showed that the compulsive score was significantly associated with five of the six covariates: age ($p<0.001$), education ($p=0.035$), lifetime alcohol history ($p<0.001$), current alcohol use ($p<0.001$), and PTSD ($p<0.001$). Age was positively correlated with the compulsive score ($r=0.138$). The mean scores for the high school- and college-educated participants were 68.1 and 68.9, respectively. Lifetime alcohol history and current alcohol use were negatively correlated with the compulsive score ($r=-0.164$ and $r=-0.108$, respectively). The mean score for the participants without PTSD exceeded the mean score of those with PTSD (68.7 vs. 42.2).

Two interactions involving group (group-by-current alcohol use and group-by-PTSD) were significant in the adjusted model ($p=0.047$ and $p=0.034$, respectively). The other significant terms in the model were race, age-by-education, and lifetime alcohol history-by-current alcohol use ($p=0.041$, $p=0.004$, and $p=0.020$, respectively). After stratifying by current alcohol use and PTSD, no differences were identified for the light drinkers without PTSD ($p=0.318$), the moderate drinkers with PTSD ($p=0.614$), and the moderate drinkers without PTSD ($p=0.802$). Significant differences were detected for the light drinkers with PTSD, with the Ranch Hands having a higher adjusted mean score than the Comparisons (51.9 vs. 25.7, $p=0.004$), and for the heavy drinkers without PTSD, where the Ranch Hand adjusted mean score was higher than the adjusted mean score of the Comparisons (71.4 vs. 67.0, $p=0.028$). There were no participants in the heavy drinker with PTSD stratum. No significant difference between the two groups was found without the two interactions involving group in the model ($p=0.791$).

Passive-Aggressive Score

The Ranch Hands and the Comparisons did not differ significantly based on the unadjusted analysis of the passive-aggressive score of the MCMI ($p=0.170$).

Age, education, lifetime alcohol history, current alcohol use, and PTSD were significantly associated with the passive-aggressive score based on the covariate tests ($p<0.001$ for all). Age was negatively correlated with the passive-aggressive score ($r=-0.142$). The high school-educated participants had a mean score of 20.9, as compared to a mean score of 17.2 for the participants with a college education. Lifetime alcohol history and current alcohol use were positively correlated with the passive-aggressive score ($r=0.152$ and $r=0.074$, respectively). The mean score of the participants with PTSD exceeded the mean score of those without PTSD (91.0 vs. 18.6).

In the adjusted analysis, there was a significant group-by-education interaction ($p=0.017$). Age ($p<0.001$), PTSD ($p<0.001$), and education-by-lifetime alcohol history ($p=0.031$) also made significant contributions to the model. Stratifying by education revealed that the high school-educated Ranch Hands had a higher adjusted mean score than the Comparisons with a high school education (49.6 vs. 46.2, $p=0.014$). No significant difference between the two

groups was found for the college-educated participants ($p=0.354$). Without the group-by-education interaction in the model, no significant difference between the two groups was detected ($p=0.270$).

Schizotypal Score

No significant group difference was found in the unadjusted analysis of the schizotypal score ($p=0.949$).

The results of the covariate tests revealed that age ($p=0.003$), education ($p<0.001$), lifetime alcohol history ($p<0.001$), and PTSD ($p<0.001$) were significantly associated with the schizotypal score. The association between the schizotypal score and current alcohol use was borderline significant ($p=0.075$). The highest mean score was among the participants born in or before 1922 (36.9), followed by those born in or after 1942 (35.7) and those born between 1923 and 1941 (33.2). The high school-educated participants had a higher schizotypal mean score than those with a college education (36.8 vs. 31.8). For lifetime alcohol history, the mean scores were 36.5, 33.1, and 37.3 for the nondrinkers, moderate drinkers, and heavy drinkers, respectively. Current alcohol use was positively correlated with the schizotypal score ($r=0.037$). The mean score of those with PTSD was higher than the mean score for the participants without PTSD (67.3 vs. 34.0).

The results of the adjusted analysis showed that the interaction of group and lifetime alcohol history was significant ($p=0.044$). The covariates that contributed significantly to the model were age, education, and PTSD ($p=0.010$, $p<0.001$, and $p<0.001$, respectively). Contrasting the two groups for each of the categories of lifetime alcohol history revealed no difference between the two groups for the nondrinkers ($p=0.977$) and borderline significant differences for the moderate ($p=0.053$) and heavy drinkers ($p=0.081$). For the moderate drinkers, the Comparisons had a marginally significantly higher adjusted mean score than the Ranch Hands (49.9 vs. 48.0). The Ranch Hands had a marginally significantly higher adjusted mean than the Comparisons for the heavy drinkers (55.0 vs. 52.1). Without the group-by-lifetime alcohol history interaction in the model, no significant group difference was detected ($p=0.446$).

Borderline Score

Based on the unadjusted analysis of the MCMI borderline score, no significant difference between the two groups was found ($p=0.278$).

Using pooled group data, age, education, lifetime alcohol history, and PTSD were found to be significantly associated with the borderline score ($p<0.001$ for all). The association with current alcohol use was marginally significant ($p=0.052$). The mean scores were 34.7, 31.8, and 35.1 for those born in or after 1942, between 1923 and 1941, and in or before 1922, respectively. The mean score for the high school-educated participants was higher than the mean score for those with a college education (35.4 vs. 30.7). Lifetime alcohol history and current alcohol use were found to be positively correlated with the borderline score ($r=0.095$ and $r=0.041$, respectively). The participants with PTSD had a higher mean score than the participants without PTSD (71.5 vs. 32.6).

In the adjusted analysis of the borderline score, there was a significant group-by-race interaction ($p=0.014$). The significant covariates in the model were age ($p=0.005$), education ($p<0.001$), lifetime alcohol history ($p<0.001$), and PTSD ($p<0.001$). Stratifying by race showed that the nonblack Comparisons had a significantly higher adjusted mean score than the nonblack Ranch Hands (52.9 vs. 51.0, $p=0.012$) and the Black Ranch Hands had a marginally significantly higher adjusted mean than the Black Comparisons (55.8 vs. 50.2, $p=0.057$). Without the group-by-race interaction in the model, the Comparisons had a significantly higher adjusted mean than the Ranch Hands (52.6 vs. 51.1, $p=0.050$).

Paranoid Score

Based on the results of the unadjusted analysis of the MCMI paranoid score, the mean score of the Ranch Hands was significantly higher than the mean score of the Comparisons (53.2 vs. 51.5, $p=0.011$).

The results of the covariate tests showed that race ($p=0.001$), education ($p<0.001$), lifetime alcohol history ($p=0.026$), and PTSD ($p=0.034$) were significantly associated with the paranoid score. The Black participants had a mean score of 56.5, as compared to a mean score of 52.0 for nonblack participants. The participants with a high school education had a higher mean score than the college-educated participants (54.1 vs. 50.4). Lifetime alcohol history was positively correlated with the paranoid score ($r=0.047$). The participants with PTSD had a mean score of 60.5, as compared to a mean score of 52.2 for those without PTSD.

In the adjusted analysis, the two groups were significantly different ($p=0.014$). The adjusted mean score of the Ranch Hands was 55.0, as compared to an adjusted mean score of 53.4 for the Comparisons. Race and education were significant covariates in the model ($p=0.002$ and $p<0.001$, respectively).

Anxiety Score

Based on the MCMI anxiety score, the Ranch Hands and Comparisons did not differ significantly in the unadjusted analysis ($p=0.200$).

Of the six covariate tests, only education and PTSD were found to be significantly associated with the anxiety score ($p<0.001$ for both). The high school-educated participants had a mean score of 49.8, as compared to the mean score of 44.3 for those with a college education. The mean of the participants with PTSD was higher than the mean score for those without PTSD (92.9 vs. 46.7).

The results of the adjusted analysis revealed a significant group-by-race interaction ($p=0.010$). PTSD and age-by-education were also significant terms in the model ($p<0.001$ and $p=0.003$, respectively). Stratifying by race showed that the two groups differed for both Blacks and nonblacks ($p=0.042$ and $p=0.014$, respectively). The adjusted mean score of the Black Ranch Hands was higher than the adjusted mean score of the Black Comparisons (75.6 vs. 68.3). For nonblacks, the Comparisons had a higher adjusted mean score than the Ranch Hands (71.0 vs. 68.7).

Somatoform Score

No difference between the two groups was identified in the unadjusted analysis of the MCMI somatoform score ($p=0.370$).

The results of the covariate tests showed that education ($p=0.011$), current alcohol use ($p=0.036$), and PTSD ($p<0.001$) were significantly associated with the somatoform score. The association between the somatoform score and lifetime alcohol history was borderline significant ($p=0.096$). The high school-educated participants had a higher mean score than those with a college education (52.1 vs. 50.3). Lifetime alcohol history and current alcohol use were negatively correlated with the somatoform score ($r=-0.035$ and $r=-0.044$, respectively). The mean score of the participants with PTSD was 68.5, as compared to a mean score of 51.0 for participants without PTSD.

In the adjusted analysis of the somatoform score, no significant difference between the Ranch Hands and Comparisons was detected ($p=0.321$). The significant terms in the model were current alcohol use, age-by-education, and race-by-PTSD ($p=0.013$, $p=0.002$, and $p=0.035$, respectively).

Hypomania Score

In the unadjusted analysis, no significant difference between the two groups was detected ($p=0.736$).

The results of the covariate tests of associations revealed significant relationships for five of the six covariates: age ($p=0.031$), race ($p=0.017$), education ($p=0.022$), lifetime alcohol history ($p=0.001$), and PTSD ($p=0.023$). Age was negatively correlated with the MCMI hypomania score ($r=-0.045$). The Black participants had a higher mean score than the nonblack participants (26.3 vs. 20.9). The participants with a college education had a mean score of 22.4 as compared to a mean score of 20.1 for those with a high school education. Lifetime alcohol history was positively correlated with the hypomania score ($r=0.067$). The participants with PTSD had a higher mean score than the participants without PTSD (37.2 vs. 21.0).

The adjusted analysis of the hypomania score did not identify a significant difference between the two groups ($p=0.646$). The significant terms in the model were age ($p=0.022$), education ($p=0.004$), lifetime alcohol history ($p<0.001$), PTSD ($p=0.034$), and race-by-current alcohol use ($p=0.020$).

Dysthymia Score

The results of the unadjusted analysis of the MCMI dysthymia score showed that the two groups did not differ significantly ($p=0.242$).

In the covariate tests of association, significant relationships were identified for education and PTSD ($p=0.004$ and $p<0.001$, respectively). The high school-educated participants had a higher mean score than those with a college education (51.3 vs. 48.6). The mean score of the participants with PTSD was 89.3, as compared to a mean score of 49.6 for participants without PTSD.

No significant difference between the two groups was detected based on the results of the adjusted analysis ($p=0.166$). Education and PTSD were significant covariates in the adjusted model ($p=0.014$ and $p<0.001$, respectively).

Alcohol Abuse Score

No significant group difference was detected in the unadjusted analysis of the alcohol abuse score of the MCMI ($p=0.376$).

Race, education, lifetime alcohol history, current alcohol use, and PTSD were found to be significantly associated with the alcohol abuse score ($p<0.001$ for all). The association with age was borderline significant ($p=0.065$). Age was negatively correlated with the alcohol abuse score ($r=-0.039$). The Black participants had a higher mean score than the nonblack participants (36.5 vs. 30.8). The mean score of the high school-educated participants was 33.5, as compared to a mean score of 28.7 for those with a college education. Lifetime alcohol history and current alcohol use were both positively correlated with the alcohol abuse score ($r=0.279$ and $r=0.187$, respectively). The participants with PTSD had a higher mean score than those without PTSD (66.0 vs. 30.6).

In the adjusted analysis there were two significant interactions involving group: group-by-race and group-by-PTSD ($p=0.027$ and $p=0.038$, respectively). Education, current alcohol use, and age-by-lifetime alcohol history were also significant ($p<0.001$, $p=0.019$, and $p=0.008$, respectively). For the Blacks without PTSD, the adjusted mean score of the Ranch Hands was significantly higher than the mean of the Comparisons (39.3 vs. 32.5, $p=0.014$). There was no significant difference between the two groups for the nonblacks with or without PTSD ($p=0.135$ and $p=0.777$, respectively). There was only one Black participant (Comparison) with PTSD. Without the two interactions involving group in the model, there was no significant difference between the Ranch Hands and Comparisons ($p=0.475$).

Drug Abuse Score

In the unadjusted analysis of the drug abuse score of the MCMI, no significant difference between the Ranch Hands and the Comparisons was found ($p=0.353$).

The covariate tests revealed significant associations between the MCMI drug abuse score and all of the covariates: age ($p=0.004$), race ($p<0.001$), education ($p=0.003$), lifetime alcohol history ($p<0.001$), current alcohol use ($p=0.004$), and PTSD ($p=0.029$). Age was found to be negatively correlated with the drug abuse score ($r=-0.060$). The Black participants had a higher mean score than the nonblack participants (55.7 vs. 46.9). The participants with a high school education had a mean score of 48.7, as compared to a mean score of 46.2 for the college-educated participants. Lifetime alcohol history and current alcohol use were positively correlated with the drug abuse score ($r=0.109$ and $r=0.061$, respectively). The participants with PTSD had a higher mean score than those without PTSD (58.1 vs. 47.2).

The adjusted analysis of the drug abuse score did not detect a significant difference between the two groups ($p=0.131$). The significant terms in the model were age ($p=0.007$), education ($p=0.040$), lifetime alcohol history ($p<0.001$), and race-by-PTSD ($p=0.035$).

Psychotic Thinking Score

For the unadjusted analysis of the MCMI psychotic thinking score, the results did not indicate a significant difference between the two groups ($p=0.952$).

The results of the covariate tests showed that all six covariates had significant relationships with the psychotic thinking score: age ($p<0.001$), race ($p=0.021$), education ($p<0.001$), lifetime alcohol history ($p<0.001$), current alcohol use ($p=0.003$), and PTSD ($p<0.001$). Age was negatively correlated with the psychotic thinking score ($r=-0.072$). The Black participants had a higher mean score than the nonblack participants (36.0 vs. 31.9). The mean score of the high school-educated participants was 36.3, as compared to a mean score of 27.9 for the college-educated participants. Lifetime alcohol history and current alcohol use were both positively correlated with the psychotic thinking score ($r=0.100$ and $r=0.063$, respectively). The participants with PTSD had a higher mean score than the participants without PTSD (70.8 vs. 31.6).

No significant difference between the Ranch Hands and Comparisons was found based on the adjusted analysis of the psychotic thinking score ($p=0.443$). Four covariates contributed significantly to the model: age ($p=0.005$), education ($p<0.001$), lifetime alcohol history ($p<0.001$), and PTSD ($p<0.001$).

Psychotic Depression Score

No significant group difference was detected in the unadjusted analysis ($p=0.797$).

Based on the covariate tests, age ($p=0.011$), education ($p<0.001$), lifetime alcohol history ($p<0.001$), current alcohol use ($p=0.013$), and PTSD ($p<0.001$) were significantly associated with the MCMI psychotic depression score. The association between the psychotic depression score and race was borderline significant ($p=0.063$). Age was negatively correlated with the psychotic depression score ($r=-0.053$). The mean score for the Black participants was 26.5, as compared to a mean score of 23.2 for the nonblack participants. The high school-educated participants had a higher mean score than those with a college education (27.1 vs. 19.5). Lifetime alcohol history and current alcohol use were both positively correlated with the psychotic depression score ($r=0.118$ and $r=0.052$, respectively). The participants with PTSD had a higher mean score than the participants without PTSD (74.9 vs. 22.8).

In the adjusted analysis of the psychotic depression score, there was a significant group-by-education interaction ($p=0.010$). Age, lifetime alcohol history, and PTSD were significant covariates in the model ($p=0.049$, $p<0.001$,

and $p < 0.001$, respectively). Stratifying by education revealed that the college-educated Comparisons had a significantly higher adjusted mean score than the Ranch Hands (45.3 vs. 42.7, $p = 0.034$). No difference between the two groups was identified for those with a high school education ($p = 0.125$).

Psychotic Delusion Score

The results of the unadjusted analysis showed that the Ranch Hands had a marginally significantly higher mean psychotic delusion score than the Comparisons (43.8 vs. 42.2, $p = 0.061$).

The covariate tests showed that age ($p = 0.039$), race ($p = 0.018$), education ($p < 0.001$), current alcohol use ($p < 0.001$), and PTSD ($p = 0.033$) were significantly associated with the psychotic delusion score. The participants born in or after 1942 had the highest mean score (44.2), followed by those born in or before 1922 (43.2) and those born between 1923 and 1941 (41.9). The Black participants had a higher mean score than the nonblack participants (47.0 vs. 42.7). The mean score of the participants with a high school education was 46.3, as compared to a mean score of 39.5 for those with a college education. Based on current alcohol use, the heavy drinkers had the highest mean score (45.8), followed by the light drinkers (43.7) and the moderate drinkers (38.9). The mean scores of the participants with and without PTSD were 53.8 and 42.8, respectively.

Based on the adjusted analysis, the difference between the two groups was borderline significant, with the Ranch Hands having a higher adjusted mean score than the Comparisons (50.9 vs. 49.3, $p = 0.062$). Race, PTSD, and education-by-current alcohol use were significant terms in the model ($p = 0.015$, $p = 0.036$, and $p = 0.045$, respectively).

Exposure Index Analysis

Tables 12-10 and 12-11 contain the results of the unadjusted and adjusted exposure index analyses of the psychological assessment, respectively. A summary of the exposure index-by-covariate interactions is presented in Table 12-12; detailed results are provided in Table I-3 of Appendix I. As in the 1985 followup report, participants with PTSD are excluded from these exposure index analyses due to the sparse number of Ranch Hands with this condition.

The final interpretation of these exposure index data must await the reanalysis of the clinical data using the results of the serum dioxin assay. This report is expected in 1991.

Questionnaire Variables: Reported Sleep Disorders

Trouble Falling Asleep

No significant differences were detected in the unadjusted or adjusted analyses of the enlisted flyer and enlisted groundcrew cohorts for trouble falling asleep.

TABLE 12-10.

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index				Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value		
			Low		Medium					High	
Trouble Falling Asleep	Officer	n	130		123		125		Overall		0.084
		Number/%									
		Yes	7	5.4%	7	5.7%	15	12.0%	M vs. L	1.06 (0.36,3.12)	0.999
	No	123	94.6%	116	94.3%	110	88.0%	H vs. L	2.40 (0.94,6.09)	0.096	
	Enlisted Flyer	n	54		63		52		Overall		0.865
		Number/%									
		Yes	3	5.6%	5	7.9%	4	7.7%	M vs. L	1.47 (0.33,6.44)	0.896
	No	51	94.4%	58	92.1%	48	92.3%	H vs. L	1.42 (0.30,6.66)	0.958	
	Enlisted Groundcrew	n	145		156		137		Overall		0.693
Number/%											
Yes		21	14.5%	18	11.5%	16	11.7%	M vs. L	0.77 (0.39,1.51)	0.556	
No	124	85.5%	138	88.5%	121	88.3%	H vs. L	0.78 (0.39,1.57)	0.604		
Waking Up During the Night	Officer	n	130		123		125		Overall		0.116
		Number/%									
		Yes	12	9.2%	14	11.4%	22	17.6%	M vs. L	1.26 (0.56,2.85)	0.722
	No	118	90.8%	109	88.6%	103	82.4%	H vs. L	2.10 (0.99,4.45)	0.074	
	Enlisted Flyer	n	54		63		52		Overall		0.267
		Number/%									
		Yes	5	9.3%	12	19.0%	6	11.5%	M vs. L	2.31 (0.76,7.03)	0.216
	No	49	90.7%	51	81.0%	46	88.5%	H vs. L	1.28 (0.37,4.48)	0.946	
	Enlisted Groundcrew	n	145		156		137		Overall		0.003
Number/%											
Yes		24	16.6%	27	17.3%	7	5.1%	M vs. L	1.06 (0.58,1.93)	0.984	
No	121	83.4%	129	82.7%	130	94.9%	H vs. L	0.27 (0.11,0.65)	0.003		

12-63

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index				Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High				
Waking Up Too Early and Can't Go Back to Sleep	Officer	n	130	123	125		Overall		0.297
		Number/%							
		Yes	11 8.5%	7 5.7%	14 11.2%		M vs. L	0.65 (0.24,1.74)	0.542
	No	119 91.5%	116 94.3%	111 88.8%		H vs. L	1.36 (0.59,3.13)	0.600	
	Enlisted Flyer	n	54	63	52		Overall		0.431
		Number/%							
		Yes	5 9.3%	4 6.3%	7 13.5%		M vs. L	0.66 (0.17,2.61)	0.806
	No	49 90.7%	59 93.7%	45 86.5%		H vs. L	1.52 (0.45,5.15)	0.708	
	Enlisted Groundcrew	n	145	156	137		Overall		0.579
Number/%									
Yes		21 14.5%	23 14.7%	15 10.9%		M vs. L	1.02 (0.54,1.94)	0.999	
No	124 85.5%	133 85.3%	122 89.1%		H vs. L	0.73 (0.36,1.47)	0.478		
Waking Up Unrefreshed	Officer	n	130	123	125		Overall		0.906
		Number/%							
		Yes	8 6.2%	6 4.9%	7 5.6%		M vs. L	0.78 (0.26,2.32)	0.868
	No	122 93.8%	117 95.1%	118 94.4%		H vs. L	0.91 (0.32,2.57)	0.999	
	Enlisted Flyer	n	54	63	52		Overall		0.340
		Number/%							
		Yes	3 5.6%	5 7.9%	7 13.5%		M vs. L	1.47 (0.33,6.44)	0.896
	No	51 94.4%	58 92.1%	45 86.5%		H vs. L	2.64 (0.65,10.84)	0.290	
	Enlisted Groundcrew	n	145	156	137		Overall		0.515
Number/%									
Yes		15 10.3%	23 14.7%	17 12.4%		M vs. L	1.50 (0.75,3.00)	0.330	
No	130 89.7%	133 85.3%	120 87.6%		H vs. L	1.23 (0.59,2.57)	0.720		

12-64

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index						Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low		Medium		High				
Involuntarily Falling Asleep During the Day	Officer	n	130		123		125		Overall		0.064
		Number/%									
		Yes	3	2.3%	7	5.7%	1	0.8%	M vs. L	2.56 (0.65,10.11)	0.290
	Enlisted Flyer	No	127	97.7%	116	94.3%	124	99.2%	H vs. L	0.34 (0.04,3.33)	0.652
		n	54		63		52		Overall		0.673
		Number/%									
	Enlisted Groundcrew	Yes	2	3.7%	4	6.3%	4	7.7%	M vs. L	1.76 (0.31,10.02)	0.832
		No	52	96.3%	59	93.7%	48	92.3%	H vs. L	2.17 (0.38,12.37)	0.642
		n	145		156		137		Overall		0.296
	Enlisted Groundcrew	Number/%									
		Yes	9	6.2%	5	3.2%	4	2.9%	M vs. L	0.50 (0.16,1.53)	0.336
		No	136	93.8%	151	96.8%	133	97.1%	H vs. L	0.45 (0.14,1.51)	0.302
Great or Disabling Fatigue During the Day	Officer	n	130		123		125		Overall		0.436
		Number/%									
		Yes	1	0.8%	1	0.8%	3	2.4%	M vs. L	1.06 (0.07,17.09)	0.999
	Enlisted Flyer	No	129	99.2%	122	99.2%	122	97.6%	H vs. L	3.17 (0.33,30.91)	0.592
		n	54		63		52		Overall		0.698
		Number/%									
	Enlisted Groundcrew	Yes	1	1.9%	1	1.6%	2	3.8%	M vs. L	0.86 (0.05,14.00)	0.999
		No	53	98.1%	62	98.4%	50	96.2%	H vs. L	2.12 (0.19,24.11)	0.972
		n	145		156		137		Overall		0.153
	Enlisted Groundcrew	Number/%									
		Yes	12	8.3%	9	5.8%	4	2.9%	M vs. L	0.68 (0.28,1.66)	0.530
		No	133	91.7%	147	94.2%	133	97.1%	H vs. L	0.33 (0.11,1.06)	0.088

12-65

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index				Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value	
			Low	Medium		High				
Frightening Dreams	Officer	n	130	123		125	Overall		0.728	
		Number/%								
		Yes	3	2.3%	5	4.1%	4	3.2%	M vs. L	1.79 (0.42,7.67)
	No	127	97.7%	118	95.9%	121	96.8%	H vs. L	1.40 (0.31,6.38)	0.956
	Enlisted Flyer	n	54	63		52	Overall		0.857	
		Number/%								
		Yes	2	3.7%	2	3.2%	1	1.9%	M vs. L	0.85 (0.12,6.27)
	No	52	96.3%	61	96.8%	51	98.1%	H vs. L	0.51 (0.05,5.80)	0.999
	Enlisted Groundcrew	n	144	156		136	Overall		0.166	
Number/%										
Yes		11	7.6%	12	7.7%	4	2.9%	M vs. L	1.01 (0.43,2.36)	0.999
No	133	92.4%	144	92.3%	132	97.1%	H vs. L	0.37 (0.11,1.18)	0.136	
Talking in Sleep	Officer	n	130	123		125	Overall		0.376	
		Number/%								
		Yes	4	3.1%	3	2.4%	7	5.6%	M vs. L	0.79 (0.17,3.59)
	No	126	96.9%	120	97.6%	118	94.4%	H vs. L	1.87 (0.53,6.55)	0.496
	Enlisted Flyer	n	54	63		52	Overall		0.588	
		Number/%								
		Yes	3	5.6%	2	3.2%	1	1.9%	M vs. L	0.56 (0.09,3.47)
	No	51	94.4%	61	96.8%	51	98.1%	H vs. L	0.33 (0.03,3.31)	0.646
	Enlisted Groundcrew	n	145	156		136	Overall		0.208	
Number/%										
Yes		9	6.2%	12	7.7%	4	2.9%	M vs. L	1.26 (0.51,3.08)	0.782
No	136	93.8%	144	92.3%	132	97.1%	H vs. L	0.46 (0.14,1.52)	0.308	

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index				Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High				
Sleep-walking	Officer	n	130	123	125		Overall		0.528
		Number/%							
		Yes	1 0.8%	3 2.4%	3 2.4%	M vs. L	3.23 (0.33,31.43)	0.580	
	No	129 99.2%	120 97.6%	122 97.6%	H vs. L	3.17 (0.33,30.91)	0.592		
	Enlisted Flyer	n	54	63	52		Overall		0.990
		Number/%							
		Yes	1 1.9%	1 1.6%	1 1.9%	M vs. L	0.86 (0.05,14.00)	0.999	
	No	53 98.1%	62 98.4%	51 98.1%	H vs. L	1.04 (0.06,17.06)	0.999		
	Enlisted Groundcrew	n	145	156	137		Overall		0.419
		Number/%							
		Yes	2 1.4%	6 3.8%	4 2.9%	M vs. L	2.86 (0.57,14.40)	0.332	
	No	143 98.6%	150 96.2%	133 97.1%	H vs. L	2.15 (0.39,11.93)	0.632		
Abnormal Movement/Activity During the Night	Officer	n	130	123	125		Overall		0.581
		Number/%							
		Yes	1 0.8%	2 1.6%	3 2.4%	M vs. L	2.13 (0.19,23.82)	0.958	
	No	129 99.2%	121 98.4%	122 97.6%	H vs. L	3.17 (0.33,30.91)	0.592		
	Enlisted Flyer	n	54	63	52		Overall		0.149
		Number/%							
		Yes	3 5.6%	1 1.6%	0 0.0%	M vs. L	0.27 (0.03,2.72)	0.506	
	No	51 94.4%	62 98.4%	52 100.0%	H vs. L	--	0.258		
	Enlisted Groundcrew	n	145	156	137		Overall		0.290
		Number/%							
		Yes	11 7.6%	7 4.5%	5 3.6%	M vs. L	0.57 (0.22,1.52)	0.374	
	No	134 92.4%	149 95.5%	132 96.4%	H vs. L	0.46 (0.16,1.36)	0.240		

12-67

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index						Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low		Medium		High				
Sleep Problems Requiring Medication	Officer	n	130		123		125		Overall		0.581
		Number/%									
		Yes	1	0.8%	2	1.6%	3	2.4%	M vs. L	2.13 (0.19,23.82)	0.958
	No	129	99.2%	121	98.4%	122	97.6%	H vs. L	3.17 (0.33,30.91)	0.592	
	Enlisted Flyer	n	54		63		52		Overall		0.343
		Number/%									
		Yes	1	1.9%	0	0.0%	0	0.0%	M vs. L	--	0.924
	No	53	98.1%	63	100.0%	52	100.0%	H vs. L	--	0.999	
	Enlisted Groundcrew	n	145		156		137		Overall		0.350
Number/%											
Yes		7	4.8%	3	1.9%	4	2.9%	M vs. L	0.39 (0.10,1.52)	0.278	
No	138	95.2%	153	98.1%	133	97.1%	H vs. L	0.59 (0.17,2.07)	0.608		
Snore Loudly in All Sleeping Positions	Officer	n	130		123		125		Overall		0.162
		Number/%									
		Yes	7	5.4%	6	4.9%	13	10.4%	M vs. L	0.90 (0.29,2.76)	0.999
	No	123	94.6%	117	95.1%	112	89.6%	H vs. L	2.04 (0.79,5.29)	0.208	
	Enlisted Flyer	n	54		63		52		Overall		0.598
		Number/%									
		Yes	4	7.4%	3	4.8%	5	9.6%	M vs. L	0.63 (0.13,2.93)	0.828
	No	50	92.6%	60	95.2%	47	90.4%	H vs. L	1.33 (0.34,5.25)	0.952	
	Enlisted Groundcrew	n	145		156		137		Overall		0.317
Number/%											
Yes		8	5.5%	16	10.3%	11	8.0%	M vs. L	1.96 (0.81,4.72)	0.191	
No	137	94.5%	140	89.7%	126	92.0%	H vs. L	1.50 (0.58,3.84)	0.546		

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index				Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High				
Insomnia	Officer	n	130	123	125		Overall		0.102
		Number/%							
		Yes	24 18.5%	21 17.1%	34 27.2%	M vs. L	0.91 (0.48,1.73)	0.902	
	No	106 81.5%	102 82.9%	91 72.8%	H vs. L	1.65 (0.91,2.99)	0.130		
	Enlisted Flyer	n	54	63	52		Overall		0.634
		Number/%							
		Yes	9 16.7%	15 23.8%	11 21.2%	M vs. L	1.56 (0.62,3.93)	0.470	
	No	45 83.3%	48 76.2%	41 78.8%	H vs. L	1.34 (0.51,3.57)	0.732		
	Enlisted Groundcrew	n	145	156	137		Overall		0.245
Number/%									
Yes		38 26.2%	45 28.8%	28 20.4%	M vs. L	1.14 (0.69,1.90)	0.702		
No	107 73.8%	111 71.2%	109 79.6%	H vs. L	0.72 (0.42,1.26)	0.316			
Overall Sleep Disorder Index	Officer	n	130	123	125		Overall		0.023
		Number/%							
		Abnormal	34 26.2%	34 27.6%	51 40.8%	M vs. L	1.08 (0.62,1.88)	0.900	
	Normal	96 73.8%	89 72.4%	74 59.2%	H vs. L	1.95 (1.15,3.30)	0.019		
	Enlisted Flyer	n	54	63	52		Overall		0.611
		Number/%							
		Abnormal	14 25.9%	20 31.7%	18 34.6%	M vs. L	1.33 (0.59,2.98)	0.628	
	Normal	40 74.1%	43 68.3%	34 65.4%	H vs. L	1.51 (0.66,3.49)	0.446		
	Enlisted Groundcrew	n	144	156	136		Overall		0.449
Number/%									
Abnormal		53 36.8%	67 42.9%	50 36.8%	M vs. L	1.29 (0.81,2.06)	0.334		
Normal	91 63.2%	89 57.1%	86 63.2%	H vs. L	1.00 (0.61,1.62)	0.999			

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index				Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High				
Average Sleep Each Night	Officer	n	130	123	125		Overall		0.870
		Mean	7.00	7.01	7.06		M vs. L	--	0.945
		95% C.I.	(6.83,7.17)	(6.85,7.16)	(6.91,7.20)		H vs. L	--	0.629
	Enlisted Flyer	n	54	63	52		Overall		0.998
		Mean	6.91	6.92	6.92		M vs. L	--	0.947
		95% C.I.	(6.64,7.17)	(6.64,7.20)	(6.48,7.37)		H vs. L	--	0.953
	Enlisted Groundcrew	n	145	156	137		Overall		0.818
		Mean	6.83	6.80	6.88		M vs. L	--	0.834
		95% C.I.	(6.67,6.99)	(6.62,6.98)	(6.68,7.08)		H vs. L	--	0.671
SCL-90-R Anxiety	Officer	n	109	103	110		Overall		0.877
		Number/% Abnormal	3 2.8%	2 1.9%	2 1.8%		M vs. L	0.70 (0.12,4.28)	0.999
		Normal	106 97.2%	101 98.1%	108 98.2%		H vs. L	0.65 (0.11,4.00)	0.992
	Enlisted Flyer	n	49	54	47		Overall		0.097
		Number/% Abnormal	0 0.0%	5 9.3%	4 8.5%		M vs. L	--	0.072
		Normal	49 100.0%	49 90.7%	43 91.5%		H vs. L	--	0.107
	Enlisted Groundcrew	n	131	143	124		Overall		0.671
		Number/% Abnormal	16 12.2%	13 9.1%	12 9.7%		M vs. L	0.72 (0.33,1.56)	0.520
		Normal	115 87.8%	130 90.9%	112 90.3%		H vs. L	0.77 (0.35,1.70)	0.656

12-70

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index						Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low		Medium		High				
SCL-90-R Depression	Officer	n	109		103		110		Overall		0.137
		Number/%									
		Abnormal	2	1.8%	4	3.9%	8	7.3%	M vs. L	2.16 (0.39,12.06)	0.630
		Normal	107	98.2%	99	96.1%	102	92.7%	H vs. L	4.20 (0.87,20.23)	0.104
	Enlisted Flyer	n	49		54		47		Overall		0.917
		Number/%									
		Abnormal	4	8.2%	5	9.3%	5	10.6%	M vs. L	1.15 (0.29,4.54)	0.999
		Normal	45	91.8%	49	90.7%	42	89.4%	H vs. L	1.34 (0.34,5.33)	0.946
	Enlisted Groundcrew	n	131		143		124		Overall		0.375
Number/%											
Abnormal		19	14.5%	18	12.6%	11	8.9%	M vs. L	0.85 (0.42,1.70)	0.774	
	Normal	112	85.5%	125	87.4%	113	91.1%	H vs. L	0.57 (0.26,1.26)	0.230	
SCL-90-R Hostility	Officer	n	109		103		110		Overall		0.003
		Number/%									
		Abnormal	0	0.0%	0	0.0%	6	5.5%	M vs. L	--	--
		Normal	109	100.0%	103	100.0%	104	94.5%	H vs. L	--	0.030
	Enlisted Flyer	n	49		54		47		Overall		0.317
		Number/%									
		Abnormal	3	6.1%	1	1.9%	4	8.5%	M vs. L	0.29 (0.03,2.88)	0.546
		Normal	46	93.9%	53	98.1%	43	91.5%	H vs. L	1.43 (0.30,6.75)	0.952
	Enlisted Groundcrew	n	131		143		124		Overall		0.572
Number/%											
Abnormal		7	5.3%	11	7.7%	6	4.8%	M vs. L	1.48 (0.56,3.93)	0.592	
	Normal	124	94.7%	132	92.3%	118	95.2%	H vs. L	0.90 (0.29,2.76)	0.999	

12-71

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index						Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low		Medium		High				
SCL-90-R Inter- personal Sensitivity	Officer	n	109		103		110		Overall		0.238
		Abnormal	1	0.9%	1	1.0%	4	3.6%	M vs. L	1.06 (0.07,17.15)	0.999
		Normal	108	99.1%	102	99.0%	106	96.4%	H vs. L	4.08 (0.45,37.06)	0.374
	Enlisted Flyer	n	49		54		47		Overall		0.572
		Abnormal	2	4.1%	5	9.3%	3	6.4%	M vs. L	2.40 (0.44,12.97)	0.522
		Normal	47	95.9%	49	90.7%	44	93.6%	H vs. L	1.60 (0.26,10.05)	0.960
	Enlisted Groundcrew	n	131		143		124		Overall		0.670
		Abnormal	12	9.2%	13	9.1%	8	6.5%	M vs. L	0.99 (0.44,2.26)	0.999
		Normal	119	90.8%	130	90.9%	116	93.5%	H vs. L	0.68 (0.27,1.73)	0.570
SCL-90-R Obsessive- Compulsive Behavior	Officer	n	109		103		110		Overall		0.885
		Abnormal	2	1.8%	2	1.9%	3	2.7%	M vs. L	1.06 (0.15,7.66)	0.999
		Normal	107	98.2%	101	98.1%	107	97.3%	H vs. L	1.50 (0.25,9.16)	0.999
	Enlisted Flyer	n	49		54		47		Overall		0.597
		Abnormal	3	6.1%	2	3.7%	4	8.5%	M vs. L	0.59 (0.09,3.69)	0.908
		Normal	46	93.9%	52	96.3%	43	91.5%	H vs. L	1.43 (0.30,6.75)	0.952
	Enlisted Groundcrew	n	131		143		124		Overall		0.389
		Abnormal	20	15.3%	14	9.8%	16	12.9%	M vs. L	0.60 (0.29,1.25)	0.234
		Normal	111	84.7%	129	90.2%	108	87.1%	H vs. L	0.82 (0.41,1.67)	0.718

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index				Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value	
			Low		Medium					High
SCL-90-R Paranoid Ideation	Officer	n	109		103		110		Overall	0.020
		Number/% Abnormal	0	0.0%	0	0.0%	4	3.6%	M vs. L	--
		Normal	109	100.0%	103	100.0%	106	96.4%	H vs. L	0.124
	Enlisted Flyer	n	49		54		47		Overall	0.132
		Number/% Abnormal	1	2.0%	0	0.0%	3	6.4%	M vs. L	0.952
		Normal	48	98.0%	54	100.0%	44	93.6%	H vs. L	3.27 (0.33,32.64) 0.586
	Enlisted Groundcrew	n	131		143		124		Overall	0.133
		Number/% Abnormal	12	9.2%	8	5.6%	4	3.2%	M vs. L	0.59 (0.23,1.49) 0.368
		Normal	119	90.8%	135	94.4%	120	96.8%	H vs. L	0.33 (0.10,1.05) 0.087
SCL-90-R Phobic Anxiety	Officer	n	109		103		110		Overall	0.997
		Number/% Abnormal	2	1.8%	2	1.9%	2	1.8%	M vs. L	1.06 (0.15,7.66) 0.999
		Normal	107	98.2%	101	98.1%	108	98.2%	H vs. L	0.99 (0.14,7.16) 0.999
	Enlisted Flyer	n	49		54		47		Overall	0.100
		Number/% Abnormal	1	2.0%	7	13.0%	3	6.4%	M vs. L	7.15 (0.85,60.37) 0.082
		Normal	48	98.0%	47	87.0%	44	93.6%	H vs. L	3.27 (0.33,32.64) 0.586
	Enlisted Groundcrew	n	131		143		124		Overall	0.261
		Number/% Abnormal	16	12.2%	12	8.4%	8	6.5%	M vs. L	0.66 (0.30,1.45) 0.398
		Normal	115	87.8%	131	91.6%	116	93.5%	H vs. L	0.50 (0.20,1.20) 0.172

12-73

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index				Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value		
			Low		Medium					High	
SCL-90-R Psychoticism	Officer	n	109		103		110		Overall	0.004	
		Abnormal	1	0.9%	2	1.9%	10	9.1%	M vs. L	2.14 (0.19,23.95)	0.958
		Normal	108	99.1%	101	98.1%	100	90.9%	H vs. L	10.80 (1.36,85.89)	0.010
	Enlisted Flyer	n	49		54		47		Overall	0.182	
		Abnormal	1	2.0%	6	11.1%	3	6.4%	M vs. L	6.00 (0.70,51.74)	0.146
		Normal	48	98.0%	48	88.9%	44	93.6%	H vs. L	3.27 (0.33,32.64)	0.586
	Enlisted Groundcrew	n	131		143		124		Overall	0.755	
		Abnormal	17	13.0%	19	13.3%	13	10.5%	M vs. L	1.03 (0.51,2.07)	0.999
		Normal	114	87.0%	124	86.7%	111	89.5%	H vs. L	0.79 (0.36,1.69)	0.674
SCL-90-R Somatization	Officer	n	109		103		110		Overall	0.283	
		Abnormal	5	4.6%	2	1.9%	7	6.4%	M vs. L	0.41 (0.08,2.17)	0.494
		Normal	104	95.4%	101	98.1%	103	93.6%	H vs. L	1.41 (0.44,4.60)	0.780
	Enlisted Flyer	n	49		54		47		Overall	0.971	
		Abnormal	7	14.3%	7	13.0%	6	12.8%	M vs. L	0.89 (0.29,2.76)	0.999
		Normal	42	85.7%	47	87.0%	41	87.2%	H vs. L	0.88 (0.27,2.84)	0.999
	Enlisted Groundcrew	n	131		143		124		Overall	0.831	
		Abnormal	19	14.5%	18	12.6%	15	12.1%	M vs. L	0.85 (0.42,1.70)	0.774
		Normal	112	85.5%	125	87.4%	109	87.9%	H vs. L	0.81 (0.39,1.68)	0.704

12-74

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index						Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low		Medium		High				
SCL-90-R GSI	Officer	n	109		103		110		Overall		0.379
		Number/%									
		Abnormal	1	0.9%	2	1.9%	4	3.6%	M vs. L	2.14 (0.19,23.95)	0.958
		Normal	108	99.1%	101	98.1%	106	96.4%	H vs. L	4.08 (0.45,37.06)	0.374
	Enlisted Flyer	n	49		54		47		Overall		0.962
		Number/%									
		Abnormal	3	6.1%	4	7.4%	3	6.4%	M vs. L	1.23 (0.26,5.78)	0.999
		Normal	46	93.9%	50	92.6%	44	93.6%	H vs. L	1.05 (0.20,5.46)	0.999
	Enlisted Groundcrew	n	131		143		124		Overall		0.617
		Number/%									
		Abnormal	19	14.5%	19	13.3%	13	10.5%	M vs. L	0.90 (0.46,1.79)	0.906
		Normal	112	85.5%	124	86.7%	111	89.5%	H vs. L	0.69 (0.33,1.47)	0.436
SCL-90-R PSDI	Officer	n	109		103		110		Overall		0.767
		Number/%									
		Abnormal	5	4.6%	7	6.8%	7	6.4%	M vs. L	1.52 (0.47,4.94)	0.690
		Normal	104	95.4%	96	93.2%	103	93.6%	H vs. L	1.41 (0.44,4.60)	0.780
	Enlisted Flyer	n	49		54		47		Overall		0.972
		Number/%									
		Abnormal	5	10.2%	5	9.3%	5	10.6%	M vs. L	0.90 (0.24,3.31)	0.999
		Normal	44	89.8%	49	90.7%	42	89.4%	H vs. L	1.05 (0.28,3.88)	0.999
	Enlisted Groundcrew	n	131		143		124		Overall		0.959
		Number/%									
		Abnormal	16	12.2%	16	11.2%	14	11.3%	M vs. L	0.91 (0.43,1.89)	0.938
		Normal	115	87.8%	127	88.8%	110	88.7%	H vs. L	0.92 (0.43,1.96)	0.974

12-75

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index						Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value	
			Low		Medium		High					
SCL-90-R PST	Officer	n	109		103		110		Overall		0.393	
		Number/%							M vs. L	0.53 (0.05,5.87)	0.999	
		Abnormal	2	1.8%	1	1.0%	4	3.6%	H vs. L	2.02 (0.36,11.26)	0.692	
		Enlisted Flyer	Normal	107	98.2%	102	99.0%	106	96.4%			
	n		49		54		47		Overall		0.801	
	Number/%								M vs. L	1.23 (0.26,5.78)	0.999	
		Enlisted Groundcrew	Abnormal	3	6.1%	4	7.4%	2	4.3%	H vs. L	0.68 (0.11,4.27)	0.999
	Normal		46	93.9%	50	92.6%	45	95.7%				
	n		131		143		124		Overall		0.694	
		Number/%							M vs. L	0.79 (0.39,1.62)	0.648	
Abnormal		18	13.7%	16	11.2%	13	10.5%	H vs. L	0.74 (0.34,1.57)	0.548		
Normal		113	86.3%	127	88.8%	111	89.5%					
MCI Schizoid Score	Officer	n	130		123		125		Overall		0.409	
		Mean ^a	21.4		21.1		23.0		M vs. L	--	0.826	
		95% C.I. ^a	(19.5,23.4)		(19.1,23.2)		(20.9,25.3)		H vs. L	--	0.295	
		Enlisted Flyer	n	53		63		52		Overall		0.249
	Mean ^a		22.7		27.0		23.4		M vs. L	--	0.132	
	95% C.I. ^a		(19.7,26.3)		(23.0,31.7)		(20.0,27.3)		H vs. L	--	0.794	
		Enlisted Groundcrew	n	144		156		136		Overall		0.410
	Mean ^a		26.2		28.1		25.9		M vs. L	--	0.292	
	95% C.I. ^a		(23.8,28.8)		(25.6,31.0)		(23.6,28.5)		H vs. L	--	0.879	

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMII Avoidant Score	Officer	n	130	123	125	Overall		0.715
		Mean ^b	12.9	12.6	13.8	M vs. L	--	0.800
		95% C.I. ^b	(11.0,15.2)	(10.7,14.7)	(11.8,16.0)	H vs. L	--	0.586
	Enlisted Flyer	n	53	63	52	Overall		0.338
		Mean ^b	15.4	19.7	17.7	M vs. L	--	0.156
		95% C.I. ^b	(12.1,19.7)	(15.7,24.6)	(14.2,22.1)	H vs. L	--	0.415
	Enlisted Groundcrew	n	144	156	136	Overall		0.211
		Mean ^b	17.7	20.6	20.5	M vs. L	--	0.128
		95% C.I. ^b	(15.5,20.3)	(18.0,23.6)	(18.1,23.1)	H vs. L	--	0.128
MCMII Dependent Score	Officer	n	130	123	125	Overall		0.324
		Mean ^c	37.9	34.7	36.0	M vs. L	--	0.144
		95% C.I. ^c	(34.6,41.3)	(32.1,37.4)	(33.2,38.8)	H vs. L	--	0.392
	Enlisted Flyer	n	53	63	52	Overall		0.940
		Mean ^c	43.5	42.1	42.5	M vs. L	--	0.733
		95% C.I. ^c	(37.7,49.6)	(37.1,47.4)	(36.9,48.4)	H vs. L	--	0.811
	Enlisted Groundcrew	n	144	156	136	Overall		0.410
		Mean ^c	41.9	42.4	45.0	M vs. L	--	0.830
		95% C.I. ^c	(38.7,45.2)	(39.1,45.8)	(41.5,48.6)	H vs. L	--	0.207

12-77

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMI Histrionic Score	Officer	n	130	123	125	Overall		0.797
		Mean ^d	65.8	65.4	66.5	M vs. L	--	0.795
		95% C.I. ^d	(63.6,68.0)	(63.2,67.6)	(64.0,68.9)	H vs. L	--	0.679
	Enlisted Flyer	n	53	63	52	Overall		0.964
		Mean ^d	62.9	62.3	62.3	M vs. L	--	0.824
		95% C.I. ^d	(59.4,66.1)	(58.6,65.8)	(59.0,65.3)	H vs. L	--	0.794
	Enlisted Groundcrew	n	144	156	136	Overall		0.128
		Mean ^d	63.9	60.6	61.4	M vs. L	--	0.055
		95% C.I. ^d	(61.5,66.2)	(58.1,63.0)	(58.9,63.7)	H vs. L	--	0.140
MCMI Narcissistic Score	Officer	n	130	123	125	Overall		0.567
		Mean	66.8	65.4	67.3	M vs. L	--	0.460
		95% C.I.	(64.4,69.1)	(62.9,68.0)	(64.7,69.9)	H vs. L	--	0.746
	Enlisted Flyer	n	53	63	52	Overall		0.735
		Mean	64.5	63.0	62.1	M vs. L	--	0.605
		95% C.I.	(60.4,68.5)	(59.1,66.8)	(57.9,66.4)	H vs. L	--	0.439
	Enlisted Groundcrew	n	144	156	136	Overall		0.778
		Mean	64.3	63.2	64.4	M vs. L	--	0.550
		95% C.I.	(61.9,66.6)	(60.7,65.7)	(61.7,67.0)	H vs. L	--	0.967

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMII Antisocial Score	Officer	n	130	123	125	Overall		0.585
		Mean	60.2	61.5	62.5	M vs. L	--	0.563
		95% C.I.	(56.9,63.5)	(58.7,64.3)	(59.5,65.5)	H vs. L	--	0.324
	Enlisted Flyer	n	53	63	52	Overall		0.650
		Mean	60.1	63.3	60.6	M vs. L	--	0.371
		95% C.I.	(54.7,65.6)	(58.9,67.6)	(54.5,66.6)	H vs. L	--	0.915
	Enlisted Groundcrew	n	144	156	136	Overall		0.419
		Mean	62.0	64.0	61.1	M vs. L	--	0.366
		95% C.I.	(58.9,65.0)	(60.9,67.2)	(57.8,64.4)	H vs. L	--	0.700
MCMII Compulsive Score	Officer	n	130	123	125	Overall		0.585
		Mean ^d	70.0	69.4	69.1	M vs. L	--	0.488
		95% C.I. ^d	(68.6,71.5)	(68.2,70.5)	(67.8,70.3)	H vs. L	--	0.341
	Enlisted Flyer	n	53	63	52	Overall		0.748
		Mean ^d	68.5	67.4	68.1	M vs. L	--	0.468
		95% C.I. ^d	(66.6,70.3)	(65.0,69.7)	(66.1,70.0)	H vs. L	--	0.787
	Enlisted Groundcrew	n	144	156	136	Overall		0.283
		Mean ^d	67.2	67.5	68.9	M vs. L	--	0.812
		95% C.I. ^d	(65.5,68.9)	(66.1,68.9)	(67.3,70.4)	H vs. L	--	0.154

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMI Passive- Aggressive Score	Officer	n	130	123	125	Overall		0.583
		Mean ^c	15.7	14.9	16.4	M vs. L	--	0.551
		95% C.I. ^c	(13.6,18.0)	(13.0,16.8)	(14.4,18.6)	H vs. L	--	0.665
	Enlisted Flyer	n	53	63	52	Overall		0.267
		Mean ^c	17.7	22.0	21.3	M vs. L	--	0.126
		95% C.I. ^c	(14.0,21.9)	(18.4,25.8)	(17.3,25.7)	H vs. L	--	0.224
	Enlisted Groundcrew	n	144	156	136	Overall		0.386
		Mean ^c	22.1	23.2	20.4	M vs. L	--	0.622
		95% C.I. ^c	(19.3,25.2)	(20.4,26.2)	(17.8,23.1)	H vs. L	--	0.387
MCMI Schizotypal Score	Officer	n	130	123	125	Overall		0.736
		Mean	29.7	28.9	30.7	M vs. L	--	0.720
		95% C.I.	(26.7,32.8)	(25.9,32.0)	(27.6,33.8)	H vs. L	--	0.667
	Enlisted Flyer	n	53	63	52	Overall		0.949
		Mean	33.9	34.8	35.1	M vs. L	--	0.795
		95% C.I.	(29.2,38.6)	(29.9,39.8)	(29.7,40.4)	H vs. L	--	0.757
	Enlisted Groundcrew	n	144	156	136	Overall		0.234
		Mean	35.3	38.1	38.9	M vs. L	--	0.192
		95% C.I.	(32.0,38.5)	(35.3,41.0)	(35.8,41.9)	H vs. L	--	0.117

12-80

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMII Borderline Score	Officer	n	130	123	125	Overall		0.045
		Mean	29.8	25.4	29.2	M vs. L	--	0.017
		95% C.I.	(27.3,32.4)	(22.9,28.0)	(26.4,31.9)	H vs. L	--	0.718
	Enlisted Flyer	n	53	63	52	Overall		0.346
		Mean	35.5	32.9	31.0	M vs. L	--	0.364
		95% C.I.	(31.1,40.0)	(29.1,36.6)	(26.4,35.6)	H vs. L	--	0.163
	Enlisted Groundcrew	n	144	156	136	Overall		0.875
		Mean	35.2	36.1	35.2	M vs. L	--	0.649
		95% C.I.	(32.1,38.3)	(33.4,38.9)	(32.3,38.2)	H vs. L	--	0.977
MCMII Paranoid Score	Officer	n	130	123	125	Overall		0.958
		Mean	51.5	51.1	51.6	M vs. L	--	0.825
		95% C.I.	(49.0,54.0)	(48.7,53.5)	(48.9,54.3)	H vs. L	--	0.947
	Enlisted Flyer	n	53	63	52	Overall		0.648
		Mean	53.8	51.2	51.5	M vs. L	--	0.378
		95% C.I.	(49.5,58.0)	(47.5,55.0)	(47.1,56.0)	H vs. L	--	0.470
	Enlisted Groundcrew	n	144	156	136	Overall		0.216
		Mean	53.4	56.5	55.1	M vs. L	--	0.078
		95% C.I.	(51.1,55.7)	(54.0,58.9)	(52.5,57.7)	H vs. L	--	0.326

12-81

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value		
			Low	Medium	High					
MCMII Anxiety Score	Officer	n	130	123	125	Overall	--	0.402		
		Mean	40.5	40.1	43.3				M vs. L	0.874
		95% C.I.	(37.1,43.9)	(36.7,43.6)	(39.6,46.9)				H vs. L	0.280
	Enlisted Flyer	n	53	63	52	Overall	--	0.448		
		Mean	44.9	45.1	49.4				M vs. L	0.963
		95% C.I.	(39.1,50.8)	(39.8,50.4)	(44.4,54.3)				H vs. L	0.257
	Enlisted Groundcrew	n	144	156	136	Overall	--	0.870		
		Mean	50.6	49.4	50.4				M vs. L	0.617
		95% C.I.	(47.1,54.1)	(46.0,52.8)	(46.6,54.2)				H vs. L	0.931
MCMII Somatoform Score	Officer	n	130	123	125	Overall	--	0.674		
		Mean	49.9	48.6	48.1				M vs. L	0.536
		95% C.I.	(47.1,52.7)	(45.8,51.5)	(45.1,51.1)				H vs. L	0.395
	Enlisted Flyer	n	53	63	52	Overall	--	0.637		
		Mean	52.2	49.3	51.0				M vs. L	0.372
		95% C.I.	(47.5,57.0)	(44.9,53.7)	(47.0,55.0)				H vs. L	0.701
	Enlisted Groundcrew	n	144	156	136	Overall	--	0.851		
		Mean	53.0	52.0	52.0				M vs. L	0.609
		95% C.I.	(50.1,55.9)	(49.2,54.7)	(48.7,55.2)				H vs. L	0.630

12-82

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMII Hypomania Score	Officer	n	130	123	125	Overall		0.590
		Mean ^c	19.9	21.5	23.0	M vs. L	--	0.576
		95% C.I. ^c	(16.3,24.0)	(17.7,25.7)	(18.8,27.5)	H vs. L	--	0.313
	Enlisted Flyer	n	53	63	52	Overall		0.996
		Mean ^c	21.2	21.6	21.5	M vs. L	--	0.927
		95% C.I. ^c	(15.1,28.4)	(15.5,28.8)	(14.8,29.4)	H vs. L	--	0.960
	Enlisted Groundcrew	n	144	156	136	Overall		0.229
		Mean ^c	24.1	19.4	20.2	M vs. L	--	0.106
		95% C.I. ^c	(20.1,28.5)	(15.8,23.4)	(16.4,24.4)	H vs. L	--	0.188
MCMII Dysthymia Score	Officer	n	130	123	125	Overall		0.662
		Mean	48.2	46.2	45.9	M vs. L	--	0.463
		95% C.I.	(44.5,51.9)	(42.2,50.2)	(42.1,49.7)	H vs. L	--	0.403
	Enlisted Flyer	n	53	63	52	Overall		0.731
		Mean	48.3	46.7	49.9	M vs. L	--	0.692
		95% C.I.	(42.9,53.6)	(41.5,52.0)	(43.6,56.3)	H vs. L	--	0.695
	Enlisted Groundcrew	n	144	156	136	Overall		0.755
		Mean	52.4	51.2	50.4	M vs. L	--	0.634
		95% C.I.	(48.6,56.2)	(48.0,54.4)	(46.6,54.3)	H vs. L	--	0.475

12-83

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value		
			Low	Medium	High					
MCMI Alcohol Abuse Score	Officer	n	130	123	125	Overall	--	0.584		
		Mean	26.9	27.3	28.8				M vs. L	0.844
		95% C.I.	(24.2,29.5)	(24.4,30.1)	(26.1,31.5)				H vs. L	0.322
	Enlisted Flyer	n	53	63	52	Overall	--	0.840		
		Mean	35.5	33.7	34.8				M vs. L	0.543
		95% C.I.	(31.2,39.8)	(29.9,37.6)	(29.9,39.7)				H vs. L	0.829
	Enlisted Groundcrew	n	144	156	136	Overall	--	0.774		
		Mean	33.5	33.0	32.0				M vs. L	0.789
		95% C.I.	(30.7,36.4)	(30.3,35.7)	(29.1,35.0)				H vs. L	0.484
MCMI Drug Abuse Score	Officer	n	130	123	125	Overall	--	0.157		
		Mean	46.5	42.7	46.9				M vs. L	0.115
		95% C.I.	(43.4,49.7)	(39.2,46.3)	(43.7,50.2)				H vs. L	0.866
	Enlisted Flyer	n	53	63	52	Overall	--	0.951		
		Mean	50.4	49.3	50.1				M vs. L	0.761
		95% C.I.	(44.8,56.0)	(44.6,53.9)	(44.6,55.5)				H vs. L	0.940
	Enlisted Groundcrew	n	144	156	136	Overall	--	0.799		
		Mean	49.1	49.9	48.3				M vs. L	0.745
		95% C.I.	(45.7,52.5)	(46.8,52.9)	(44.5,52.0)				H vs. L	0.733

12-84

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMII Psychotic Thinking Score	Officer	n	130	123	125	Overall		0.305
		Mean	24.7	24.3	27.7	M vs. L	--	0.863
		95% C.I.	(21.4,28.0)	(21.0,27.6)	(24.3,31.1)	H vs. L	--	0.213
	Enlisted Flyer	n	53	63	52	Overall		0.384
		Mean	32.0	35.8	37.2	M vs. L	--	0.338
		95% C.I.	(26.3,37.8)	(30.7,40.9)	(32.5,41.9)	H vs. L	--	0.176
	Enlisted Groundcrew	n	144	156	136	Overall		0.316
		Mean	33.9	36.1	37.6	M vs. L	--	0.366
		95% C.I.	(30.6,37.3)	(32.8,39.4)	(34.5,40.7)	H vs. L	--	0.124
MCMII Psychotic Depression Score	Officer	n	130	123	125	Overall		0.897
		Mean	17.8	16.9	16.9	M vs. L	--	0.677
		95% C.I.	(14.7,20.8)	(13.9,19.8)	(13.8,20.0)	H vs. L	--	0.701
	Enlisted Flyer	n	53	63	52	Overall		0.708
		Mean	27.9	24.9	27.1	M vs. L	--	0.422
		95% C.I.	(22.7,30.1)	(19.8,30.0)	(21.4,32.8)	H vs. L	--	0.836
	Enlisted Groundcrew	n	144	156	136	Overall		0.619
		Mean	25.6	26.5	28.0	M vs. L	--	0.714
		95% C.I.	(22.1,29.1)	(23.1,29.9)	(24.7,31.3)	H vs. L	--	0.322

TABLE 12-10. (continued)

Unadjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Est. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCHI Psychotic Delusion Score	Officer	n	130	123	125	Overall		0.716
		Mean	40.1	38.5	40.6	M vs. L	--	0.544
		95% C.I.	(36.7,43.5)	(34.8,42.2)	(37.0,44.1)	H vs. L	--	0.853
	Enlisted Flyer	n	53	63	52	Overall		0.981
		Mean	44.8	44.2	44.8	M vs. L	--	0.865
		95% C.I.	(39.1,50.6)	(39.0,49.3)	(39.4,50.2)	H vs. L	--	0.992
	Enlisted Groundcrew	n	144	156	136	Overall		0.106
		Mean	44.1	47.6	48.8	M vs. L	--	0.127
		95% C.I.	(40.9,47.3)	(44.5,50.6)	(45.6,52.0)	H vs. L	--	0.041

^aTransformed from natural logarithm scale.

^bTransformed from natural logarithm (X+1) scale.

^cTransformed from square root scale.

^dTransformed from square scale.

--Relative risk/confidence interval/p-value not given due to cell with zero frequency; estimated relative risk not applicable for continuous analysis of a variable.

TABLE 12-11.

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
Trouble Falling Asleep	Officer	n	128	121	124	Overall		0.058
						M vs. L	0.91 (0.29,2.88)	0.874
						H vs. L	2.52 (0.95,6.65)	0.062
	Enlisted Flyer	n	53	62	50	Overall		0.755
						M vs. L	1.66 (0.32,8.75)	0.549
						H vs. L	1.85 (0.33,10.37)	0.485
	Enlisted Groundcrew	n	141	155	133	Overall		0.422
						M vs. L	0.63 (0.31,1.26)	0.191
						H vs. L	0.83 (0.41,1.68)	0.599
Waking Up During the Night	Officer	n	128	121	124	Overall		0.165
						M vs. L	1.07 (0.45,2.56)	0.880
						H vs. L	1.93 (0.88,4.26)	0.103
	Enlisted Flyer	n	53	62	50	Overall		0.322
						M vs. L	2.26 (0.71,7.19)	0.166
						H vs. L	1.32 (0.36,4.85)	0.678
	Enlisted Groundcrew	n	141	155	133	Overall		0.002
						M vs. L	0.97 (0.52,1.81)	0.916
						H vs. L	0.26 (0.11,0.64)	0.003

12-87

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
Waking Up Too Early Can't Go Back to Sleep	Officer	n	128	121	124	Overall		0.177
						M vs. L	0.57 (0.19,1.67)	0.305
						H vs. L	1.42 (0.59,3.44)	0.431
	Enlisted Flyer	n	53	62	50	Overall		0.272
						M vs. L	0.65 (0.15,2.77)	0.565
						H vs. L	1.89 (0.52,6.89)	0.336
	Enlisted Groundcrew	n	141	155	133	Overall		0.629
						M vs. L	1.04 (0.54,2.03)	0.898
						H vs. L	0.75 (0.36,1.55)	0.441
Waking Up Unrefreshed	Officer	n	128	121	124	Overall		0.821
						M vs. L	0.71 (0.21,2.38)	0.576
						H vs. L	0.97 (0.32,2.98)	0.962
	Enlisted Flyer	n	53	62	50	Overall		0.136
						M vs. L	3.01 (0.44,20.79)	0.264
						H vs. L	5.66 (0.84,38.32)	0.076
	Enlisted Groundcrew	n	141	155	133	Overall		0.709
						M vs. L	1.34 (0.66,2.73)	0.413
						H vs. L	1.21 (0.58,2.56)	0.612

12-88

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
Involuntarily Falling Asleep During the Day	Officer	n	128	121	124	Overall		****
						M vs. L	****	****
						H vs. L	****	****
	Enlisted Flyer	n	53	62	50	Overall		0.390
						M vs. L	2.46 (0.35,17.51)	0.368
						H vs. L	3.62 (0.50,26.04)	0.202
Great or Disabling Fatigue During the Day	Enlisted Groundcrew	n	141	155	133	Overall		0.436**
						M vs. L	0.56 (0.17,1.77)**	0.322**
						H vs. L	0.49 (0.14,1.69)**	0.257**
	Officer	n	128	121	124	Overall		****
						M vs. L	****	****
						H vs. L	****	****
Great or Disabling Fatigue During the Day	Enlisted Flyer	n	53	62	50	Overall		0.432**
						M vs. L	2.37 (0.03,205.6)**	0.704**
						H vs. L	8.08 (0.13,505.5)**	0.322**
	Enlisted Groundcrew	n	141	155	133	Overall		0.108
						M vs. L	0.60 (0.23,1.53)	0.286
						H vs. L	0.31 (0.09,1.00)	0.050

12-89

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
Frightening Dreams	Officer	n	128	121	124	Overall		****
						M vs. L	****	****
						H vs. L	****	****
	Enlisted Flyer	n	53	62	50	Overall		0.974
						M vs. L	1.03 (0.09,12.13)	0.979
						H vs. L	0.78 (0.05,12.86)	0.863
	Enlisted Groundcrew	n	140	155	132	Overall		****
						M vs. L	****	****
						H vs. L	****	****
Talking in Sleep	Officer	n	128	121	124	Overall		0.468**
						M vs. L	0.74 (0.15,3.61)**	0.710**
						H vs. L	1.68 (0.44,6.36)**	0.444**
	Enlisted Flyer	n	53	62	50	Overall		0.941**
						M vs. L	1.40 (0.13,14.64)**	0.779**
						H vs. L	0.96 (0.06,14.35)**	0.975**
	Enlisted Groundcrew	n	141	155	132	Overall		0.212
						M vs. L	1.12 (0.45,2.82)	0.802
						H vs. L	0.42 (0.12,1.46)	0.172

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
Sleep-walking	Officer	n	128	121	124	Overall		0.471**
						M vs. L	3.73 (0.35,39.92)**	0.277**
						H vs. L	3.21 (0.29,35.75)**	0.343**
	Enlisted Flyer	n	53	62	50	Overall		0.798
						M vs. L	1.93 (0.03,107.13)	0.747
						H vs. L	3.51 (0.07,176.30)	0.530
	Enlisted Groundcrew	n	141	155	133	Overall		0.617
						M vs. L	2.24 (0.42,11.92)	0.346
						H vs. L	1.64 (0.27,10.09)	0.595
Abnormal Movement/ Activity During the Night	Officer	n	128	121	124	Overall		0.607**
						M vs. L	2.43 (0.19,31.28)**	0.496**
						H vs. L	3.23 (0.27,38.06)**	0.352**
	Enlisted Flyer	n	53	62	50	Overall		0.231
						M vs. L	0.37 (0.03,4.29)	0.429
						H vs. L	--	0.747
	Enlisted Groundcrew	n	141	155	133	Overall		0.316
						M vs. L	0.53 (0.20,1.44)	0.214
						H vs. L	0.49 (0.16,1.46)	0.199

12-91

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
Sleep Problems Requiring Medication	Officer	n	128	121	124	Overall		0.597
						M vs. L	2.00 (0.17,23.34)	0.581
						H vs. L	3.11 (0.30,31.96)	0.340
	Enlisted Flyer	n	53	62	50	Overall		0.999
						M vs. L	--	0.993
						H vs. L	--	0.980
	Enlisted Groundcrew	n	141	155	133	Overall		0.422
						M vs. L	0.40 (0.10,1.69)	0.215
						H vs. L	0.81 (0.22,3.05)	0.757
Snore Loudly in All Sleeping Positions	Officer	n	128	121	124	Overall		0.083
						M vs. L	0.88 (0.23,3.40)	0.850
						H vs. L	2.58 (0.84,7.93)	0.097
	Enlisted Flyer	n	53	62	50	Overall		0.295
						M vs. L	1.41 (0.22,8.94)	0.718
						H vs. L	3.48 (0.61,19.80)	0.161
	Enlisted Groundcrew	n	141	155	133	Overall		0.119**
						M vs. L	2.64 (0.99,7.01)**	0.052**
						H vs. L	1.99 (0.71,5.58)**	0.189**

12-92

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
Insomnia	Officer	n	128	121	124	Overall		0.108
						M vs. L	0.81 (0.41,1.60)	0.548
						H vs. L	1.56 (0.84,2.88)	0.159
	Enlisted Flyer	n	53	62	50	Overall		0.701**
						M vs. L	1.45 (0.56,3.76)**	0.444**
						H vs. L	1.43 (0.52,3.95)**	0.484**
	Enlisted Groundcrew	n	141	155	133	Overall		0.397
						M vs. L	1.09 (0.65,1.83)	0.750
						H vs. L	0.75 (0.42,1.32)	0.321
Overall Sleep Disorder Index	Officer	n	128	121	124	Overall		0.069**
						M vs. L	1.04 (0.58,1.88)**	0.894**
						H vs. L	1.81 (1.02,3.20)**	0.043**
	Enlisted Flyer	n	53	62	50	Overall		****
						M vs. L	****	****
						H vs. L	****	****
	Enlisted Groundcrew	n	140	155	132	Overall		0.675
						M vs. L	1.22 (0.75,1.97)	0.419
						H vs. L	1.02 (0.62,1.68)	0.927

12-93

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
Average Sleep Each Night	Officer	n	128	121	124	Overall		0.829**
		Adj. Mean**	6.82	6.87	6.89	M vs. L	--	0.695**
		95% C.I.**	(6.43,7.21)	(6.48,7.25)	(6.51,7.27)	H vs. L	--	0.547**
	Enlisted Flyer	n	53	62	50	Overall		****
		Adj. Mean	****	****	****	M vs. L	--	****
		95% C.I.	****	****	****	H vs. L	--	****
	Enlisted Groundcrew	n	141	155	133	Overall		0.960**
		Adj. Mean**	6.62	6.62	6.66	M vs. L	--	0.989**
		95% C.I.**	(6.39,6.86)	(6.38,6.86)	(6.41,6.90)	H vs. L	--	0.810**
SCL-90-R Anxiety	Officer	n	107	101	109	Overall		0.960
						M vs. L	0.82 (0.12,5.39)	0.835
						H vs. L	0.77 (0.11,5.22)	0.788
	Enlisted Flyer	n	48	53	45	Overall		0.022
						M vs. L	--	--
						H vs. L	--	--
	Enlisted Groundcrew	n	127	142	122	Overall		0.589
						M vs. L	0.66 (0.29,1.50)	0.323
						H vs. L	0.75 (0.33,1.68)	0.481

12-94

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
SCL-90-R Depression	Officer	n	107	101	109	Overall		0.128
						M vs. L	2.88 (0.47,17.77)	0.254
						H vs. L	4.72 (0.90,24.88)	0.067
	Enlisted Flyer	n	48	53	45	Overall		0.719**
						M vs. L	1.52 (0.33,7.05)**	0.594**
						H vs. L	1.84 (0.40,8.45)**	0.430**
	Enlisted Groundcrew	n	127	142	122	Overall		0.276
						M vs. L	0.74 (0.36,1.52)	0.412
						H vs. L	0.52 (0.23,1.17)	0.115
SCL-90-R Hostility	Officer	n	107	101	109	Overall		0.002
						M vs. L	--	--
						H vs. L	--	--
	Enlisted Flyer	n	48	53	45	Overall		0.250
						M vs. L	0.28 (0.03,2.89)	0.287
						H vs. L	1.54 (0.32,7.44)	0.594
	Enlisted Groundcrew	n	127	142	122	Overall		0.922
						M vs. L	1.24 (0.43,3.58)	0.688
						H vs. L	1.12 (0.34,3.68)	0.851

12-95

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
SCL-90-R Inter-personal Sensitivity	Officer	n	107	101	109	Overall		0.138
						M vs. L	1.35 (0.06,30.13)	0.848
						H vs. L	7.34 (0.62,87.59)	0.115
	Enlisted Flyer	n	48	53	45	Overall		0.528
						M vs. L	2.61 (0.46,14.92)	0.280
						H vs. L	1.68 (0.26,11.08)	0.587
	Enlisted Groundcrew	n	127	142	122	Overall		0.637
						M vs. L	0.95 (0.40,2.28)	0.911
						H vs. L	0.65 (0.25,1.71)	0.382
SCL-90-R Obsessive-Compulsive Behavior	Officer	n	107	101	109	Overall		0.893
						M vs. L	0.93 (0.12,7.48)	0.946
						H vs. L	1.42 (0.21,9.64)	0.722
	Enlisted Flyer	n	48	53	45	Overall		****
						M vs. L	****	****
						H vs. L	****	****
	Enlisted Groundcrew	n	127	142	122	Overall		0.248
						M vs. L	0.53 (0.25,1.13)	0.102
						H vs. L	0.81 (0.39,1.67)	0.565

12-96

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
SCL-90-R Paranoid Ideation	Officer	n	107	101	109	Overall		0.013
						M vs. L	--	--
						H vs. L	--	--
	Enlisted Flyer	n	48	53	45	Overall		0.053
						M vs. L	--	--
						H vs. L	3.77 (0.31,45.43)	0.296
	Enlisted Groundcrew	n	127	142	122	Overall		0.174
						M vs. L	0.57 (0.22,1.49)	0.252
						H vs. L	0.35 (0.11,1.15)	0.085
SCL-90-R Phobic Anxiety	Officer	n	107	101	109	Overall		0.926
						M vs. L	1.13 (0.14,9.39)	0.907
						H vs. L	1.52 (0.18,13.04)	0.702
	Enlisted Flyer	n	48	53	45	Overall		****
						M vs. L	****	****
						H vs. L	****	****
	Enlisted Groundcrew	n	127	142	122	Overall		0.176
						M vs. L	0.57 (0.24,1.34)	0.200
						H vs. L	0.44 (0.17,1.10)	0.080

12-97

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
SCL-90-R Psychoticism	Officer	n	107	101	109	Overall		0.007
						M vs. L	1.63 (0.13,19.92)	0.701
						H vs. L	9.91 (1.17,84.22)	0.036
	Enlisted Flyer	n	48	53	45	Overall		****
						M vs. L	****	****
						H vs. L	****	****
	Enlisted Groundcrew	n	127	142	122	Overall		0.753
						M vs. L	0.99 (0.47,2.06)	0.970
						H vs. L	0.76 (0.34,1.69)	0.502
SCL-90-R Somatization	Officer	n	107	101	109	Overall		0.252
						M vs. L	0.36 (0.06,1.98)	0.238
						H vs. L	1.25 (0.37,4.21)	0.720
	Enlisted Flyer	n	48	53	45	Overall		0.998
						M vs. L	1.03 (0.31,3.45)	0.963
						H vs. L	1.04 (0.30,3.58)	0.954
	Enlisted Groundcrew	n	127	142	122	Overall		0.644
						M vs. L	0.79 (0.39,1.63)	0.530
						H vs. L	0.71 (0.33,1.50)	0.363

12-98

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
SCL-90-R GSI	Officer	n	107	101	109	Overall		****
						M vs. L	****	****
						H vs. L	****	****
	Enlisted Flyer	n	48	53	45	Overall		0.781
						M vs. L	1.81 (0.30,10.81)	0.515
						H vs. L	1.68 (0.26,10.86)	0.586
	Enlisted Groundcrew	n	127	142	122	Overall		0.669
						M vs. L	0.82 (0.40,1.67)	0.582
						H vs. L	0.71 (0.33,1.53)	0.379
SCL-90-R PSDI	Officer	n	107	101	109	Overall		0.599
						M vs. L	1.80 (0.52,6.23)	0.351
						H vs. L	1.67 (0.49,5.77)	0.415
	Enlisted Flyer	n	48	53	45	Overall		0.937
						M vs. L	1.09 (0.29,4.13)	0.898
						H vs. L	1.17 (0.30,4.49)	0.821
	Enlisted Groundcrew	n	127	142	122	Overall		0.947**
						M vs. L	0.88 (0.41,1.90)**	0.742**
						H vs. L	0.93 (0.42,2.05)**	0.859**

12-99

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
SCL-90-R PST	Officer	n	107	101	109	Overall		0.271**
						M vs. L	0.44 (0.03,5.97)**	0.537**
						H vs. L	2.36 (0.35,15.85)**	0.376**
	Enlisted Flyer	n	48	53	45	Overall		0.747**
						M vs. L	1.84 (0.31,11.09)**	0.504**
						H vs. L	1.07 (0.14,8.23)**	0.947**
	Enlisted Groundcrew	n	127	142	122	Overall		0.631
						M vs. L	0.72 (0.34,1.52)	0.395
						H vs. L	0.73 (0.34,1.59)	0.431
MCMI Schizoid Score	Officer	n	128	121	124	Overall		0.262
		Adj. Mean ^a	20.8	20.1	22.4	M vs. L		0.597
		95% C.I. ^a	(16.5,26.2)	(16.0,25.2)	(17.9,28.1)	H vs. L	--	0.284
	Enlisted Flyer	n	52	62	50	Overall		0.158
		Adj. Mean ^a	19.2	23.2	19.3	M vs. L		0.095
		95% C.I. ^a	(14.8,25.0)	(18.2,29.4)	(15.0,24.9)	H vs. L	--	0.963
	Enlisted Groundcrew	n	140	155	133	Overall		0.473**
		Adj. Mean ^{**a}	24.3	25.6	23.5	M vs. L		0.453**
		95% C.I. ^{**a}	(21.5,27.5)	(22.6,29.0)	(20.7,26.8)	H vs. L	--	0.640**

12-100

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCI Avoidant Score	Officer	n	128	121	124	Overall		0.731
		Adj. Mean ^b	13.5	12.7	13.9	M vs. L	--	0.605
		95% C.I. ^b	(9.2,19.8)	(8.7,18.5)	(9.5,20.2)	H vs. L	--	0.798
	Enlisted Flyer	n	52	62	50	Overall		0.245
		Adj. Mean ^b	10.1	13.3	11.6	M vs. L	--	0.095
		95% C.I. ^b	(6.8,14.9)	(9.4,18.9)	(7.9,16.8)	H vs. L	--	0.426
	Enlisted Groundcrew	n	140	155	133	Overall		0.310
		Adj. Mean ^b	16.6	19.1	18.6	M vs. L	--	0.149
		95% C.I. ^b	(13.9,19.8)	(16.0,22.7)	(15.5,22.3)	H vs. L	--	0.249
MCI Dependent Score	Officer	n	128	121	124	Overall		0.313**
		Adj. Mean ^{**c}	44.6	40.9	43.1	M vs. L	--	0.131**
		95% C.I. ^{**c}	(35.4,54.8)	(32.1,50.8)	(33.9,53.3)	H vs. L	--	0.554**
	Enlisted Flyer	n	52	62	50	Overall		0.891
		Adj. Mean ^c	43.6	41.9	43.4	M vs. L	--	0.661
		95% C.I. ^c	(30.2,59.6)	(29.9,55.9)	(30.3,58.8)	H vs. L	--	0.950
	Enlisted Groundcrew	n	140	155	133	Overall		0.356
		Adj. Mean ^c	51.7	53.7	55.7	M vs. L	--	0.466
		95% C.I. ^c	(44.1,60.0)	(45.6,62.5)	(47.7,64.4)	H vs. L	--	0.151

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMI Histrionic Score	Officer	n	128	121	124	Overall		0.869**
		Adj. Mean** ^d	61.6	61.6	62.4	M vs. L	--	0.982**
		95% C.I.** ^d	(54.2,68.2)	(54.0,68.3)	(55.1,69.0)	H vs. L	--	0.657**
	Enlisted Flyer	n	52	62	50	Overall		0.973
		Adj. Mean ^d	66.5	66.1	66.6	M vs. L	--	0.861
		95% C.I. ^d	(60.3,72.1)	(60.5,71.2)	(60.8,71.8)	H vs. L	--	0.967
	Enlisted Groundcrew	n	140	155	133	Overall		****
		Adj. Mean ^d	****	****	****	M vs. L	--	****
		95% C.I. ^d	****	****	****	H vs. L	--	****
MCMI Narcissistic Score	Officer	n	128	121	124	Overall		0.855
		Adj. Mean	66.3	66.1	67.1	M vs. L	--	0.880
		95% C.I.	(60.2,72.5)	(60.1,72.1)	(61.1,73.0)	H vs. L	--	0.698
	Enlisted Flyer	n	52	62	50	Overall		0.826
		Adj. Mean	68.3	66.9	66.6	M vs. L	--	0.619
		95% C.I.	(61.5,75.2)	(60.6,73.1)	(59.9,73.2)	H vs. L	--	0.569
	Enlisted Groundcrew	n	140	155	133	Overall		****
		Adj. Mean	****	****	****	M vs. L	--	****
		95% C.I.	****	****	****	H vs. L	--	****

12-102

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMII Antisocial Score	Officer	n	128	121	124	Overall		0.729
		Adj. Mean	60.7	62.2	62.4	M vs. L	--	0.524
		95% C.I.	(53.2,68.2)	(54.8,69.5)	(55.0,69.7)	H vs. L	--	0.464
	Enlisted Flyer	n	52	62	50	Overall		0.589
		Adj. Mean	57.3	61.2	58.9	M vs. L	--	0.308
		95% C.I.	(48.3,66.3)	(53.0,69.4)	(50.2,67.6)	H vs. L	--	0.683
	Enlisted Groundcrew	n	140	155	133	Overall		0.525
		Adj. Mean	61.8	63.3	60.6	M vs. L	--	0.526
		95% C.I.	(57.7,66.0)	(59.1,67.5)	(56.3,65.0)	H vs. L	--	0.613
MCMII Compulsive Score	Officer	n	128	121	124	Overall		0.490
		Adj. Mean ^d	71.7	70.8	70.7	M vs. L	--	0.310
		95% C.I. ^d	(68.6,74.7)	(67.6,73.8)	(67.6,73.7)	H vs. L	--	0.291
	Enlisted Flyer	n	52	62	50	Overall		0.727
		Adj. Mean ^d	70.1	68.9	69.5	M vs. L	--	0.426
		95% C.I. ^d	(66.6,73.5)	(65.7,72.1)	(66.0,72.7)	H vs. L	--	0.661
	Enlisted Groundcrew	n	140	155	133	Overall		0.394
		Adj. Mean ^d	67.9	68.8	69.4	M vs. L	--	0.403
		95% C.I. ^d	(66.0,69.8)	(66.9,70.7)	(67.4,71.3)	H vs. L	--	0.177

12-103

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCHI Passive- Aggressive Score	Officer	n	128	121	124	Overall		0.798
		Adj. Mean ^c	15.1	14.4	15.3	M vs. L	--	0.636
		95% C.I. ^c	(10.5,20.4)	(10.0,19.5)	(10.9,20.5)	H vs. L	--	0.863
	Enlisted Flyer	n	52	62	50	Overall		0.140
		Adj. Mean ^c	11.9	16.2	15.8	M vs. L	--	0.067
		95% C.I. ^c	(7.4,17.5)	(11.3,22.0)	(10.7,22.0)	H vs. L	--	0.111
	Enlisted Groundcrew	n	140	155	133	Overall		0.667
		Adj. Mean ^c	22.7	22.7	21.1	M vs. L	--	0.983
		95% C.I. ^c	(19.1,26.5)	(19.1,26.6)	(17.5,24.9)	H vs. L	--	0.440
MCHI Schizotypal Score	Officer	n	128	121	124	Overall		0.506
		Adj. Mean	33.1	30.7	32.8	M vs. L	--	0.280
		95% C.I.	(25.1,41.2)	(22.8,38.5)	(24.8,40.7)	H vs. L	--	0.873
	Enlisted Flyer	n	52	62	50	Overall		0.959
		Adj. Mean	29.4	30.5	30.0	M vs. L	--	0.772
		95% C.I.	(16.7,42.1)	(19.0,42.0)	(17.5,42.5)	H vs. L	--	0.873
	Enlisted Groundcrew	n	140	155	133	Overall		0.476
		Adj. Mean	38.9	41.0	41.5	M vs. L	--	0.347
		95% C.I.	(33.3,44.5)	(35.2,46.8)	(36.0,47.0)	H vs. L	--	0.254

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMI Borderline Score	Officer	n	128	121	124	Overall		****
		Adj. Mean	****	****	****	M vs. L	--	****
		95% C.I.	****	****	****	H vs. L	--	****
	Enlisted Flyer	n	52	62	50	Overall		0.299
		Adj. Mean	36.5	34.0	31.5	M vs. L	--	0.418
		95% C.I.	(25.9,47.1)	(24.5,43.6)	(21.1,41.9)	H vs. L	--	0.121
	Enlisted Groundcrew	n	140	155	133	Overall		****
		Adj. Mean	****	****	****	M vs. L	--	****
		95% C.I.	****	****	****	H vs. L	--	****
MCMI Paranoid Score	Officer	n	128	121	124	Overall		0.915
		Adj. Mean	54.5	53.8	53.1	M vs. L	--	0.706
		95% C.I.	(48.2,60.8)	(47.6,59.9)	(47.7,59.9)	H vs. L	--	0.726
	Enlisted Flyer	n	52	62	50	Overall		0.708**
		Adj. Mean**	55.7	53.2	53.9	M vs. L	--	0.416**
		95% C.I.**	(48.6,62.7)	(46.8,59.7)	(47.1,60.7)	H vs. L	--	0.577**
	Enlisted Groundcrew	n	140	155	133	Overall		0.153
		Adj. Mean	55.1	58.6	57.0	M vs. L	--	0.053
		95% C.I.	(51.9,58.4)	(55.3,61.8)	(53.6,60.4)	H vs. L	--	0.308

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value		
			Low	Medium	High					
MCMI Anxiety Score	Officer	n	128	121	124	Overall	--	0.425		
		Adj. Mean	50.1	48.4	51.8				M vs. L	0.513
		95% C.I.	(41.5,58.7)	(40.0,56.8)	(43.4,60.2)				H vs. L	0.517
	Enlisted Flyer	n	52	62	50	Overall	--	0.490		
		Adj. Mean	46.0	46.9	50.5				M vs. L	0.820
		95% C.I.	(37.1,55.0)	(38.7,55.0)	(41.9,59.2)				H vs. L	0.263
	Enlisted Groundcrew	n	140	155	133	Overall	--	0.909		
		Adj. Mean	51.0	50.0	50.9				M vs. L	0.689
		95% C.I.	(46.3,55.7)	(45.3,54.6)	(46.0,55.7)				H vs. L	0.964
MCMI Somatoform Score	Officer	n	128	121	124	Overall	--	0.455		
		Adj. Mean	53.2	51.1	50.8				M vs. L	0.311
		95% C.I.	(46.2,60.3)	(44.1,58.0)	(43.9,57.7)				H vs. L	0.250
	Enlisted Flyer	n	52	62	50	Overall	--	0.648		
		Adj. Mean	55.0	52.1	53.4				M vs. L	0.353
		95% C.I.	(47.6,62.4)	(45.4,58.8)	(46.3,60.6)				H vs. L	0.628
	Enlisted Groundcrew	n	140	155	133	Overall	--	0.959**		
		Adj. Mean**	54.9	54.5	54.3				M vs. L	0.855**
		95% C.I.**	(51.1,58.7)	(50.7,58.3)	(50.3,58.2)				H vs. L	0.775**

12-106

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCHI Hypomania Score	Officer	n	128	121	124	Overall		0.618
		Adj. Mean ^c	18.4	20.8	20.9	M vs. L	--	0.407
		95% C.I. ^c	(10.3,28.8)	(12.3,31.6)	(12.4,31.6)	H vs. L	--	0.384
	Enlisted Flyer	n	52	62	50	Overall		0.859
		Adj. Mean ^c	28.0	28.4	31.0	M vs. L	--	0.939
		95% C.I. ^c	(16.5,42.5)	(17.7,41.6)	(19.2,45.7)	H vs. L	--	0.613
	Enlisted Groundcrew	n	140	155	133	Overall		0.364
		Adj. Mean ^c	31.0	26.3	28.3	M vs. L	--	0.157
		95% C.I. ^c	(25.1,37.6)	(20.9,32.5)	(22.4,34.8)	H vs. L	--	0.430
MCHI Dysthymia Score	Officer	n	128	121	124	Overall		0.407
		Adj. Mean	57.8	54.4	54.7	M vs. L	--	0.223
		95% C.I.	(48.4,67.3)	(45.2,63.6)	(45.6,63.9)	H vs. L	--	0.273
	Enlisted Flyer	n	52	62	50	Overall		0.866
		Adj. Mean	47.1	46.0	48.2	M vs. L	--	0.780
		95% C.I.	(37.6,56.6)	(37.3,54.7)	(39.0,57.4)	H vs. L	--	0.805
	Enlisted Groundcrew	n	140	155	133	Overall		0.717
		Adj. Mean	51.9	50.3	49.9	M vs. L	--	0.529
		95% C.I.	(47.2,56.7)	(45.5,55.1)	(44.9,54.8)	H vs. L	--	0.447

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value		
			Low	Medium	High					
MCMII Alcohol Abuse Score	Officer	n	128	121	124	Overall	---	****		
		Adj. Mean	****	****	****				M vs. L	****
		95% C.I.	****	****	****				H vs. L	****
	Enlisted Flyer	n	52	62	50	Overall	---	0.805		
		Adj. Mean	35.8	34.4	36.2				M vs. L	0.639
		95% C.I.	(28.8,42.7)	(28.1,40.6)	(29.5,42.9)				H vs. L	0.878
	Enlisted Groundcrew	n	140	155	133	Overall	---	0.843		
		Adj. Mean	37.8	37.5	36.6				M vs. L	0.881
		95% C.I.	(34.2,41.3)	(33.9,41.0)	(33.0,40.3)				H vs. L	0.572
MCMII Drug Abuse Score	Officer	n	128	121	124	Overall	---	0.357		
		Adj. Mean	49.2	46.0	49.0				M vs. L	0.202
		95% C.I.	(41.1,57.3)	(38.1,54.0)	(41.1,56.9)				H vs. L	0.937
	Enlisted Flyer	n	52	62	50	Overall	---	0.836		
		Adj. Mean	55.4	54.3	56.6				M vs. L	0.768
		95% C.I.	(46.6,64.2)	(46.4,62.3)	(48.1,65.1)				H vs. L	0.769
	Enlisted Groundcrew	n	140	155	133	Overall	---	****		
		Adj. Mean	****	****	****				M vs. L	****
		95% C.I.	****	****	****				H vs. L	****

12-108

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMI Psychotic Thinking Score	Officer	n	128	121	124	Overall		0.462
		Adj. Mean	21.1	19.8	22.8	M vs. L	--	0.596
		95% C.I.	(12.9,29.3)	(11.7,27.8)	(14.8,30.8)	H vs. L	--	0.482
	Enlisted Flyer	n	52	62	50	Overall		0.389**
		Adj. Mean**	26.2	30.8	30.8	M vs. L	--	0.224**
		95% C.I.**	(17.5,35.0)	(22.8,38.7)	(22.4,39.3)	H vs. L	--	0.241**
	Enlisted Groundcrew	n	140	155	133	Overall		0.334**
		Adj. Mean**	35.0	37.2	38.5	M vs. L	--	0.343**
		95% C.I.**	(30.8,39.2)	(33.0,41.4)	(34.1,42.9)	H vs. L	--	0.145**
MCMI Psychotic Depression Score	Officer	n	128	121	124	Overall		0.392
		Adj. Mean	17.8	15.5	15.0	M vs. L	--	0.297
		95% C.I.	(10.5,25.2)	(8.3,22.7)	(7.8,22.2)	H vs. L	--	0.197
	Enlisted Flyer	n	52	62	50	Overall		0.844
		Adj. Mean	26.4	24.3	26.0	M vs. L	--	0.586
		95% C.I.	(17.4,35.4)	(16.1,32.5)	(17.2,34.7)	H vs. L	--	0.917
	Enlisted Groundcrew	n	140	155	133	Overall		0.618
		Adj. Mean	25.7	26.4	28.1	M vs. L	--	0.785
		95% C.I.	(21.3,30.2)	(21.9,30.8)	(23.5,32.7)	H vs. L	--	0.340

12-109

TABLE 12-11. (continued)

Adjusted Exposure Index for Psychology Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Exposure Index Contrast	Adj. Relative Risk (95% C.I.)	p-Value
			Low	Medium	High			
MCMII Psychotic Delusion Score	Officer	n	128	121	124	Overall		0.853**
		Adj. Mean**	43.2	41.9	43.1	M vs. L	--	0.614**
		95% C.I.**	(32.7,53.8)	(31.2,52.5)	(32.4,53.8)	H vs. L	--	0.969**
	Enlisted Flyer	n	52	62	50	Overall		0.972
		Adj. Mean	31.2	32.0	32.1	M vs. L	--	0.842
		95% C.I.	(17.1,45.3)	(19.3,44.7)	(18.5,45.7)	H vs. L	--	0.832
	Enlisted Groundcrew	n	140	155	133	Overall		0.100
		Adj. Mean	50.1	54.2	54.6	M vs. L	--	0.075
		95% C.I.	(43.4,56.9)	(47.1,61.3)	(47.8,61.5)	H vs. L	--	0.054

****Exposure index-by-covariate interaction ($p < 0.01$)--adjusted relative risk/mean, confidence interval, and p-value not presented.

**Exposure index-by-covariate interaction ($0.01 < p < 0.05$)--adjusted relative risk/mean, confidence interval, and p-value derived from a model fitted after deletion of this interaction.

--Relative risk/confidence interval/p-value not given due to cells with zero frequency; estimated relative risk not applicable for continuous analysis of a variable.

^aTransformed from natural logarithm scale.

^bTransformed from natural logarithm (X+1) scale.

^cTransformed from square root scale.

^dTransformed from square scale.

TABLE 12-12.

Summary of Exposure Index-by-Covariate
Interactions From Adjusted Analyses for Psychology Variables*

Variable	Occupation	Covariate	p-Value
Involuntarily Falling Asleep During the Day	Officer	Age	0.008
		Education	0.006
		Lifetime Alcohol History	0.022
Involuntarily Falling Asleep During the Day	Enlisted Groundcrew	Education	0.011
Great or Disabling Fatigue During the Day	Officer	Age	0.010
		Lifetime Alcohol History	0.022
Great or Disabling Fatigue During the Day	Enlisted Flyer	Lifetime Alcohol History	0.034
		Race	0.021
Frightening Dreams	Officer	Age	0.001
		Education	0.020
		Lifetime Alcohol History	0.040
Frightening Dreams	Enlisted Groundcrew	Age	0.024
		Race	0.015
		Education	0.003
		Current Alcohol Use	0.017
Talking in Sleep	Officer	Current Alcohol Use	0.025
Talking in Sleep	Enlisted Flyer	Age	0.023
		Current Alcohol Use	0.031
Sleepwalking	Officer	Lifetime Alcohol History	0.020
Abnormal Movement/Activity During the Night	Officer	Current Alcohol Use	0.015
Snore Loudly in All Sleeping Positions	Enlisted Groundcrew	Age	0.024
Insomnia	Enlisted Flyer	Education	0.035
Overall Sleep Disorder Index	Officer	Lifetime Alcohol History	0.022
Overall Sleep Disorder Index	Enlisted Flyer	Education	0.005
Average Sleep Each Night	Officer	Current Alcohol Use	0.025
Average Sleep Each Night	Enlisted Flyer	Age	0.001
Average Sleep Each Night	Enlisted Groundcrew	Age	0.033

TABLE 12-12. (continued)

Summary of Exposure Index-by-Covariate
Interactions From Adjusted Analysis for Psychology Variables*

Variable	Occupation	Covariate	p-Value
SCL-90-R Depression	Enlisted Flyer	Age	0.042
SCL-90-R Obsessive- Compulsive Behavior	Enlisted Flyer	Age	<0.001
		Education	0.035
		Current Alcohol Use	0.011
SCL-90-R Phobic Anxiety	Enlisted Flyer	Education	<0.001
		Current Alcohol Use	<0.001
SCL-90-R Psychoticism	Enlisted Flyer	Age	0.002
		Lifetime Alcohol History	0.002
		Current Alcohol Use	0.050
SCL-90-R GSI	Officer	Age	0.006
SCL-90-R PSDI	Enlisted Groundcrew	Age	0.020
SCL-90-R PST	Officer	Age	0.021
SCL-90-R PST	Enlisted Flyer	Age	0.020
		Education	0.015
MIMI Schizoid Score	Enlisted Groundcrew	Race	0.021
MIMI Dependent Score	Officer	Age	0.044
MIMI Histrionic Score	Officer	Lifetime Alcohol History	0.014
MIMI Histrionic Score	Enlisted Groundcrew	Race	0.001
MIMI Narcissistic Score	Enlisted Groundcrew	Race	0.008
MIMI Borderline Score	Officer	Lifetime Alcohol History	0.002
MIMI Borderline Score	Enlisted Groundcrew	Education	0.007
MIMI Paranoid Score	Enlisted Flyer	Age	0.042
MIMI Somatoform Score	Enlisted Groundcrew	Education	0.032
MIMI Alcohol Abuse Score	Officer	Lifetime Alcohol History	0.004
		Current Alcohol Use	0.002
MIMI Drug Abuse Score	Enlisted Groundcrew	Race	0.001
MIMI Psychotic Thinking Score	Enlisted Flyer	Age	0.034

TABLE 12-12. (continued)

Summary of Exposure Index-by-Covariate
Interactions From Adjusted Analysis for Psychology Variables*

Variable	Occupation	Covariate	p-Value
MMI Psychotic Thinking Score	Enlisted Groundcrew	Age	0.015
MMI Psychotic Delusion Score	Officer	Lifetime Alcohol History Current Alcohol Use	0.048 0.018

*Refer to Table I-3 for a further investigation of these interactions.

For the officer cohort, the overall test revealed a borderline significant difference based on the unadjusted and adjusted analyses ($p=0.084$ and $p=0.058$, respectively). The percentages of officers who reported having trouble falling asleep were 5.4, 5.7, and 12.0 for the low, medium, and high exposure categories, respectively. For both analyses, the high versus low contrasts were borderline significant ($p=0.096$, unadjusted and $p=0.062$, adjusted). In the unadjusted analysis of the high versus low contrast, the estimated relative risk was 2.40 (95% C.I.: [0.94,6.09]). Based on the adjusted analysis of this contrast, the adjusted relative risk was 2.52 (95% C.I.: [0.95,6.65]).

Waking Up During the Night

For the enlisted flyer cohort, no significant difference for waking up during the night was detected in either the unadjusted or adjusted analysis. The overall tests for the officer cohort also did not reveal any significant differences; however, the high versus low contrast in the unadjusted analysis showed a borderline significant difference (Est. RR: 2.10, 95% C.I.: [0.99,4.45], $p=0.074$). The percentages of officers who reported that they wake up during the night were 9.2, 11.4, and 17.6 for the low, medium, and high exposure categories, respectively.

In the unadjusted analysis of the enlisted groundcrew, a significant difference was detected in the overall test ($p=0.003$). The percentages of enlisted groundcrew who reported this sleep disorder were 16.6, 17.3, and 5.1 for the low, medium, and high exposure categories, respectively. The high versus low contrast revealed a significant difference (Est. RR: 0.27, 95% C.I.: [0.11,0.65], $p=0.003$). The adjusted analyses revealed similar results. Significant differences were detected in the overall test ($p=0.002$) and the high versus low contrast (Adj. RR: 0.26, 95% C.I.: [0.11,0.64], $p=0.003$). The results for the analyses of the enlisted groundcrew cohort did not support an increasing dose-response relationship.

Waking Up Too Early and Can't Go Back to Sleep

No significant differences were detected in the unadjusted or adjusted exposure analyses of waking too early in any of the occupational cohorts.

Waking Up Unrefreshed

The unadjusted exposure index analyses of waking up unrefreshed did not reveal any significant differences. This finding was supported by the adjusted analyses for the officer and enlisted groundcrew cohorts. For the unadjusted analysis of the enlisted flyer cohort, the percentages of Ranch Hands who reported that they wake up unrefreshed were 5.6, 7.9, and 13.5 for the low, medium, and high exposure categories, respectively. In the adjusted analysis, the high versus low contrast detected a marginally significant difference (Adj. RR: 5.66, 95% C.I.: [0.84,38.32], $p=0.076$).

Involuntarily Falling Asleep During the Day

Based on the unadjusted analyses for the enlisted flyer and enlisted groundcrew cohorts, no significant differences in involuntary daytime sleep were identified. For the unadjusted analysis of the officer cohort, the overall test revealed a marginally significant difference among exposure categories (2.3% for low, 5.7% for medium, and 0.8% for high; $p=0.064$); however, the results of the medium versus low and high versus low contrasts were not significant.

The adjusted results supported the unadjusted findings for the enlisted flyer cohort. For the officer cohort, there were three significant interactions with the exposure index: age ($p=0.008$), education ($p=0.006$), and lifetime alcohol history ($p=0.022$). After stratifying by these covariates, there were many sparse cells. For the Ranch Hand officers who were born between 1923 and 1941, have a high school education, and were classified as moderate drinkers based on their lifetime alcohol history, a borderline significant difference was detected in the overall test (28.6% for low, 40.0% for medium, and 0.0% for high; $p=0.095$). The medium versus low and high versus low contrasts for this stratum were not significant.

There was a significant exposure index-by-education interaction found in the adjusted analysis of the enlisted groundcrew cohort ($p=0.011$). After stratifying by education, a significant difference was found for the high school-educated enlisted groundcrew (7.8% for low, 1.7% for medium, and 2.0% for high; $p=0.032$). For this stratum, the medium versus low contrast was marginally significant ($p=0.065$) but not suggestive of a dose-response effect. Without the significant interaction in the model, no significant differences were detected.

Great or Disabling Fatigue During the Day

The unadjusted exposure index analyses did not detect any significant differences for the officer and enlisted flyer cohorts in the presence of daytime fatigue. For the enlisted groundcrew cohort, the high versus low exposure contrast was borderline significant, although the result did not support an increasing dose-response relationship (8.3% for low, 5.8% for medium, and 2.9% for high; $p=0.088$). This contrast was significant in the adjusted analysis ($p=0.050$).

In the adjusted analysis of the officer cohort, the age and lifetime alcohol history interactions with the exposure index were significant ($p=0.010$ and $p=0.022$, respectively). After stratifying by the covariates, a borderline significant difference was identified for the moderate drinkers born between 1923 and 1941 where there was a total of three abnormalities, which were all in the high exposure category ($p=0.079$). For the enlisted flyer cohort, there were significant interactions involving the exposure index for race and lifetime alcohol history ($p=0.021$ and $p=0.034$, respectively). No significant differences were detected within the enlisted flyer cohort after stratifying by the covariates or without the significant interactions in the model.

Frightening Dreams

No significant differences in the occurrence of frightening dreams were detected in the unadjusted analyses. These findings were supported by the adjusted analyses; however, there were significant interactions involving the exposure index in the analyses of the officer and enlisted groundcrew cohorts. After stratifying by the covariates, there were many sparse cells. No significant differences were revealed. The significant interactions involving the exposure index for the officer cohort were age ($p=0.001$), education ($p=0.020$), and lifetime alcohol history ($p=0.040$). For the enlisted groundcrew cohort, the age ($p=0.024$), race ($p=0.015$), education ($p=0.003$), and current alcohol use ($p=0.017$) interactions with the exposure index were significant.

Talking in Sleep

There was no evidence of a significant dose-response relationship for talking during sleep based on the unadjusted analyses. The adjusted analyses of the enlisted groundcrew cohort also did not detect any significant differences. For the officer cohort, there was a significant exposure index-by-current alcohol use interaction ($p=0.025$). However, after stratifying by current alcohol use, no significant differences were detected. The analyses without the significant exposure index-by-current alcohol use interaction in the model also did not reveal any significant differences.

For the enlisted flyer cohort, the age and current alcohol use interactions with the exposure index were significant ($p=0.023$ and $p=0.031$, respectively). Stratifying by these covariates, two enlisted flyers in the low exposure category who were born in or after 1942 and classified as light drinkers based on current alcohol use reported talking in their sleep. In comparison, no enlisted flyers with these characteristics in the medium and high exposure categories reported that they talk in their sleep. The result of the overall test was marginally significant (20.0% for low, 0.0% for medium, and 0.0% for high; $p=0.064$), but the individual contrasts were not significant. No significant differences were found without the significant interactions in the model.

Sleepwalking

The results of the unadjusted analyses of sleepwalking did not reveal any significant differences. These findings were supported by the adjusted analyses for the enlisted flyer and enlisted groundcrew cohorts. For the officer cohort, the exposure index-by-lifetime alcohol history interaction was significant ($p=0.020$). No significant differences were found in the officer cohort after stratifying by lifetime alcohol history or without the interaction in the model.

Abnormal Movement/Activity During the Night

No significant differences in abnormal movement/activity during the night were detected in the unadjusted and adjusted analyses for the enlisted flyer

and enlisted groundcrew cohorts. In the unadjusted analysis of the officer cohort, no significant difference was identified, and in the adjusted analysis there was a significant exposure index-by-current alcohol use interaction ($p=0.015$). Exploration of the interaction found no significant differences. There were also no significant differences detected in the analysis without the interaction in the model.

Sleep Problems Requiring Medication

Based on the unadjusted and adjusted analyses, no significant differences in sleeping problems requiring medication were detected in any of the occupational cohorts.

Snore Loudly in All Sleeping Positions

The unadjusted analyses of snoring did not reveal any significant differences in any occupational cohort. This was also true for the adjusted analysis of the enlisted flyer cohort. In the officer cohort, where the percentages of officers who reported that they snore loudly in all sleeping positions were 5.4, 4.9, and 10.4 for the low, medium, and high exposure categories, respectively, the result of the adjusted overall test was borderline significant ($p=0.083$). The high versus low contrast was also marginally significant (Adj. RR: 2.58, 95% C.I.: [0.84, 7.93], $p=0.097$).

In the adjusted analysis of the enlisted groundcrew cohort, there was a significant exposure index-by-age interaction ($p=0.024$). After stratifying by age, a significant difference was found for the enlisted groundcrew born between 1923 and 1941 ($p=0.024$). The high versus low contrast was also significant ($p=0.020$). Of the enlisted groundcrew born between 1923 and 1941, 15.7 percent of those in the high exposure category reported having this sleep disorder, as compared to 1.8 percent on the low exposure category and 6.1 percent in the medium exposure category. The overall test for the enlisted groundcrew born in or after 1942 was borderline significant (6.3% for low, 11.6% for medium, and 2.6% for high; $p=0.061$) although the individual contrasts were not significant. Without the exposure index-by-age interaction in the model, the medium versus low exposure contrast was borderline significant (5.5% for low, 10.3% for medium, and 8.0% for high; $p=0.052$).

Insomnia

Based on the unadjusted exposure index analyses of insomnia, there were no significant differences detected. Similar results were found for the officer and enlisted groundcrew cohorts in the adjusted analyses. For the enlisted flyer cohort, there was a significant exposure index-by-education interaction ($p=0.035$). Stratifying by education showed that the overall test for the college-educated stratum was borderline significant (0.0% for low, 31.3% for medium, and 27.3% for high; $p=0.087$). The medium versus low exposure contrast was also borderline significant ($p=0.074$). Without the exposure index-by-education interaction in the model, no significant differences were detected.

Overall Sleep Disorder Index

For the officer cohort, the percentages of abnormalities on the overall sleep disorder index were 26.2, 27.6, and 40.8 for the low, medium, and high exposure categories, respectively. In the unadjusted analysis, the overall test and the high versus low exposure contrast were significant ($p=0.023$ and $p=0.019$, respectively). The estimated relative risk for the high versus low exposure contrast was 1.95 (95% C.I.: [1.15,3.30]). In the adjusted analysis of the officer cohort, there was a significant exposure index-by-lifetime alcohol history interaction ($p=0.022$). Stratifying by this covariate revealed that the overall test for the officers classified as heavy drinkers was significant (38.1% for low, 23.1% for medium, and 61.3% for high; $p=0.013$). The high versus low exposure contrast for the officers classified as moderate drinkers based on lifetime alcohol history was marginally significant (22.7% for low, 27.2% for medium, and 36.3% for high; $p=0.069$). Without the interaction in the model, high versus low exposure contrast was significant (Adj. RR: 1.81, 95% C.I.: [1.02,3.20], $p=0.043$). The overall test for the officer cohort was borderline significant without the interaction term in the model ($p=0.069$).

For the enlisted flyer cohort, the results of the unadjusted analysis did not reveal any significant differences. However, in the adjusted analysis, there was a significant exposure index-by-education interaction ($p=0.005$). Further examination of the interaction showed that the overall test for the enlisted flyers with a college education was significant ($p=0.016$). For this stratum, the percentages of participants who were classified as abnormal were 0.0, 43.8, and 45.5 for the low, medium, and high exposure categories, respectively. The high versus low and medium versus low exposure contrasts within this stratum were also significant ($p=0.022$ and $p=0.015$, respectively).

In the analyses of the enlisted groundcrew cohort, no significant differences were detected.

Average Sleep Each Night

The unadjusted exposure index analyses did not detect any significant differences in the average hours of sleep each night. These findings were supported by the adjusted analyses when significant interactions involving the exposure index were excluded from the model for the officer and enlisted groundcrew cohorts.

For the officer cohort, there was a significant exposure index-by-current alcohol use interaction ($p=0.025$). Stratifying by current alcohol use showed that the medium versus low exposure contrast for the officers who were classified as moderate drinkers was significant (adjusted means: 6.75 hours for low, 7.28 hours for medium, and 6.95 hours for high; $p=0.033$).

In the adjusted analysis of the enlisted flyer cohort, the exposure index-by-age interaction was significant ($p=0.001$); however, no individual contrasts were found to be significant.

The exposure index-by-age interaction was also significant in the adjusted analysis of the enlisted groundcrew cohort ($p=0.033$). Stratifying by

age identified no significant differences for the enlisted groundcrew born in or after 1942. For those born between 1923 and 1941, the adjusted means were 6.64 hours, 7.12 hours, and 6.60 hours for the low, medium, and high exposure categories, respectively. The contrast of the medium and low categories was borderline significant ($p=0.051$). The medium versus low exposure contrast was also marginally significant for the enlisted groundcrew born in or before 1922, where the adjusted means were 7.09 hours, 4.82 hours, and 6.69 hours for the low, medium, and high exposure categories, respectively ($p=0.069$).

Physical Examination Variables: SCL-90-R

Anxiety

No significant differences in anxiety from the SCL-90-R were detected for the officer and enlisted groundcrew cohorts. For the enlisted flyer cohort, the percentages of abnormalities were 0.0, 9.3, and 8.5 for the low, medium, and high exposure categories, respectively. In the unadjusted analysis, the overall test and the medium versus low exposure contrast were borderline significant ($p=0.097$ and $p=0.072$, respectively). In the adjusted analysis, the overall test was significant ($p=0.022$).

Depression

The results of the unadjusted analyses of depression from the SCL-90-R did not reveal any significant differences. These findings were supported by the results of the adjusted analysis for the enlisted groundcrew cohort. For the officer cohort, the percentages of abnormalities were 1.8, 3.9, and 7.3 for the low, medium, and high exposure categories, respectively. The high versus low exposure contrast was borderline significant (Adj. RR: 4.72, 95% C.I.: [0.90, 24.88], $p=0.067$). In the enlisted flyer cohort, there was a significant exposure index-by-age interaction ($p=0.042$). Further investigation of the interaction did not identify any significant differences.

Hostility

No differences were detected for hostility in the analyses of the enlisted flyer and enlisted groundcrew cohorts. In the officer cohort, there were six abnormalities, which were all in the high exposure category. In the unadjusted analyses, the overall test and high versus low contrast were significant ($p=0.003$ and $p=0.030$, respectively). The overall test was also significant in the adjusted analysis ($p=0.002$).

Interpersonal Sensitivity

Neither the unadjusted nor adjusted analyses of the interpersonal sensitivity from the SCL-90-R identified any significant differences in any occupation.

Obsessive-Compulsive Behavior

Based on the unadjusted analyses, there were no significant differences in obsessive-compulsive behavior. The same results were found for the adjusted analyses of the officer and enlisted groundcrew cohorts. In the adjusted analysis of the enlisted flyer cohort, there were three significant interactions involving the exposure index: age ($p < 0.001$), education ($p = 0.035$), and current alcohol use ($p = 0.011$). Sparse cells resulted from stratifying by these three covariates. Further analysis did not detect any significant differences.

Paranoid Ideation

In the officer cohort, there were four abnormalities in paranoid ideation on the SCL-90-R. All of these were in the high exposure category ($p = 0.020$ unadjusted and $p = 0.013$ adjusted). For the enlisted flyer cohort, there was one abnormality in the low exposure category and three in the high exposure category. Although the unadjusted analysis of the enlisted flyer cohort did not detect any significant differences, the overall test was borderline significant based on the adjusted analysis ($p = 0.053$). Among the enlisted groundcrew, the percentages of abnormalities were 9.2, 5.6, and 3.2 for the low, medium, and high exposure categories, respectively. The high versus low exposure contrast for the enlisted groundcrew in both the unadjusted and adjusted analyses was borderline significant (Est. RR: 0.33, 95% C.I.: [0.10, 1.05], $p = 0.087$ unadjusted; Adj. RR: 0.35, 95% C.I. [0.11, 1.15], $p = 0.085$ adjusted). The enlisted groundcrew results did not support an increasing dose-response relationship.

Phobic Anxiety

No differences in phobic anxiety were detected in the officer cohort.

In the enlisted flyer cohort, 2.0 percent of the low, 13.0 percent of the medium, and 6.4 percent of the high exposure categories had abnormal scores. The overall test for the enlisted flyer category was borderline significant, based on the unadjusted analysis ($p = 0.100$). The high versus low exposure contrast was also borderline significant (Est. RR: 7.15, 95% C.I.: [0.85, 60.37], $p = 0.082$). In the adjusted analysis, the interactions with education and current alcohol use involving the exposure index were significant ($p < 0.001$ for both). Stratifying by the two covariates showed that the overall test for the light drinkers with a high school education was significant (3.0% for low, 16.1% for medium, and 0.0% for high; $p = 0.026$).

For the enlisted groundcrew cohort, the percentages of abnormalities were 12.2, 8.4, and 6.5 for the low, medium, and high exposure categories, respectively. No significant differences were detected in the unadjusted analyses; however, in the adjusted analyses, the high versus low exposure contrast was borderline significant (Adj. RR: 0.44, 95% C.I.: [0.17, 1.10], $p = 0.080$).

Psychoticism

In the officer cohort, the percentages of abnormalities on the psychoticism scale were 0.9, 1.9, and 9.1 for the low, medium, and high exposure categories, respectively. Based on the unadjusted analyses, the overall test was significant ($p=0.004$), and there was a significant difference detected in the high versus low exposure contrast (Est. RR: 10.80, 95% C.I.: [1.36,85.89], $p=0.010$). Based on the adjusted analysis, the overall test for the officer cohort was borderline significant ($p=0.007$), and the high versus low exposure contrast was significant (Adj. RR: 9.91, 95% C.I.: [1.17,84.22], $p=0.036$).

The unadjusted analysis of the enlisted flyer cohort did not reveal any significant differences. In the adjusted analysis, there were three significant interactions involving the exposure index: age ($p=0.002$), lifetime alcohol history ($p=0.002$), and current alcohol use ($p=0.050$). After stratification, there were many sparse cells. The only significant result found was for the overall test for enlisted flyers who were born between 1923 and 1941, classified as heavy drinkers based on lifetime alcohol history, and classified as light drinkers based on current alcohol use ($p=0.042$). For this stratum, there were two abnormalities, which were in the high exposure category.

For the enlisted groundcrew, there were no significant differences identified in the unadjusted analysis. These findings were supported by the adjusted results.

Somatization

No significant differences were detected in the unadjusted or adjusted analyses of somatization from the SCL-90-R in any occupational cohort.

GSI

The results of the unadjusted analyses revealed no significant differences in the GSI. These findings were supported by the adjusted results for the enlisted flyer and enlisted groundcrew cohorts. For the officer cohort, there was a significant exposure index-by-age interaction ($p=0.006$). After stratifying by age, there was one abnormality among those born in or before 1922, which was in the high exposure category; the overall test detected a significant difference ($p=0.031$).

PSDI

No significant differences in the PSDI were found in the unadjusted and adjusted analyses of the officer and enlisted flyer cohorts. Although the unadjusted analysis of the enlisted groundcrew did not reveal any significant differences, there was a significant exposure index-by-age interaction ($p=0.020$). After stratifying by age, the overall test for those born between 1923 and 1941 revealed a borderline significant difference (10.0% for low, 0.0% for medium, and 14.3% for high; $p=0.096$). There were no significant differences without the interaction in the model.

PST

Based on the unadjusted analyses, there were no significant differences detected in the PST. A similar result was obtained in the adjusted analysis of the enlisted groundcrew cohort; this was also true for the officer and enlisted flyer cohorts when significant interactions involving the exposure index were excluded from the model. For the officer cohort, there was a significant exposure index-by-age interaction ($p=0.021$). Further investigation showed that there was only one abnormality among the officers who were born in or before 1922, which was in the high exposure category ($p=0.031$). In the enlisted flyer cohort, the exposure index-by-age and the exposure index-by-education interactions were significant ($p=0.020$ and $p=0.015$, respectively). However, no significant differences were found after stratifying by age and education.

Physical Examination Variables: MCHI

Schizoid Score

In the unadjusted analyses of the schizoid score, no significant differences were detected. A similar result was found for the officer cohort based on the adjusted analysis. In the enlisted flyer cohort, the adjusted mean scores were 19.2, 23.2, and 19.3 for the low, medium, and high exposure categories, respectively. In the adjusted analysis, the medium versus low exposure contrast was marginally significant ($p=0.095$). For the enlisted groundcrew, the exposure index-by-race interaction was significant ($p=0.021$). After stratifying by race, the medium versus low and high versus low exposure contrasts for the Black enlisted groundcrew were significant but not suggestive of a dose-response effect (adjusted means of 31.3 for low, 19.3 for medium, and 19.6 for high; $p=0.025$ and $p=0.039$, respectively). Without the significant interactions in the model, no significant differences were found.

Avoidant Score

No significant differences were detected in the unadjusted or adjusted analyses of the avoidant score for the officer and enlisted groundcrew cohorts. The results of unadjusted analysis of the enlisted flyer cohort also did not identify any significant differences. For the enlisted flyer cohort, the mean avoidant scores based on the adjusted analysis were 10.1, 13.3, and 11.6 for the low, medium, and high exposure categories, respectively. The result of the medium versus low exposure contrast was borderline significant ($p=0.095$).

Dependent Score

In the officer cohort, no differences in the dependent score were detected in the unadjusted analysis. In the adjusted analysis, there was a significant exposure index-by-age interaction ($p=0.044$). After stratifying by age, the medium versus low exposure contrasts for the officers who were born in or after 1942 and who were born in or before 1922 were significant ($p=0.045$).

and $p=0.032$, respectively). For the officers born in or after 1942, the adjusted means were 44.5, 35.0, and 41.2 for the low, medium, and high exposure categories, respectively. The adjusted means were 62.0 for the low, 39.6 for the medium, and 69.5 for the high exposure categories among the officers who were born in or before 1922. Without the interaction in the model, there were no significant differences.

No significant differences were found in the exposure index analyses for the enlisted flyer and enlisted groundcrew cohorts.

Histrionic Score

Based on the unadjusted analyses of the histrionic score, there were no significant differences among the exposure categories for the officer cohort. In the adjusted analysis, the exposure index-by-lifetime alcohol history interaction was significant ($p=0.014$). After stratifying by lifetime alcohol history, the adjusted mean scores for the nondrinking officers were 57.8, 37.1, and 63.6 for the low, medium, and high exposure categories, respectively. Based on the adjusted analysis, the medium versus low exposure contrast was borderline significant ($p=0.080$). Without the interaction in the model, there were no significant differences identified.

No significant differences were found in the analyses of the enlisted flyer cohort.

For the enlisted groundcrew cohort, the mean scores were 63.9, 60.6, and 61.4 for the low, medium, and high exposure categories, respectively. The medium versus low exposure contrast was borderline significant ($p=0.055$). The exposure index-by-race interaction was significant in the adjusted analysis of the enlisted groundcrew cohort ($p=0.001$). Stratifying by race revealed that all four contrasts were significant. For the Black enlisted groundcrew, the adjusted mean scores were 61.2, 74.7, and 73.6 for the low, medium, and high exposure categories, respectively ($p=0.005$ for medium versus low; $p=0.015$ for high versus low). The adjusted mean scores for the nonblack enlisted groundcrew were 63.5, 57.9, and 59.9 for the low, medium, and high exposure categories, respectively ($p=0.002$ for medium vs. low; $p=0.046$ for high vs. low).

Narcissistic Score

No differences were found in the unadjusted and adjusted analyses for the narcissistic score in the officer and enlisted flyer cohorts. For the enlisted groundcrew cohort, no difference was identified in the unadjusted analysis. In the adjusted analysis, the exposure index-by-race interaction was significant ($p=0.008$). After stratifying by race, the adjusted mean scores for the Black enlisted groundcrew were 64.6, 72.2, and 82.4 for the low, medium, and high exposure categories, respectively. The high versus low contrast was significant ($p=0.003$).

Antisocial Score

The results of the exposure index analyses of the MCMI antisocial score did not detect any significant differences among the exposure categories.

Compulsive Score

None of the unadjusted or adjusted analyses of the MCMC compulsive score revealed a significant difference among the exposure categories.

Passive-Aggressive Score

The unadjusted analyses did not identify any significant differences. The results of the adjusted analyses supported these findings except for the enlisted flyer cohort, where the medium versus low exposure contrast was marginally significant ($p=0.067$). The adjusted mean scores for the enlisted flyers were 11.9, 16.2, and 15.8 for the low, medium, and high exposure categories, respectively.

Schizotypal Score

No significant differences were found among the exposure categories based on the analyses of the MCMC schizotypal score.

Borderline Score

In the unadjusted analysis of the borderline score the officer cohort, the overall test and medium versus low contrasts were significant ($p=0.045$ and $p=0.017$, respectively). The mean scores for the officers were 29.8, 25.4, and 29.2 for the low, medium, and high exposure categories, respectively. In the adjusted analysis, the exposure index-by-lifetime alcohol history interaction was significant ($p=0.002$). After stratifying by the covariate, the results showed that the medium versus low and high versus low exposure contrasts were significant for the heavy drinkers (adjusted mean scores: 45.4, 30.6, and 36.5 for low, medium, and high, respectively; $p=0.001$ for medium vs. low and $p=0.041$ for high vs. low). The medium versus low exposure contrast for the moderate drinkers was marginally significant (adjusted mean scores: 34.3, 30.6, and 33.4 for low, medium, and high exposure categories, respectively; $p=0.095$).

No differences were detected in the analyses for the enlisted flyers.

In the unadjusted analysis of the enlisted groundcrew, no significant differences were found. In the adjusted analysis, there was a significant exposure index-by-education interaction ($p=0.007$). Stratifying by education revealed a significant difference between the medium and low exposure categories for the college-educated enlisted groundcrew (adjusted mean scores: 33.2, 45.1, and 36.1 for the low, medium, and high exposure categories; $p=0.005$).

Paranoid Score

In the analyses of the paranoid score in the officer cohort, no significant differences were detected. This finding was also true for the unadjusted analysis of the enlisted flyer cohort and for the adjusted analysis without the significant exposure index-by-age interaction ($p=0.042$).

Stratifying by age showed that there was a significant difference between the high and low exposure categories for the enlisted flyers born in or after 1942, although the finding did not support an increasing dose-response relationship (adjusted mean scores: 59.6 for low, 52.3 for medium, and 44.2 for high; $p=0.030$ high vs. low). For the enlisted groundcrew, the mean scores were 53.4, 56.5, and 55.1 for low, medium, and high, respectively. The medium versus low contrasts were marginally significant for the unadjusted and adjusted analyses ($p=0.078$ and $p=0.053$, respectively).

Anxiety Score

No differences were identified among the exposure levels in the analyses of the MCMI anxiety score for any of the three occupational cohorts.

Somatoform Score

For the officer and enlisted flyer cohorts, no significant differences in the somatoform score were detected. Based on the unadjusted analysis of the enlisted groundcrew cohort, no difference among exposure levels were found. In the adjusted analysis, there was a significant exposure index-by-education interaction ($p=0.032$). After stratifying by education, a significant difference between the medium and low exposure categories among the college educated was revealed ($p=0.030$). The adjusted mean scores for the enlisted groundcrew with a college education were 52.4, 61.3, and 55.9 for the low, medium, and high exposure categories, respectively. Without the interaction in the model, no significant differences were found in the enlisted groundcrew cohort.

Hypomania Score

The unadjusted and adjusted analyses did not reveal any significant differences in the hypomania score for any of the three occupational categories.

Dysthymia Score

The results of the exposure index analyses of the MCMI dysthymia score did not identify any significant differences among the exposure levels.

Alcohol Abuse Score

The unadjusted analyses of the MCMI alcohol abuse score did not detect any significant differences among the exposure categories. These findings were supported by the results of the adjusted analyses of the enlisted flyer and enlisted groundcrew cohorts.

In the adjusted analysis of the officer cohort, there were two significant interactions involving the exposure index: lifetime alcohol history and current alcohol use ($p=0.004$ and $p=0.002$, respectively).

Stratifying by the two alcohol covariates resulted in sparse cells. The results showed that the adjusted mean scores for the officers classified as heavy drinkers based on lifetime alcohol history and current alcohol use in the high and low exposure categories were significantly different (adjusted mean scores: 31.3 for low, n=4; n=0 for medium; and 69.0 for high, n=2; p=0.004).

Drug Abuse Score

There were no significant differences found among the exposure categories for the officer and enlisted flyer cohorts based on the analyses of the MCMI drug abuse score.

For the enlisted groundcrew cohort, no significant differences were detected in the unadjusted analysis. In the adjusted analysis, there was a significant exposure index-by-race interaction (p=0.001). The adjusted mean scores for the Black enlisted groundcrew were 45.4, 60.9, and 72.3 for the low, medium, and high exposure categories, respectively. Both the medium versus low and high versus low exposure contrasts were significant for this stratum (p=0.038 and p=0.001, respectively).

Psychotic Thinking Score

Based on the unadjusted analysis, no significant differences in the psychotic thinking score were detected. These findings were supported by the adjusted analyses for the officer cohort. In the enlisted flyer and enlisted groundcrew cohorts, the exposure index-by-age interactions were significant (p=0.034 and p=0.015, respectively). After stratifying by age, a significant difference was detected for the high versus low exposure contrast among the enlisted flyers born between 1923 and 1941 (adjusted mean scores: 24.5 for low, 30.0 for medium, and 33.8 for high; p=0.032). For the enlisted groundcrew cohort, the high versus low exposure contrast for those born between 1923 and 1941 was borderline significant (adjusted mean scores: 32.5 for low, 28.6 for medium, and 38.8 for high; p=0.097). No significant differences were found without the exposure index-by-age interaction in the model for either cohort.

Psychotic Depression Score

The results of the exposure index analyses on the MCMI psychotic depression score did not reveal any significant differences for any occupational cohort.

Psychotic Delusion Score

For the officer cohort, no significant differences in the psychotic delusion score were identified in the unadjusted analyses or the adjusted analyses without significant interactions involving the exposure index. The lifetime alcohol history and current alcohol use interactions with the exposure index were significant (p=0.048 and p=0.018, respectively). Sparse

cells resulted from stratifying by the two alcohol covariates. The adjusted mean scores for the officers who were classified as moderate drinkers for both the lifetime alcohol history and current alcohol use were 25.5, 45.6, and 48.3 for the low, medium, and high exposure categories, respectively. For this stratum, both the medium versus low and high versus low exposure contrasts were significant ($p=0.019$ and $p=0.010$, respectively). For the officers who were heavy drinkers based on lifetime alcohol history and light drinkers based on current alcohol use, the medium versus low exposure contrast was borderline significant ($p=0.091$). This result did not support an increasing dose-response relationship, given that the highest adjusted mean score was for the low exposure category. There were four officers in the low exposure category and two in the high exposure category in the heavy drinker stratum based on both lifetime and current alcohol use. The high versus low exposure contrast for this stratum was significant (75.5 vs. 40.8; $p=0.048$).

No differences were found for the enlisted flyer cohort.

The mean psychotic delusion scores for the enlisted groundcrew cohort were 44.1, 47.6, and 48.8 for the low, medium, and high exposure categories, respectively. The high versus low exposure contrast was significant based on the unadjusted analysis ($p=0.041$). In the adjusted analysis, the overall test, medium versus low exposure contrast, and high versus low exposure contrast were borderline significant ($p=0.100$, $p=0.075$, and $p=0.054$, respectively).

DISCUSSION

Prior to the Air Force Health Study (AFHS) 1982 Baseline study, little scientifically validated information existed regarding the relationship between dioxin exposure and disturbances of cognition and emotions in man. The Baseline and 1985 followup studies attempted to explore these possible relationships using well-established questionnaires, personality inventories, and neuropsychological assessment techniques. These instruments included the CMI, the MMPI, and the HRB.

Analysis of extensive data generated by the CMI, MMPI, and HRB revealed few statistically significant differences between those Air Force veterans who sustained some level of exposure to dioxin (Ranch Hands) and their unexposed Comparison group. More specifically, the two groups did not differ significantly on several tests of cognitive (brain) function. The exposed (Ranch Hand) group reported a moderately greater number of diffuse medical (somatic) complaints on the CMI. They also registered moderately higher (but not statistically significant) scores on the MMPI scales that are influenced most heavily by physical complaints such as generalized feelings of lassitude and malaise, energy loss, mental and physical slowing, etc. The herbicide-exposed groundcrew group only demonstrated significantly higher scores on the MMPI depression scale.

Factors contributing to the modest differences between groups were not clearly indicated by estimated dioxin exposure data. It is possible that observed differences in psychological dependent variables might be related to some combination of negative expectations, anxiety, and amplified somatic sensitivity on the part of the exposed personnel. As the 1985 followup

concluded, the possibility existed that subjectively experienced and reported symptoms were more accurate than available exposure data.

A limited number of previous dioxin exposure studies reported similar findings to those described above. Investigations of both military and civilian groups failed to reveal evidence for organic brain dysfunction.^{23,37} However, evidence of significantly elevated levels of tension/anxiety and anger/hostility were reported for at least one civilian group.³⁷ Psychological tests employed by some of these previous studies were limited when viewed in relation to the range of psychological assessment included in the prior Air Force studies. Nevertheless, the existence of independent corroborating data combined with previous AFHS findings indicated the importance of continuing some form of appropriate psychological assessment for the 1987 followup.

At the conclusion of the 1985 followup, a significant number of participants registered complaints regarding the lengthy and repetitious nature of the psychometric evaluation. Subsequent concern regarding potential loss of subjects for the 1987 followup led to specific changes in the psychometric component of the study. Previously unrevealing tests of cognition (HRB) were suspended, thereby reducing testing time by several hours. The issue of test-retest boredom was addressed by selecting two new psychometric instruments that would provide ongoing assessment of important psychological variables, while requiring one-half the administration time of the MMPI.

The SCL-90-R is a 90-item checklist of physical and mental symptoms that provides a reasonable measure of health-related concerns and associated anxiety, depression, and general emotional discomfort. The second test selected for the 1987 reevaluation was the MCMI. The MCMI provided backup measures of depression, anxiety, somatization, and hypochondriasis for the SCL-90-R, while also screening for personality disorders and major psychiatric syndromes including psychosis. Both the SCL-90-R and the MCMI have been extensively used in clinical and research settings requiring economical assessment of psychiatric disorder, physical disability status and response to specific therapies. Some methodological difficulties occurred when comparing data generated by these two tests to scores previously obtained using the MMPI. However, factor analysis and correlational studies indicated that specific scales and factors included in the new tests correlated reasonably well with comparable elements of the MMPI.⁴⁷⁻⁵³ Therefore, acceptable continuity of psychological dependent variables was assured.

Addition of data concerning sleep disorders, as well as the 29 scales and 3 indices comprising the SCL-90-R and the MCMI, produced a relatively substantial increase in the number of psychological dependent variables requiring analysis for the 1987 followup. Similarly, the number of dependent variable-covariate associations requiring examination increased, as did the probability of observing a proliferation of statistically significant interactions.

Examination of the psychological dependent variable-by-covariate associations reported to date indicates a host of statistically significant relationships. For example, previously well-known relationships between advancing age and disturbed sleep were noted, as was the well-known phenomenon of sleep disturbance following excessive consumption of alcohol. An additional predictable outcome involved a strong relationship between the presence

of PTSD and a disturbance of virtually all sleep and psychological variables. Although the number of participants with PTSD was relatively small (approximately 1% of each group), the effects of this condition were quite striking and make this an important finding. A more definitive method for the diagnosis of PTSD is the structured psychiatric interview, a technique considered to be too logistically difficult in the context of this study. Therefore, the assessment of PTSD using a subscale of the MMPI was used. While the MMPI subscale may be less precise than the psychiatric interview, it was significantly associated with expected psychological endpoints in the covariate adjusted analyses, and it appears to be a useful technique in the assessment of PTSD in population-based studies.

On the other hand, some significant but puzzling and questionably valid or useful relationships were also demonstrated. For example, White subjects reported sleep disturbances more frequently than their Black counterparts. In addition, the study revealed a powerful relationship between education level and the number of sleep disorders registered. While 38.3 percent of high school-educated subjects reported sleep disturbances, only 30.4 percent of those with college-level education complained of disordered sleep. The 30.4 percent figure compares reasonably well with the 33.0 percent figure cited by sleep researchers as the number of adult Americans likely to report some sleep disturbances in any given year.⁵⁴ The apparent fact that study subjects with 12 or fewer years of education experience more sleep disturbance might be caused by greater levels of dissatisfaction with employment, financial pressures, participation in higher rates of shift work, and less regular exercise.

Further inspection of the 1987 data revealed a general persistence of several psychological results that were described as noteworthy in the Baseline and 1985 followup studies. On the SCL-90-R, the Ranch Hand group demonstrated statistically greater levels of depression than Comparison group members. They also manifested more physical complaints (somatization) and health-related anxieties than their Comparison group counterparts. The Ranch Hands also recorded higher scores on those MCMI scales thought to reflect antisocial and passive-aggressive traits and psychotic delusional tendencies. These latter psychological variables might be described as "new" in that they were not reported in the earlier studies. However, the appearance of these maladaptive traits and symptoms probably represents the emergence of artifacts related more to differences in the psychometric properties of the tests used than in the appearance of some new symptom complex.

Continuing manifestations of depression, somatic complaints, and health-related anxiety by members of the Ranch Hand cohort are not surprising. A similar persistence of entrenched symptom complexes has been demonstrated by other populations who have received exposure to known or suspected toxins.⁵⁵⁻⁵⁸ Such individuals frequently demonstrate a pattern of self-perpetuating psychological and somatic symptoms that individual group members tend to experience in varying degrees. Air Force groundcrew members who report high levels of herbicide exposure may be particularly vulnerable to repeated suggestions that they have suffered negative psychological and physical consequences secondary to their exposure. Individuals with psychological makeups predisposing them to higher levels of anxiety, psychophysiological disturbances, and somatic concern tend to react rather dramatically to their situation. This type of response can operate to perpetuate a static and/or escalating number of physical and psychological symptoms.

Research has been conducted on the psycho-maintenance* of chronic physical illness that clearly indicated that a significant percentage (5-10%) of any medical population possess a psychological makeup that predisposes them to the development of symptom-reactive anxiety and psychophysiological disturbances that tend to develop in an escalating manner.^{60,61} As a result, individuals of this type included in the current study may have obtained relatively high scores on those SCL-90-R and MCMI measures that are sensitive to the presence of anxiety, depression, and psychophysiological disturbances. Further, individuals who perceive themselves as injured may tend to harbor significant feelings of resentment and hostility that may contribute significantly to the previously noted high scores on antisocial, passive-aggressive, and psychotic delusion scales. In addition, a significantly higher level of alcohol consumption that may represent a form of self-medication may have also contributed to the significantly higher scale scores of the herbicide-exposed group members.

While factors other than dioxin exposure may have contributed to Ranch Hand test score abnormalities, previous studies in clinical medicine also suggest that caution may be appropriate. Studies have followed medical patients who were originally diagnosed as suffering from hysteria, hypochondriasis, or other psychiatric disorders. In some of these studies, more than 60 percent of the patients given psychiatric diagnoses eventually demonstrated neurological diseases, endocrine dysfunction, and other medical disorders.⁶²⁻⁶⁵ It is therefore important to monitor the health of the study participants over the ensuing years.

SUMMARY

The 1987 psychological assessment was based on verified psychological disorders; reported sleep disorders; and two psychological instruments, the SCL-90-R and the MCMI. The results of the psychological assessment are summarized in Table 12-13.

Five psychological disorders, which were self-reported and verified by medical record review, were analyzed in the psychological assessment: psychoses, alcohol dependence, drug dependence, anxiety, and other neuroses. No significant differences between the Ranch Hands and the Comparisons were detected based on the unadjusted analyses of psychoses, drug dependence, and anxiety. A marginally significant difference between the two groups was found for alcohol dependence and other neuroses ($p=0.068$ and $p=0.056$, respectively), with a greater percentage of Ranch Hands than Comparisons having these conditions.

The sleep disorder segment of the psychological assessment consisted of self-reported responses on 12 individual sleep disorders, 2 composite sleep disorder variables (based on the individual sleep disorders), and average hours of sleep each night. The results of the analyses without adjustments

*Psycho-maintenance refers to psychological and behavioral perpetuation and/or exacerbation of physical illness.⁵⁹

TABLE 12-13.

Overall Summary Results of Unadjusted and Adjusted
Group Contrast Analyses of Psychology Variables

Variable	Type of Analysis	Unadjusted	Adjusted	Direction of Results
<u>Psychological Disorders</u>				
Psychoses	D	NS	--	
Alcohol Dependence	D	NS*	--	RH>C
Drug Dependence	D	NS	--	
Anxiety	D	NS	--	
Other Neuroses	D	NS*	--	RH>C
<u>Sleep Disorders</u>				
Trouble Falling Asleep	D	NS	NS	
Waking up During the Night	D	NS	****	
Waking up Too Early and Can't Go Back to Sleep	D	NS	** (NS)	
Waking Up Unrefreshed	D	NS	NS	
Involuntarily Falling Asleep During the Day	D	NS	NS	
Great or Disabling Fatigue During the Day	D	0.026	NS*	RH>C
Frightening Dreams	D	NS	NS	
Talking in Sleep	D	0.041	****	RH>C
Sleepwalking	D	NS	NS	
Abnormal Movement/Activity During the Night	D	NS	** (NS)	
Sleep Problems Requiring Medication	D	NS	NS	
Snore Loudly in All Sleeping Positions	D	NS	NS	
Insomnia	D	NS	** (NS)	
Overall Sleep Disorder Index	D	NS	** (NS)	
Average Sleep Each Night	C	NS	NS	
<u>SCL-90-R</u>				
Anxiety	D	NS	NS	
Depression	D	NS*	NS	RH>C
Hostility	D	NS	****	
Interpersonal Sensitivity	D	NS	NS	
Obsessive-Compulsive Behavior	D	NS	NS	
Paranoid Ideation	D	NS	NS	
Phobic Anxiety	D	NS	NS	

TABLE 12-13. (continued)

Overall Summary Results of Unadjusted and Adjusted
Group Contrast Analyses of Psychology Variables

Variable	Type of Analysis	Unadjusted	Adjusted	Direction of Results
<u>SCL-90-R (continued)</u>				
Psychoticism	D	NS	NS	
Somatization	D	NS*	** (NS)	RH>C
GSI	D	NS*	NS	RH>C
PSDI	D	NS	** (NS)	
PST	D	NS	NS	
<u>MCHI</u>				
Schizoid Score	C	NS	NS	
Avoidant Score	C	NS	****	
Dependent Score	C	0.048	** (0.020)	C>RH
Histrionic Score	C	NS	** (NS)	
Narcissistic Score	C	NS*	0.015	RH>C
Antisocial Score	C	<0.001	0.001	RH>C
Compulsive Score	C	NS	** (NS)	
Passive-Aggressive Score	C	NS	** (NS)	
Schizotypal Score	C	NS	** (NS)	
Borderline Score	C	NS	** (0.050)	C>RH
Paranoid Score	C	0.011	0.014	RH>C
Anxiety Score	C	NS	****	
Somatoform Score	C	NS	NS	
Hypomania Score	C	NS	NS	
Dysthymia Score	C	NS	NS	
Alcohol Abuse Score	C	NS	** (NS)	
Drug Abuse Score	C	NS	NS	
Psychotic Thinking Score	C	NS	NS	
Psychotic Depression Score	C	NS	****	
Psychotic Delusion Score	C	NS*	NS*	RH>C

D: Discrete analysis performed.

NS: Not significant ($p > 0.10$).

--: Analysis not done.

NS*: Borderline significant ($0.05 < p \leq 0.10$).

RH>C: Higher prevalence rate or mean in Ranch Hands than in Comparisons.

****: Group-by-covariate interaction ($p < 0.01$); refer to Table I-2 for a detailed description of this interaction.

** (NS): Group-by-covariate interaction ($0.01 < p < 0.05$); not significant when interaction is deleted; refer to Table I-2 for a detailed description of this interaction.

C: Continuous analysis performed.

** (0.020) and ** (0.050): Group-by-covariate interaction ($0.01 < p < 0.05$); significant when interaction is deleted (p -value given).

C>RH: Higher mean in Comparisons than in Ranch Hands.

for covariates indicated that significantly more Ranch Hands than Comparisons reported that they experience great or disabling fatigue during the day and that they talk in their sleep ($p=0.026$ and $p=0.041$, respectively). The adjusted analysis of great or disabling fatigue during the day was marginally significant ($p=0.065$). In the adjusted analysis of talking in sleep, there was a significant group-by-PTSD interaction. Further analysis identified that of the participants without PTSD, marginally more Ranch Hands than Comparisons reported that they talk in their sleep ($p=0.089$).

The unadjusted analyses of the other 13 sleep disorder variables did not reveal any significant differences: trouble falling asleep, waking up during the night, waking up too early and can't go back to sleep, waking up unrefreshed, involuntarily falling asleep during the day, frightening dreams, sleepwalking, abnormal movement or activity during the night, sleep problems requiring medication, snoring loudly in all positions, insomnia, overall sleep disorder index, and average sleep each night. In general, this finding was supported by the results of the adjusted analyses, although significant group-by-covariate interactions were present in 5 of the 13 analyses. Further exploration of the interactions revealed no significant group differences in any stratum for three of the five variables. Of the participants born in or before 1922, significantly more Comparisons than Ranch Hands were classified as having insomnia ($p=0.012$). Marginally more Comparisons than Ranch Hands who were born in or before 1922 reported that they wake up during the night ($p=0.078$).

The SCL-90-R, a multidimensional self-reported symptom inventory designed to measure symptomatic psychological distress, yields nine primary symptom dimensions and three global indices of distress. No differences between the two groups were found for 7 of the 12 SCL-90-R scores: anxiety, interpersonal sensitivity, obsessive-compulsive behavior, paranoid ideation, phobic anxiety, psychoticism, and positive symptom total. Marginally significant differences between the two groups were detected for depression ($p=0.090$), somatization ($p=0.073$), and GSI (an index of symptom severity) ($p=0.081$), with a higher percentage of abnormalities in the Ranch Hands than in the Comparisons, based on the unadjusted analyses. For depression and the GSI, no differences were revealed after adjustment for covariates. In the adjusted analysis of somatization, there was a significant group-by-education interaction present in the model. Further investigation of the interaction showed that the high school-educated Ranch Hands had a significantly higher percentage of abnormalities on somatization than the Comparisons with a high school education ($p=0.025$).

Although no difference between the two groups was revealed in the unadjusted analysis of the SCL-90-R PSDI (an index of symptom intensity), there was a significant group-by-race interaction in the adjusted analysis. Exploration of the interaction revealed that the Black Comparisons had a marginally higher percentage of abnormalities than the Black Ranch Hands on this index ($p=0.079$). The unadjusted analysis of hostility from the SCL-90-R did not identify a significant difference between the two groups, and there was a significant group-by-PTSD interaction in the adjusted analysis. Stratifying by the presence or absence of PTSD did not reveal any significant differences between the Ranch Hands and the Comparisons in either stratum.

The MCMI, a self-administered test that measures eight basic personality patterns, three pathological personality disorders, and nine clinical symptom syndromes. The results of the unadjusted analyses of the MCMI scores showed no significant group differences for 15 of the 20 scores: schizoid, avoidant, histrionic, compulsive, passive-aggressive, schizotypal, borderline, anxiety, somatoform, hypomania, dysthymia, alcohol abuse, drug abuse, psychotic thinking, and psychotic depression. In the adjusted analyses of these variables, there were significant group-by-covariate interactions for 9 of the 15 analyses, which made the direct contrast of the two groups more difficult. Stratifying by the covariates in order to contrast the two groups within each stratum did not reveal a consistent pattern of significant detriment to either group. Significant differences were noted in 10 strata, and there were marginally significant differences detected in 6 strata. The mean score of the Ranch Hands exceeded that of the Comparisons for five of the significant strata and four of the marginally significant strata. However, many of these were strata where few participants were present (e.g., Blacks, participants with PTSD). Consequently, corresponding unadjusted results and models without the significant group-by-covariate interaction are primarily nonsignificant. For all except one variable where the analysis was repeated without the group-by-covariate interaction(s), no significant differences were revealed. In the analysis of the borderline score without the significant interaction involving group, the results showed that the Comparisons had a significantly higher mean score than the Ranch Hands ($p=0.050$).

The Ranch Hands were found to have significantly higher mean antisocial and paranoid scores than the Comparisons (antisocial: $p<0.001$ for unadjusted and $p=0.001$ for adjusted; paranoid: $p=0.011$ for unadjusted and $p=0.014$ for adjusted). On the psychotic delusion score, the mean score for the Ranch Hands was marginally higher than the Comparison mean score ($p=0.061$ for unadjusted and $p=0.062$ for adjusted). The results of the unadjusted analysis of the narcissistic score showed that the mean score for the Ranch Hands was marginally significantly higher than the mean score for the Comparisons ($p=0.090$); after adjusting for covariates, a significant difference was detected ($p=0.015$). Based on the unadjusted analysis, the Comparisons had a significantly higher mean dependent score than the Ranch Hands ($p=0.048$). In the adjusted analysis, there was a significant group-by-race interaction. Stratifying by race revealed that the nonblack Comparisons had a significantly higher mean score than the nonblack Ranch Hands ($p=0.005$) and the Black Ranch Hands had a marginally higher mean score than the Black Comparisons ($p=0.086$). Without the group-by-race interaction in the model, the Comparisons had a significantly higher mean score than the Ranch Hands ($p=0.020$).

The results of the exposure index analyses did not reveal a consistent pattern of an increasing dose-response relationship for any occupational cohort across the variables. The majority of the unadjusted analyses did not detect any significant differences among the exposure categories for the different occupational cohorts. Interactions involving the exposure index were frequently found in the adjusted analyses; however, exploration of the interactions did not identify a subgroup within the Ranch Hands that consistently demonstrated an increasing dose-response relationship. The occasional observation of significant and borderline findings in the officer cohort is difficult to interpret in view of the evolving understanding of the relatively low level of dioxin exposure experienced by officers.

In summary, significant or marginally significant differences between the Ranch Hands and the Comparisons were found for some variables within each of the four psychological assessment instruments of verified psychological disorders, reported sleep disorders, and the self-administered SCL-90-R and MCMI psychological examinations. However, there was a lack of consistency across similar variables included on the SCL-90-R, MCMI, and reported information. For these differences the Ranch Hands generally manifested a higher percentage of abnormalities or a higher mean score than the Comparisons. However, this is not surprising in light of the fact that individuals who perceive themselves as having been harmed might be more likely to report the symptoms observed as significant in this analysis. Profound effects of PTSD were noted for most all psychological variables. These results should be reexamined carefully for positive correlations between the complaints and increased levels of dioxin exposure when data from the serum dioxin assay become available. Additionally, significant group-by-covariate interactions were observed frequently in the adjusted analysis, which often made direct contrast of the two groups with adjustment for significant covariates difficult.

CHAPTER 12

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