

HEALTH STATUS OF VIETNAM VETERANS

VOLUME IV PSYCHOLOGICAL AND NEUROPSYCHOLOGICAL EVALUATION

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Centers for Disease Control**

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*The Centers for Disease Control
Vietnam Experience Study
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**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Centers for Disease Control
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CHAPTER 1

Introduction

1. INTRODUCTION

1.1 BACKGROUND

Since the time of the Vietnam conflict, many individuals and groups have expressed concern about the psychological health of American military personnel who served in Vietnam and about their adaptation to civilian life after they returned home (Blank, 1982; Egendorf *et al.*, 1981; Helzer *et al.*, 1979; Laufer *et al.*, 1984). Vietnam veterans have been reported to suffer from a broad spectrum of psychological disorders. In the Vietnam Experience Study (VES), we evaluated the long-term impact of service in Vietnam on the veterans' social and economic status, psychological health, and neuropsychological functioning.

Details on the development of the VES are in Volume II (Telephone Interview) of this monograph. In brief, Congress passed two laws mandating studies of health effects related to service in Vietnam. In 1979, Public Law 96-151 (Veterans Health Programs Extension and Improvement Act of 1979, (HR 3892), 93 STAT 1092-1098) required that the Veterans Administration (VA) conduct an epidemiological study of U.S. veterans to assess the possible health effects of exposure to herbicides and dioxin during the Vietnam conflict. In 1981, Public Law 97-72 (Veterans' Health Care, Training, and Small Business Loan Act of 1981, (HR 34997), 95 STAT 1047-1063) expanded this mandate to include the study of other environmental exposures that may have occurred in Vietnam. In 1983, the Centers for Disease Control (CDC) became responsible for the design, conduct, and analysis of studies responsive to these laws.

The study protocol developed by CDC called for three distinct but related studies (Centers for Disease Control, 1983). The first study, the VES is the subject of this monograph.

The purpose of the second study, the Agent Orange Study, was to assess whether adverse health effects could be attributed to herbicide exposure in Vietnam. An initial evaluation of methods for assessing exposure, however, raised questions about proceeding with the study. When we used current levels of dioxin in serum as an indicator of exposure, we found that few Army ground troops had been heavily exposed to herbicides in Vietnam or elsewhere (Centers for Disease Control, 1987). As a result, the proposed Agent Orange Study was not pursued.

The third study, the Selected Cancers Study, is being conducted now. It is designed to evaluate Vietnam veterans' risks of contracting six cancers that have been suggested as being related to exposure to phenoxyherbicide or dioxin. The results of this study will be published in 1990.

The purpose of the VES was to evaluate the health effects that may have resulted from the general experience of having served in Vietnam. The VES was designed as a retrospective cohort study to compare the health of a group of male U.S. Army veterans of the Vietnam conflict with the health of a group of male Army Vietnam-era veterans who did not serve in Vietnam. The study had four major components: (1) a mortality follow-up; (2) a health interview; (3) a medical and psychological examination; and (4) an evaluation of reproductive outcomes and child health.

The purpose of the mortality follow-up component was to evaluate the rate of death among Vietnam veterans relative to the rate for a comparison group of veterans who served elsewhere. The results of the mortality follow-up have been published in a separate monograph (Boyle *et al.*, 1987) and summary article (Centers for Disease Control Vietnam Experience Study, 1987). In brief, over the entire follow-up period through 1983, the postservice mortality

of Vietnam veterans was 17% higher than that for other veterans. The excess mortality occurred mainly in the first 5 years after discharge from active duty. During that time the excess was about 45%, and it involved injuries from motor vehicle crashes, suicides, homicides, and unintentional poisonings (which includes drug overdoses). After the first 5 years, mortality among Vietnam veterans was similar to that among other Vietnam-era veterans, except for the rate of drug-related deaths, which continued to be elevated.

The results of the other three components of the VES are the subject of this monograph, *Health Status of Vietnam Veterans*. The titles and contents of the five volumes are as follows: Volume I (Synopsis) – a summary of the VES results; Volume II (Telephone Interview) – a comparison of the past and present health status of Vietnam and other Vietnam-era veterans, in terms of various self-reported health outcomes; Volume III (Medical Examination) – the results of the physical health examinations; Volume IV (Psychological and Neuropsychological Evaluation) – the findings from the psychological and neuropsychological evaluations; and Volume V (Reproductive Outcomes and Child Health) – the data on veterans' reproductive outcomes and their children's health.

The purpose of the medical and psychological examination component was to objectively evaluate the current health status of Vietnam veterans. The psychological examinations of the VES were designed to evaluate 1) the prevalence of psychiatric conditions, such as post-traumatic stress disorder (PTSD), generalized anxiety, depression, drug abuse or dependence, and alcohol abuse or dependence, that might be related to service in Vietnam; 2) current psychological functioning as indicated by the Minnesota Multiphasic Personality Inventory (MMPI) (Dahlstrom *et al.*, 1972); and 3) aspects of neuropsychological functioning, such as memory, that might have been directly or indirectly affected by service in Vietnam. The examinations also screened for other symptoms or conditions that have not been the focus of previous research.

The Vietnam experience is actually a group of interrelated experiences, some of which are common to all wars and some of which are unique to the war in Vietnam. Experiences common to all wars include combat, physical injury, exposure to infectious diseases, and difficult living conditions. Possible experiences of the Vietnam conflict which would not be common to all wars include potential exposure to herbicides, insecticides, or other potentially hazardous chemicals; fighting a guerrilla war in which it was difficult to distinguish allies from enemies; lack of a cohesive unit identification because of rotating assignments; playing a role in a losing cause; use of illicit drugs, such as heroin; lack of an adjustment period before returning to civilian life; and society's negative reaction and neglect of the returning veteran. Some researchers have suggested that these aspects of the Vietnam war have adversely affected the health and well-being of Vietnam veterans (Blank, 1982; Egendorf *et al.*, 1981; Horowitz and Solomon, 1975; Roberts *et al.*, 1981; Walker and Cavenar, 1982; Yager *et al.*, 1984).

Many aspects of the Vietnam Experience varied over the course of the conflict. The intensity of combat was greatest in 1968-1969 around the time of the Tet Offensive, whereas problems with illicit drug use and demoralization were more common during the withdrawal phase, which began in 1970 (Robins *et al.*, 1974). Furthermore, most men who served in Vietnam had support, rather than tactical roles, and those who served in support roles on large, relatively secure bases may have had little or no direct exposure to combat.

Within the constraints of this study, we could not address all of the psychosocial factors that may have influenced Vietnam veterans' adjustment to civilian life. Rather, our primary

intent was to assess the overall impact of the Vietnam Experience on a broad cross-section of men who served there compared with a group of veterans with similar characteristics who served in other countries. For some conditions, secondary analyses were done to evaluate the effect of Vietnam service within subgroups of veterans (e.g., draftees versus volunteers) and to assess whether effects are more closely associated with certain aspects of the Vietnam experience, such as combat exposure.

1.2 HYPOTHESES

In this study, the major general hypotheses that we addressed are based on the results of previous research relevant to the Vietnam veterans' experiences (see Section 1.1). Two major concerns have been expressed. First, Vietnam veterans are reported to show a higher prevalence of psychiatric, psychological, and behavioral problems. Probably the most discussed of these problems is post-traumatic stress disorder (PTSD). Second, Vietnam veterans are thought to show the neuropsychological or cognitive deficits seen after exposure to an environmental toxin. The possible effects of dioxin, a contaminant found in the Agent Orange herbicide used in Vietnam, has been the main focus of this line of investigation (Lathrop *et al.*, 1984-1987).

If these two outcomes—(1) psychiatric, psychological, and behavioral problems and (2) neuropsychological deficits—did not interact, they could be assessed simply and directly. Unfortunately, however, when persons who are significantly depressed or anxious undergo neuropsychological tests, they may show signs of memory dysfunction. Other psychiatric conditions such as drug and alcohol abuse or dependence have their own direct neurotoxic correlates and related neuropsychological deficits. Probably the most complicated area of relevance is that of chronic or acute stress, which has both physiological and cognitive correlates and which has been linked to the onset and maintenance of both medical and psychiatric conditions, ranging from hypertension to psychosis (Rabkin, 1982; Rosenman and Chesney, 1982; Zegans, 1982). On the other hand, persons with acquired neuropsychological deficits may have psychiatric symptoms and conditions, especially anxiety and depression, that are related to the deficits, or loss of function (Lezak, 1983). In addition, brain systems directly affected by any neurotoxin could directly influence the arousal and cognitive systems that control emotional functioning. Such interactions between the psychiatric or behavioral and the neuropsychological dimensions make it difficult to clearly identify "primary" deficits and, more importantly, they complicate the analysis of data.

In dealing with such a complex analytical task, we had to specify clearly both the hypotheses being evaluated and the assessment models and diagnostic constructs being utilized to address them. On the basis of previous research findings, we identified certain conditions and deficits that could be related to the general stress of service in Vietnam, such as combat-related stresses, or to known or presumed exposure to herbicides, such as Agent Orange.

We hypothesized that among Vietnam veterans the prevalence of the following psychiatric conditions would be increased:

1. PTSD
2. Generalized anxiety
3. Major depression
4. Drug abuse or dependence
5. Alcohol abuse or dependence

The prevalences of other psychiatric conditions (schizophrenia, mania, obsession, anti-social personality, panic disorder, and somatization) were also assessed but were not

analyzed as extensively, since the prevalences of these conditions were low for both the Vietnam and non-Vietnam cohorts and since the conditions were not considered *a priori* to be related to Vietnam service.

We hypothesized that Vietnam veterans would have relative decrements in the following neuropsychological constructs:

1. Memory
2. Mental control and attention
3. Manual dexterity
4. Arousal and activation
5. Frontal/executive functions

Neuropsychological assessment models differentiate between these various abilities, but, theoretically, they all are interrelated. Because of the interrelationships and the desire to provide a more comprehensive screening of major neuropsychological systems, we included the additional constructs of language and visual-spatial functions. We did not, however, hypothesize these constructs to show relative deficiencies among the Vietnam veterans except as they might be affected by other factors.

Two additional hypotheses were also addressed. We hypothesized that Vietnam veterans would show (1) an increase in general psychopathology but not of a specific disorder and (2) generally lower neuropsychological functioning across all areas, with no specific deficits. These two possibilities are based on the assumption that, since as each veteran has a genetic or biological predisposition and environmental history, a generalized process would not lead to a specific type of psychopathology. In addition, the nervous system's response may be generalized, again suggesting non-specific psychological consequences.

1.3 OVERVIEW OF PRESENTATION

In the following chapters, we compare the VES psychological and neuropsychological results for a group of 2,490 male Army veterans who served in Vietnam with results for a group of 1,972 Vietnam-era male Army veterans who served elsewhere. Chapter 2 presents the study methods, including the selection of the sample and the study design, conduct, and analysis. Chapter 3 presents the participation rates and characteristics of the study participants. Chapter 4 presents the findings on psychiatric conditions as evaluated by using the Diagnostic Interview Schedule (DIS) (Robins *et al.*, 1987). Chapter 5 presents results on current psychological status, as assessed by the Minnesota Multiphasic Personality Inventory (MMPI) (Dahlstrom *et al.*, 1972). Chapter 6 presents a summary analysis of current psychological status based on the combined findings from the DIS and MMPI. Chapter 7 presents results on neuropsychological functioning. Chapter 8 summarizes and synthesizes the findings from the different psychological and neuropsychological evaluations and presents analyses on issues such as the influence of combat and perceived exposure to herbicides. The appendices provide more detail on certain aspects of the psychological and neuropsychological methods and results. Two supplemental volumes provide more detailed information on study procedures and data quality relevant to the psychological and neuropsychological testing. Supplement B presents analyses of data quality for all the medical and psychological examinations and tests. Supplement C contains copies of the procedures manuals, questionnaires, and data collection forms that were used in the medical and psychological examinations.

CHAPTER 2
Study Procedures

2. STUDY PROCEDURES

In this chapter, we describe the design, conduct, and analysis methods for the psychological and neuropsychological evaluation component of the Vietnam Experience Study (VES). The focus is on psychological and neuropsychological assessment methods. Details on the general VES design and sample selection are provided in Volumes II and III.

2.1 COHORT DEFINITION

The primary objective in defining the study and comparison groups was to obtain two cohorts that were as similar as possible with regard to major health-influencing factors other than service in Vietnam. The more alike the groups were in those factors, the greater the likelihood that any differences between them in mortality or morbidity after discharge would be the result of service in Vietnam. To achieve this objective, we included only veterans meeting the following criteria:

1. U.S. Army veterans.
2. Male veterans.
3. Military occupational specialty (MOS) other than "duty soldier" or "trainee."
4. Single term of enlistment in the Army.
5. Minimum of 16 weeks of active service time.
6. Pay grade E-1 to E-5 at discharge.
7. Entered military service for the first time between January 1, 1965, and December 31, 1971.
8. Duty stations for men in the comparison group limited to the United States, Germany, and Korea.

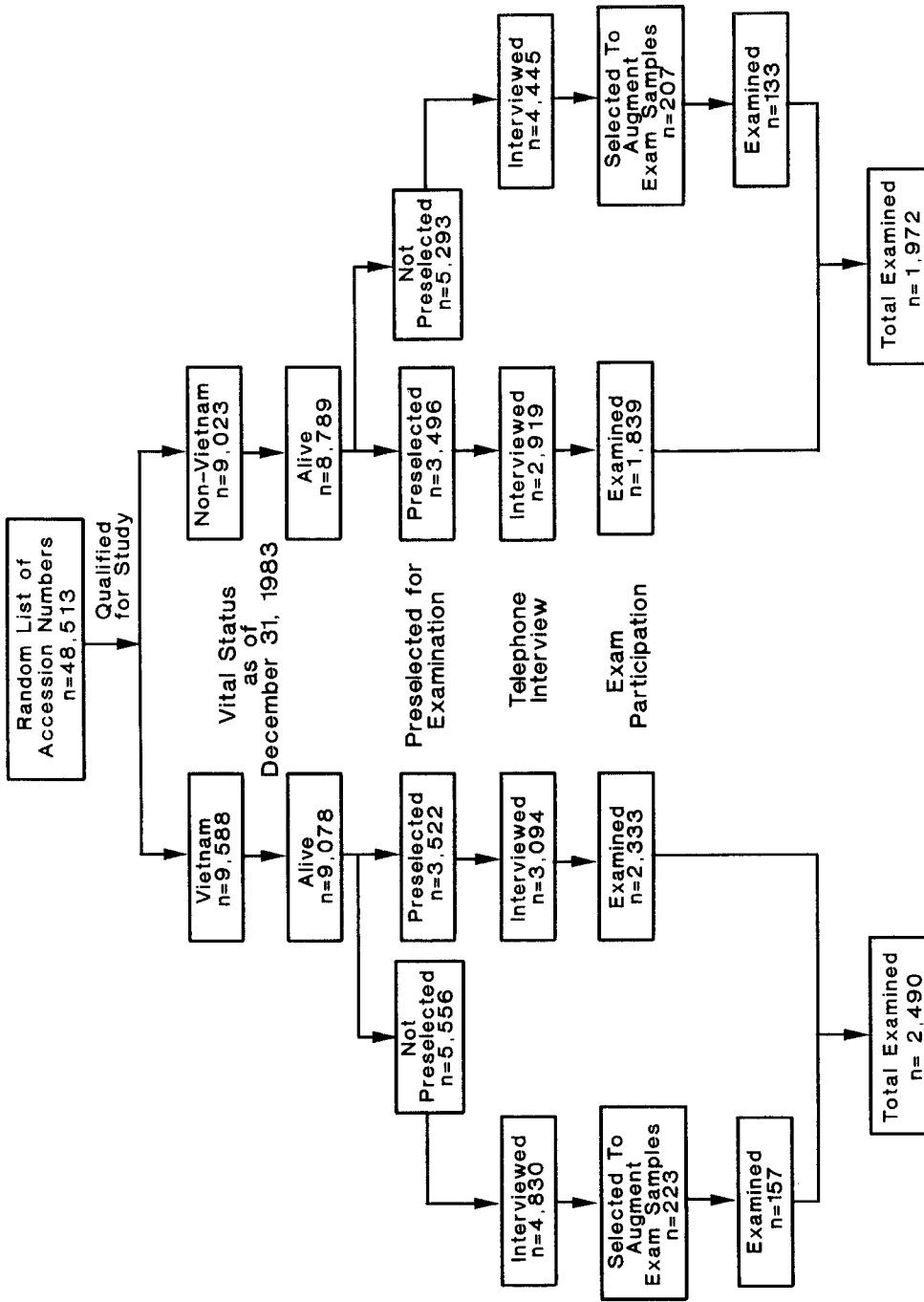
An eligible veteran's cohort status was determined entirely on the basis of information contained in Army personnel files; these records listed the countries in which a veteran had served. To be included in the Vietnam cohort, a veteran had to have served in Vietnam at any time during his term of enlistment. The Army designated 12 months as the normal maximum tour in Vietnam (U.S. Department of the Army, 1967), but we placed no minimum on the number of months a veteran had to have served in Vietnam. To be included in the non-Vietnam cohort, a veteran had to have served at least one tour of duty in Germany, Korea, or the United States and to have never served in the Army in Vietnam.

2.2 SELECTION OF EXAMINATION PARTICIPANTS

Vietnam-era veterans were randomly selected from a set of computer tapes containing accession numbers, each of which refers to a unique military personnel record on file at the National Personnel Records Center (NPRC) in St. Louis, Missouri. NPRC supplied the Centers for Disease Control (CDC) with five million accession numbers for U.S. Army veterans whose service records had been received between September 1964 and June 1977. NPRC estimated that numbers for the vast majority of discharged U.S. Army Vietnam-era veterans would be included among them.

To identify the required 16,000 veterans expected to meet the eligibility criteria, for the study, we randomly selected about 48,000 accession numbers. Then, to determine eligibility, we reviewed the personnel files corresponding to these numbers. As outlined in Figure 2.1, 99% (N = 48,513) of the random numbers generated corresponded to an accession number

Figure 2.1 Flow Diagram of Medical Examination Participation From Sample Selection to Examination



on the NPRC computer tapes. Of these, 1,355 referred to records that could not be located after several attempts. From the remaining numbers, 18,581 men qualified for the study (9,558 Vietnam and 9,023 non-Vietnam veterans).

Data abstraction forms and files of veterans who appeared to meet the criteria for the study were forwarded to the U.S. Army and Joint Services Environmental Support Group (ESG) in Washington, D.C., where a second qualification process was completed. Detailed information was then abstracted from the files of those veterans found to be qualified for the study. Most of the data for the study were taken from the Department of Defense Form 214 and the Department of the Army Form 20. All data abstraction forms were then sent to CDC for keying and editing.

The first step in the tracing and recruitment of eligible study participants was to determine each veteran's current vital status and his most recent home address. Several sources were used to determine vital status. In-service deaths were identified during the review of military personnel files to determine study eligibility. Deaths occurring after separation from active duty and the most recent address for veterans not known to have died were identified with the assistance of several Federal agencies:

1. Veterans Administration—Beneficiary Identification and Record Locator Subsystem (BIRLS).
2. Social Security Administration.
3. Internal Revenue Service (IRS) (through special arrangement with the National Institute for Occupational Safety and Health).
4. National Center for Health Statistics (NCHS)—National Death Index.

Each of these agencies receives notifications (in different degrees of completeness) of deaths and maintains this information in computer-based files. We usually obtained the most recent known address for veterans not known to have died through the IRS files.

The next step in recruiting the participants was to locate the eligible participants and invite them to take part in a telephone interview. The Research Triangle Institute (RTI) personnel located, contacted, and interviewed the veterans. Details are presented in Volume II of this monograph. In brief, to locate the veteran, RTI used the following information sources and methods: telephone directory assistance; telephone contacts with veterans; searches of automated credit bureaus; state motor vehicle records; city and town directories, public records, and utility records; and contacts with relatives, neighbors, and employers.

In the next phase, a random sample of veterans was selected for the examination component of the VES from among those eligible to participate in the telephone interview. The overall goal was to have about 4,000 veterans undergo medical examinations. To achieve this goal, about 6,000 veterans were preselected to participate in the examinations. In addition, 430 names of telephone interview participants were later added to the examination sample. This was done to achieve an adequate sample size for semien analysis, a medical test added toward the end of the study (see Volume III). Lovelace Medical Foundation (LMF), the examination contractor, recruited and scheduled the participants who were selected for the examinations..

2.3 SAMPLE SIZE AND POWER

The goal of the examination component was to examine about 2,000 veterans in each of the two cohorts. This sample size was selected to provide sufficient power (beta-error =

alpha-error = 0.05, one sided) to detect a twofold increase in relative risk for conditions that ordinarily occur at a prevalence of 1.5%-2.0%. For continuous measures, such as the results of most neuropsychological tests, a sample size of 2,000 per group should be sufficient for detecting even modest differences between the two groups.

2.4 TEST BATTERY

2.4.1 Assessment Concepts

The evaluation of the veterans' psychiatric, psychological, and neuropsychological functioning was designed to provide a comprehensive and valid multimethod assessment within the confines of a large epidemiological study. The choice of assessment tools and their relationship to the hypotheses that we addressed in this portion of the study need to be discussed.

Both the VES and the Agent Orange Study were designed to have three components: mortality, telephone interview, and physical and psychological examination. The VES was conducted first because the methods used to select the VES sample were not as difficult or as time-consuming as the methods proposed for selecting the Agent Orange Study sample. While the VES was being conducted, a pilot study of Agent Orange exposure assessment indicated that the Agent Orange Study was not feasible and the study was not conducted (see Chapter 1). We had planned to use the same questionnaires and examination procedures for both studies. Thus, some of the tests in the VES were included because they were to be included in the Agent Orange Study, for which the hypothesis was far more specific.

The ultimate goal of the psychiatric, psychological, and neuropsychological assessments was twofold: 1) to address major hypotheses regarding the increased prevalence among Vietnam veterans of psychiatric, psychological, or neuropsychological symptoms and disorders and 2) to ensure adequate screening for other related symptoms and conditions which have not been the focus of previous research. In addition, because one of the major concerns about Vietnam veterans' psychological health relates to the effects of combat, we included a measure of self-reported combat exposure. In selecting measures and tools for these assessments, we also considered their reliability, validity, historical relevance, acceptance by the professional communities who use them, and their practical use within the framework of the examinations.

The psychiatric, psychological, and neuropsychological assessments were not designed to provide a complete clinical diagnostic evaluation for each veteran, although they almost did so, especially in the psychiatric area. The final test battery used in the VES is presented in Table 2.1. All of these measures and tools have limitations, but they were considered to be the best available and the most credible for this study. The limitations of using self-report psychiatric interviews, psychological questionnaires, and neuropsychological performance-based tests to assess psychiatric, psychological, and neuropsychological conditions are inherent in the process and are not specific to this study. These limitations must be taken into account when the findings are considered. A licensed clinical psychologist reviewed the results of each evaluation and discussed them with the veteran, thus ensuring their accuracy and validity at a level consistent with that of standard clinical practice.

Concerning assessment, the study had two major requirements. The first requirement was to evaluate certain psychiatric conditions and psychological status. The second was to

Table 2.1 Questionnaires and Tests Used in the Vietnam Experience Study Psychological and Neuropsychological Evaluation

I. Psychiatric and Psychological Evaluation
A. Diagnostic Interview Schedule
B. Minnesota Multiphasic Personality Inventory
II. Neuropsychological Evaluation
A. Army Classification Battery—General Technical Score
B. Wechsler Adult Intelligence Scale—Revised
1. Information
2. Block design
C. California Verbal Learning Test
D. Rey-Osterrieth Complex Figure Drawing
E. Word List Generation Test
F. Wisconsin Card Sorting Test
G. Paced Serial Addition Test
H. Grooved Pegboard Test
I. Wide Range Achievement Test—Revised
—Reading Subtest
III. Other
A. Edinburgh Handedness Inventory
B. Combat Exposure Questionnaire

evaluate neuropsychological functioning. These requirements need to be discussed in relation to the conceptual framework and the tools and tests used in the study. Because this report has other purposes, this discussion is brief and focuses on the major issues associated with evaluating psychiatric disorders and neuropsychological functioning.

In psychiatry the major conceptual model of disease is based on a cluster of specific symptoms within a given time period. Ideally, each necessary symptom would be identified, and a person who had all of the required symptoms could be diagnosed as having a specific psychiatric disorder. Unfortunately, assessing and measuring each symptom (or construct) is difficult. Symptoms can be assessed through self-report or through psychological testing. Direct self-report is consistent with the psychiatric model of diagnosis, but the approach has potential problems with overreporting or underreporting, depending on the purpose of the psychiatric interview. In addition, the examiner must interpret the severity of self-reported symptoms, unless the symptoms can be compared with specific normative data.

Typically, the psychological model of diagnosis assesses psychological constructs in a less direct manner, using a test-based approach. The underlying assumption is that such tests can provide a more accurate and standardized assessment of a specific construct. In addition, such tests typically have normative data bases for comparing the subject's scores to scores for the population from which the tests were derived.

These two approaches usually lead to either a dichotomous symptom rating (*e.g.*, yes or no) in the psychiatric interview case or a test score on a dimension (*e.g.*, wordlessness scale) in the psychological test case. As with most dimensional data, the test score could be dichotomized as either normal or abnormal, depending on arbitrary criteria based on the test's normative data base. Unfortunately, when data are so reduced, potentially important information is usually lost.

In addition, multidimensional, as opposed to syndrome-based, models of psychiatric or psychological conditions require a different approach to assessment. The advantages and disadvantages of a syndrome-driven, interview-based diagnostic system compared with a multidimensional, test-based diagnostic system have been argued for years, without being resolved (Kendell, 1975). In most instances, the two approaches to assessing a person's

psychiatric or psychological status lead to generally similar conclusions if major diagnostic groupings are used (e.g., psychosis, anxiety disorders, depression). They can, however, provide different views of a person's functioning, and therefore can be seen as overlapping, but specialized, approaches to similar issues.

Besides the issue of how best to assess each symptom, there is the more basic issue of which and how many symptoms are required for a diagnosis. In the VES, we used the diagnostic criteria developed by the American Psychiatric Association and published in the Diagnostic and Statistical Manual of Mental Disorders, 3rd edition (DSM-III) (1980). Many of the diagnostic criteria described in this classification system have been used in clinical practice for years, but from the standpoint of reliability and validity, they have not been studied extensively.

An additional issue is that of diagnostic entity versus psychological symptom. For example, the term "depression" can refer to a specific diagnostic category based on DSM-III criteria and to a particular mood or symptom. "Anxiety" is another term that can have two meanings. In this study, the term "stress" also can have two meanings—one related to a diagnostic category, such as post-traumatic stress disorder (PTSD), and another related to events or experiences, such as chronic stress and the resulting psychological effects.

Because of these issues, we assessed psychiatric or psychological disorders and symptoms in two ways. In one approach, trained psychological technicians administered a structured psychiatric interview, the Diagnostic Interview Schedule (DIS), (Robins *et al.*, 1987), and DSM-III diagnoses were obtained. This diagnostic tool has been used in epidemiological studies of psychiatric disorders (Eaton and Kessler, 1985). It is based on reported behaviors and symptoms elicited in an in-person interview. The limitations of psychiatric diagnoses based on self-reported information from a single interview have been documented in previous studies (Kendell, 1975). The DIS is also a fairly new tool, which has only recently been used in large studies of psychiatric conditions. Its reliability and validity are topics of current research (Robins *et al.*, 1981a, 1982).

In the other approach, the most widely known and clinically used psychological test, the Minnesota Multiphasic Personality Inventory (MMPI) (Dahlstrom *et al.*, 1972), was administered, and a quantitative evaluation of a veteran's current personality, emotional status and level of psychopathology was obtained. The MMPI is a self-administered questionnaire and is not based solely on self-reported psychiatric symptoms. It includes special scales for assessing the validity of responses and can identify subjects whose profiles may not be valid because of their "faking bad" or "faking good" responses. This measure is based on a multidimensional assessment model of psychopathology and yields a profile of scores across 4 validity and 10 clinical scales. The MMPI also includes scoring procedures that can yield diagnostic categories from the scale; the diagnoses so derived are, however, not based on the DSM-III system. The reason is that the scale was developed during the 1940s and 1950s and is based on concepts from that era which is one of its limitations. Another limitation is that each of the scales within the MMPI assesses multiple factors, which makes the results difficult to interpret. The multidimensional nature of this test also makes it difficult to present results that can be easily comprehended, especially when they are compared with a diagnosis from a psychiatric interview.

When reviewing the results it is important to recognize that both the DIS and MMPI have strengths and weaknesses. Furthermore, since they take conceptually and methodologically different approaches to assessing psychological conditions and psychiatric disorders, the findings may not correspond exactly.

To assess neuropsychological functions, we chose several specific tests that screen for language, visual-spatial, memory, dexterity, attention, and executive functions. These constructs are considered to be the major ones evaluated in most standard comprehensive neuropsychological assessments (Lezak, 1983). A major issue in the use of neuropsychological tests is their multifactorial nature. No one test measures one specific construct, such as memory, and a person may obtain a low score on a test for numerous reasons. Usually, therefore, many tests that are related to similar constructs are used. In this way, a single test score is not confirmatory of a specific deficit. Only patterns of test results can be interpreted with confidence. Statistical methods, such as factor analysis, can be used to describe the underlying neuropsychological constructs being assessed by a specific battery of tests.

2.4.2 Tests

Diagnostic Interview Schedule

The Diagnostic Interview Schedule (DIS), first used in 1981, is a standardized questionnaire for use by lay interviewers in assessing the prevalence of psychiatric disorders in the general population (Eaton and Kessler, 1985; Robins *et al.*, 1981b). Diagnoses are made according to explicit criteria developed by the American Psychiatric Association and published in the Diagnostic and Statistical Manual of Mental Disorders, 3rd edition (DSM-III) (1980). To reduce testing time and to tailor the questionnaire to conditions that occur among men in the age range of VES participants, we modified the DIS as follows:

1. Questions were deleted for conditions that are rare among 30- to 50-year-old men (e.g., anorexia nervosa).
2. The somatization section was deleted and an index of somatization was developed at CDC on the basis of responses to the medical history questionnaire. Veterans were given the diagnosis of somatization if they responded positively to 7 of 21 symptoms and if a review of their medical history indicated no underlying medical condition that could account for the symptoms.
3. The compulsive behavior questions were removed, because this form of the obsessive-compulsive condition is rare in young men.
4. On the basis of data from the Epidemiologic Catchment Area (ECA) study (Eaton and Kessler, 1985), the number of phobias in the phobia section was reduced from 18 to 8 of the more common phobias.
5. For legal reasons, questions suggestive of child abuse were removed from the antisocial personality section.
6. The post-traumatic stress disorder (PTSD) section was moved to the end of the questionnaire. A pilot study of 147 veterans conducted in April 1985 indicated that some veterans became upset while responding to questions in this section. This reaction could have altered responses to subsequent questions.
7. Questions about the use of medical care were deleted for all conditions except PTSD. This was done because Vietnam veterans may have had more opportunity for medical

care through the Agent Orange medical programs at Veterans Administration hospitals. They also may have been more likely to seek care for conditions they believed were related to their Vietnam experience.

8. The drug abuse or dependence section was modified so that questions about dependence, onset, and duration of symptoms were asked for all drugs combined rather than for each drug separately. This was done to reduce administration time.
9. Questions were added to assess the prevalence in the past month of symptoms of generalized anxiety, depression, PTSD, alcohol abuse or dependence, and drug abuse or dependence.

Interviews with the modified DIS generally took 40-50 minutes.

Computerized algorithms provided by the Department of Psychiatry at Washington University (St. Louis, Missouri) were used at CDC to create diagnostic categories based on criteria listed in the DSM-III. These algorithms were developed for use in the 1981 study of psychiatric conditions in the general population (the ECA study). For some conditions (e.g., depression), the original algorithms used the seeking of medical care or the taking of medication as an index of the severity of the condition. Since these questions were not asked in the modified version of the DIS, none of these conditions were scored by their severity.

The DIS was used to assess the following DSM-III Axis I and II disorders:

- A. Anxiety Disorders
 1. PTSD
 2. Generalized anxiety disorder
 3. Simple phobias
 4. Panic disorder
 5. Obsession
- B. Mood Disorders
 1. Major depression
 2. Bipolar disorder
- C. Psychoactive Substance Use Disorders
 1. Alcohol dependence or abuse
 2. Drug dependence or abuse
- D. Personality disorders
 1. Antisocial (Axis II)
- E. Somatoform Disorders
 1. Somatization disorder
- F. Schizophrenia
- G. Delusional Paranoid Disorder
- H. Impulse Control Disorders
 1. Pathological gambling

Minnesota Multiphasic Personality Inventory

The Minnesota Multiphasic Personality Inventory (MMPI) is a standardized questionnaire designed to "provide in quantitative form a set of evaluations of personality status and emotional adjustment; each subject is asked to answer 566 different items either True or False as they apply to him, although he may also indicate that some of them do not apply" (Dahlstrom *et al.*, 1972). Standard computerized scoring (National Computer System) provided scores for 4 validity indicators and 10 clinical or personality scales. Numerous

special scales and indices are also available for scoring and some of them were used in this study. The following validity, clinical, and special scales were scored in this study (the descriptions are from Dahlstrom *et al.*, 1972):

Validity Scales

Cannot Say (?) Scale - This scale represents the total number of items the veteran omitted or double-marked. Since 96.8% of the participants received a score of 0 and only 8 participants had scores greater than 30 (a level that may weaken the scoring and interpretation of the other scales), this scale was not included in the total analysis.

L-Scale - This "is a 15 item scale designed to identify deliberate or intentional efforts to evade answering the test frankly and honestly."

F-Scale - "This scale has variously been designated as the frequency (or infrequency) scale, the confusion scale, and sometimes merely as the validity scale. It was designed to detect unusual responding or atypical ways of answering test items."

K-Scale - "The development of the K-scale was devoted to increasing the sensitivity of the validity indices on the test, to identify the impact of more subtle score-enhancing or score-diminishing factors, and to providing a means of statistically correcting the values of the clinical scales themselves to offset the effect of these factors on the clinical profile." All clinical scale scores in this study were K-corrected, according to standard practice.

Clinical Scales

Scale 1 (Hs) - "The first scale published on the MMPI was an attempt to measure the personality characteristics related to the neurotic pattern of hypochondriasis. Persons diagnosed to have this disorder show abnormal concern for bodily functions."

Scale 2 (D) - "The second scale in the clinical profile was established empirically to measure the degree and depth of the clinical symptom pattern of depression."

Scale 3 (Hy) - "This scale was developed to aid in the identification of patients using the neurotic defenses of the conversion form of hysteria."

Scale 4 (Pd) - "This scale was developed to measure the personality characteristics of the amoral and asocial subgroup of persons with psychopathic personality disorders. The major features of this personality pattern include a repeated and flagrant disregard for social customs and mores."

Scale 5 (Mf) - "Scale 5 was designed to identify the personality features related to the disorder of male sexual inversion."

Scale 6 (Pa) - "This scale was developed to evaluate the clinical pattern of paranoia."

Scale 7 (Pt) - "This scale was derived in the evaluation of the neurotic pattern of psychasthenia, or the obsessive-compulsive syndrome."

Scale 8 (Sc) - "The psychotic pattern of schizophrenia for which this scale was derived is very heterogeneous and contains many contradictory behavioral features. This may be in part a result of the way that the pattern is identified in terms of bizarre or unusual thoughts or behavior. Most commonly, persons showing this psychiatric reaction are characterized as constrained, cold, and apathetic or indifferent."

Scale 9 (Ma) - "The personality pattern for which this scale was derived is the affective disorder hypomania. Three features characterize this pattern: overactivity, emotional excitement, and flight of ideas."

Scale 0 (Si) - This scale measures a "person's uneasiness in social situations or in dealing with others." This scale was developed in relationship to social introversion- \rightarrow troversion.

In addition to these basic validity and clinical scales, these special scales were scored:

1. Wiener (1948) Obvious and Subtle Scales for Scales 2, 3, 4, 6, and 9
2. Harris and Lingoes Clinical Subscales for Scales 2, 3, 4, 6, 8, and 9 (as cited in Greene, 1980)
3. Wiggins (1966) Content Scales
4. Welsh (1956) Factor A and R Scales
5. Ego Strength Scale (Barron, 1953)
6. Taylor Manifest Anxiety Scale (Dahlstrom *et al.*, 1972)
7. Emotional Disorder Scale (Dahlstrom *et al.*, 1972)
8. Body Symptoms and Tension Scales (Stein, 1968)
9. Alcoholism Scale (MacAndrew, 1965)
10. Drug Abuse Scale (Dahlstrom *et al.*, 1972)
11. Carelessness Scale (Greene, 1978)
12. Test-Retest Scale (Greene, 1979)

More detailed descriptions of the MMPI scales and subscales are in Appendix C.

Neuropsychological Tests

Neuropsychological functioning was evaluated with the following tests:

1. *General Technical (GT) Score from the Army Classification Battery (ACB)* (Montague *et al.*, 1957). This score is the average of the standard scores from the Verbal Reasoning and Arithmetic Reasoning subtests. The GT score is a crude estimate of general intelligence, and results of the test have been correlated with the results of more standard intelligence tests. The veterans in this study took the ACB of tests when they were inducted into the Army. The GT score from this initial testing, pre-Vietnam service, was available from Army records. The same test forms were administered to the participants during the VES examination to provide a current estimate of the veterans' general IQ on the same measures.

2. *Wechsler Adult Intelligence Scale - Revised (WAIS-R) Information and Block Design Subtests* (Wechsler, 1981). The information subtest is a measure of general information and is highly correlated with educational and socioeconomic background. It has also been considered a measure of long-term verbal memory, since most of the questions require the subject to recall information typically learned in school. This test correlates highly with general IQ and verbal functions. The block design subtest is a measure of visual-perceptual-motor, visual-spatial, and nonverbal reasoning abilities. This test correlates highly with general IQ and is timed so that mental and motor speed are also a component in a subject's performance.

3. *California Verbal Learning Test* (Delis *et al.*, 1987). This new test assesses active verbal learning and memory functioning by requiring the subject to recall a list of 16 words over 5 repeated learning trials. It provides numerous memory-related scores, including total learning, immediate and delayed recall and recognition.

4. *Rey-Osterrieth Complex Figure Drawing* (Osterrieth, 1944). This drawing test requires the subject to reproduce a complex spatial figure. It assesses visual-perceptual-motor, visual-spatial, planning, organizational, and graphomotor functioning. After the design has been copied, the subject is required to recall and draw the design from short-delay memory. After a 20-minute delay, during which, in the VES, the veteran performed another test, the subject is again required to recall and draw the design from long-delay memory.

5. *Word List Generation Test* (Benton and Hamsher, 1976). This measure assesses language system functioning, speed of word retrieval from memory, and general vocabulary. In 60 seconds a participant has to generate as many words as possible that begin with a specific set of letters (F, A, S). In addition, the subject is asked to generate first names of people.

6. *Wisconsin Card Sorting Test* (Berg, 1948). This test assesses concept formation, problem solving, and the use of feedback in decision making. It is a measure of executive functions. The subject is required to sort cards containing various numbered and colored shapes into a set of categories based on the examiner's feedback.

7. *Paced Serial Addition Test* (Gronwall and Sampson, 1974). This test is a measure of mental control, mental speed, and computational and attentional abilities. The subject is required to mentally add a sequence of numbers in rapid succession. Each set of numbers is presented at an increasingly rapid rate. Because of the stress this test caused some veterans in the pilot study, when a veteran's performance fell below 50% correct on any series, the test was discontinued.

8. *Grooved Pegboard Test* (Klove, 1963). This test assesses manual dexterity and fine motor skills. With each hand, the participant is required to place a set of pegs into grooved holes as quickly as possible. The time required to complete the task is the score of interest.

9. *Wide Range Achievement Test - Revised (WRAT-R) Reading Subtest Score* (Jastak and Jastak, 1965). This subtest, which consists of reading single words, is highly correlated with educational background. The WRAT-R was used to screen veterans' reading abilities before they began the MMPI, which requires at least a 6th grade reading level. Veterans who did not meet this reading level were given all materials on audiotape.

10. *Edinburgh Handedness Inventory Laterality Ratio* (Oldfield, 1971). This scale assesses a subject's hand use in a variety of typical instances (writing, throwing, etc.). A score of 1.00 represents a "pure" right hander, and a 0.00 represents a "pure" left-hander. Any veteran whose score fell below .70 on this scale (11.8% of total sample) was classified as a nonright hander. These handedness classifications were used as covariates in the neuropsychological data analysis because nonright handers in some samples can exhibit patterns of neuropsychological function different from the more common patterns that right handers exhibit.

In addition to the questionnaires and tests described in this section, the veterans also completed the Combat Exposure Questionnaire. This is a 12-question self-administered questionnaire on the veteran's combat experiences. The questions were developed originally by Egendorf *et al.* (1981) for use in the "Legacies of Vietnam" study. The responses to the questions are "never," "rarely," "sometimes," "often" and "very often," and these responses are scored 0 to 4, respectively. Based on the procedures used in the "Legacies" study, scores for the last 6 questions are doubled, and the scores for each of the 12 questions are added together. Thus, scores have a possible range of 0 to 72.

Details on the procedures used in administering these tests, including the exact instructions given to the veterans and the exact scoring procedures, are given in the *Psychology Manual for the Lovelace Veterans Health Study*, which the Lovelace staff developed and which is included in Supplement C (Medical and Psychological Procedure Manuals and Forms) of this monograph. The supplement also contains a copy of the *Results Interview Manual, Psychology*, which documents the procedures used to provide feedback

to the veterans on their psychological testing during an interview with a licensed clinical psychologist on the day after their evaluations.

2.5 TESTING PROCEDURES

The veterans' psychiatric, psychological, and neuropsychological status was assessed during the second day of the 3-day evaluation at the Lovelace Medical Foundation in Albuquerque, New Mexico. All examinations were performed between June 1985 and September 1986. The participants' expenses—including travel, meals, lodging, and a nominal stipend—were paid out of study funds. Participants were given a special assurance of confidentiality and all gave their informed consent, in writing, to participate. All veterans underwent the medical component of their evaluation on the first day of testing (see Volume III). The psychiatric, psychological and neuropsychological assessment included tests administered both to individuals and to groups. The individually administered tests and the MMPI were given in the morning and the group administered tests and the DIS were given in the afternoon. The Combat Exposure Questionnaire was given after the Diagnostic Interview Schedule (DIS).

The following areas were assessed: memory, concentration and attention, intellectual ability, response organization and inhibition, verbal fluency, fine motor skills, reading recognition, visuospatial skills, handedness, and emotional and psychiatric status. Because the memory tests examined both verbal and visuospatial memory abilities in both immediate and delayed recall, the individually administered tests were arranged so that only nonverbal tests were given between the immediate and delayed recall components of a verbal memory test, thereby keeping the interim tests from interfering with the tests in the memory component. Conversely, verbal tests were interspersed between the immediate and delayed recall components of the nonverbal, visuospatial test of memory.

Facilities and Staff:

All psychological and neuropsychological tests were administered in the psychological testing facility developed by the Lovelace Medical Foundation for this study. All group tests were administered in a large, well-lighted, comfortable room. All individual tests were administered in smaller private testing rooms. The facility included a lounge and an eating area for the participants. The testing site had one-way mirror and videotaping capabilities for monitoring and supervising testing sessions. In addition, each room could be monitored via a central audio system.

The personnel involved in the psychiatric, psychological, and neuropsychological component of the study included 1 full-time clinical neuropsychologist, 2 half-time clinical psychologists, 1 quarter-time clinical psychologist, 1 lead psychology technician, 12 full-time psychology technicians, 4 part-time psychology technicians, and 4 full-time editing technicians. The full-time neuropsychologist was responsible for supervising data collection and ensuring quality control. The lead psychology technician assisted in training technicians to administer and score the tests and in directly monitoring the administration of the tests and the compilation of data. The psychology technicians had at least a B.A. or a B.S. degree in psychology or a related field, and they administered and scored the tests. The editing technicians, who had B.A. or B.S. degrees in psychology or the liberal arts, edited the DIS data.

Training and Supervision:

The psychology technicians and editors took an intensive 6-week training course to learn standardized administration and scoring techniques for the tests used in this study. Eight days of the training were devoted to the DIS, with consultants from Washington University and Survey Research Associates directing the training. The schedule for the training is shown in Supplement C (Medical and Psychological Procedure Manuals and Forms). Training and supervision largely consisted of the direct observation of technicians by the chief neuropsychologist, the lead psychology technician, and the CDC staff psychologist. The technicians, with practice participants, participated in the observed training sessions until they accurately administered the tests.

Ongoing direct observation was also used to ensure standardized administration and scoring. During the early phases of the study, each technician was observed for 2 hours per week and during the later phases, for a minimum of 1 hour per month. Each technician audiotaped the first 3 interviews of the DIS and every 10th interview after the first 3. In addition, weekly group meetings were conducted to address standardization issues and to develop consistent responses to problems. Members of the CDC staff also closely monitored all training and conducted periodic reviews of the actual testing.

Testing Schedule:

As many as 28 participants were tested per day, Tuesday through Friday. Participants arrived at the test site by 8 a.m. and assembled in the group testing room. Participants were informed that they would be receiving a full day of psychological and neuropsychological assessment, including both individual and group-administered tests. They were specifically instructed not to reveal any information about their military experiences unless they were asked a question for which that information was a necessary part of the answer. Technicians were not informed of the participants' cohort status. Participants were given numbered badges to wear throughout the day; the numbers on the badges corresponded to a testing room number and testing order.

Participants with even numbered badges were asked to report to the testing room that corresponded with their badge number. First, the WRAT-R reading test was administered. After completing that test, participants returned to the group testing room. When all of the even-numbered subjects had returned, the Breath Alcohol Test (BAT) was administered individually and then the MMPI test was given to the group. If a participant had a breath alcohol reading of more than 0.005, but less than 0.010, he was permitted to complete the MMPI, but the BAT was repeated later in the morning, before the individual tests. After the BAT, participants who received a grade equivalent score of 6B or less on the WRAT-R reading test were taken to separate rooms, where they were given an audiotaped version of the MMPI test. This was done to improve the accuracy of responses for subjects whose reading levels were below that required by the MMPI. After the MMPI test, participants had a 10-minute break and were then brought to the individual testing rooms where the individual tests were completed. After these tests, participants were given a 45-minute lunch break.

The afternoon session began at 1:30 pm. Even-numbered participants were taken to the group testing room, where the Army Classification Battery and then the Edinburgh Handedness Inventory tests were administered. Participants were then instructed to assemble in the waiting lounge for a short break until they were asked to report to the individual testing rooms for administration of the DIS and the Combat Exposure Question-

naire. If the participant had taken an audiotaped version of the MMPI, he was also given an audiotaped version of the Combat Exposure Questionnaire.

Odd-numbered participants were first administered the BAT in the group testing room. If a participant had a breath alcohol reading of greater than 0.005 (but less than 0.010) he was switched with an even numbered participant and completed the MMPI testing during the first half of the morning. Following the MMPI, and before the participant was administered the individual tests, the BAT was repeated. Participants who had acceptable breath alcohol readings on the first BAT, were given the individual tests after the BAT. The WRAT-R reading test was the first test administered during the individual session. After all the individual tests had been completed, the odd-numbered participants were asked to report to the group testing room where the MMPI was administered. As with the even-numbered participants, if a participant had a grade equivalent of 6B or less on the reading test, the MMPI was administered by audiotape. After completing the MMPI, the participants had a break.

During the afternoon session, odd-numbered participants were taken to individual testing rooms where they were given the DIS and then the Combat Exposure Questionnaire. After a short break, they were assembled in the group testing room for the Army Classification Battery and the Edinburgh Handedness Inventory. As with the even numbered participants, audiotaped versions of the tests were used if necessary.

2.6 DATA QUALITY

A great deal of emphasis was placed on obtaining the most accurate information possible while, at the same time, collecting the information from both cohorts in the same fashion. Minimizing the possibility of differential ascertainment in the two cohorts was of paramount concern. To ensure that the evaluation of the two groups was as similar as possible we never provided Lovelace Medical Foundation (LMF) with information about where any of the participants had served while in the Army.

Several methods were used to assure the quality of the data collected. High quality, standardized tests and procedures were employed—in particular those that are accurate and precise, objective, and easily administered on a large scale. Procedures manuals and data collection forms were developed. These manuals outlined a uniform set and sequence of procedures for performing each test. Use of the data collection forms assured that information on each participant was collected and recorded in the same way.

Only specially trained technicians were allowed to administer the examinations and psychological and neuropsychological tests. Both supervisors at LMF and members of the CDC staff monitored the technicians performance. Members of the CDC staff made periodic site visits to the examination facilities to assure that the protocol was being followed and that contractual performance standards were being met.

Data quality was assessed routinely during the data collection phase of the study. As shown in Supplement B (Medical and Psychological Data Quality), except for results of the Combat Exposure Questionnaire, we found no significant differences ($p < 0.01$) in the distribution of any test result by technician, by test order, or by time of examination (in 3-month intervals). Veterans who reported experiencing high levels of combat were more likely to schedule themselves for examination in the early part of the study.

We also conducted a small pilot study ($n = 187$ veterans) to assess whether psychology technicians could identify Vietnam veterans. If so, they could bias the DIS or neuropsychology tests they administered. Before the DIS, technicians correctly guessed the cohort status

of 63% of the Vietnam veterans, but they also incorrectly guessed that 52% of the non-Vietnam veterans were Vietnam veterans. By the end of the DIS, technicians had correctly ascertained cohort status for 75% of the Vietnam and 72% of the non-Vietnam veterans. Thus, the technicians could not distinguish cohort status from subtle cues such as dress or behavior, but as a result of responses provided during the DIS, they were able to distinguish cohort status to some degree.

Technicians and reviewing psychologists evaluated whether they considered the results of each test administered to be valid. On the basis of their assessment of the participant in the debriefing interview and the technicians' comments, reviewing psychologists at LMF reported that 98% or more of the results were valid for both groups of veterans. The major reasons given for questionable test results were language problems (e.g., some Hispanics had problems understanding questions in the DIS), motor impairment, and non-compliance. Because the percentage of veterans with questionable findings is small, all tests were routinely included in the analysis.

2.7 DATA COLLECTION AND PROCESSING

The psychological and neuropsychological data were recorded onto forms specifically designed for data entry. Copies of these forms are in Supplement C (Medical and Psychological Procedure Manuals and Forms). During their training and orientation sessions, all psychology technicians were instructed in how to complete the data entry forms. The forms were completed at the time of testing. After being completed, they were reviewed for completeness and consistency. After this review, all forms were placed in a systematic order in each participant's medical record folder.

For data entry, the records were organized into batches by date of examination and delivered to personnel who entered the data into a computer, which produced data tapes. The following data forms could be optically scanned: General Technical Test, Combat Exposure Questionnaire, Minnesota Multiphasic Personality Inventory (MMPI), Faced Auditory Serial Addition Test (PASAT), Rey-Osterrieth, Wechsler Adult Intelligence Scale-Revised (WAIS-R), Wisconsin Card Sort. Data on most other forms were manually keypunched to generate computer data tapes. All data were keyed into the computer by one data entry clerk and verified by a second clerk's reentering them. As the data were being entered, on-line data editing programs checked for valid codes and skip patterns. Invalid entries were automatically rejected; this input problem had to be solved before the computer would accept additional entries. A special editing program was used to edit DIS data. The California Verbal Learning Test (CVLT) data were entered by using an interactive data entry program.

The partially edited data tapes were sent monthly to CDC for further editing and for the data to be prepared for statistical analysis. All data, upon receipt from Lovelace, were edited by using programs that checked each item for valid codes, out-of-range values, and errors in logic or consistency. Lists of edit failures were sent to Lovelace for verification or correction according to the hard-copy record. Corrections were then returned to CDC where appropriate changes were made to the master data files. After the editing was completed, medical records were sent to the Federal Archives Record Center (FARC) in Atlanta, Georgia, for microfilming and storage. These records were later used to resolve minor discrepancies that were not identified during the editing process but were found during data analysis.

2.8 APPROACH TO DATA ANALYSIS

The goal of the analyses was to obtain valid estimates of the association between service in Vietnam and particular conditions or test results. These estimates were derived from analyses in which findings for the Vietnam group as a whole were compared with findings for the non-Vietnam group as a whole. Several analyses were undertaken to make certain that the results were not influenced, or confounded, by differences between the two cohorts in health-influencing characteristics unrelated to military experience. Analyses were also conducted to determine if certain subgroups of Vietnam veterans might be at different risks for particular conditions. In epidemiologic terms, the purpose of these analyses was to determine whether there was any effect modification or interaction. Since we performed a large number of comparisons and tests, we took a conservative approach towards evaluating and presenting such results. We performed tests for interactions only when the number of cases of a particular condition was sufficient to allow us to obtain stable estimates of interaction. Stratum-specific results are presented only when differences in the measure of association among particular strata were substantive.

Six characteristics, or covariates, were specified before analysis as being of primary interest for consideration as potential confounders or effect modifiers. They are race, age at entry into the Army, year of entry into the Army, military occupational specialty (MOS), enlistment status (volunteer or draftee), and entry general technical (GT) score on the Army Classification Battery. Table 2.2 shows how these variables were defined and categorized for analysis. By including both year of entry and age at entry into the Army, we made it possible for age at examination to be indirectly accounted for in all analyses. The six primary covariates were determined before a man was assigned to a particular military duty location, and the characteristics were abstracted from military records.

Although additional information on a veteran's service experience was available from military records, it was not used to assess confounding and effect modification. These variables include military service characteristics that are intertwined with the service

Table 2.2 Primary Entry Covariates and Associated Categorizations Employed in All Multivariate Analyses

Variable	Categories for Analysis
Race	White Black Other
Age at entry into Army, years	<20 ≥20
Year of entry into Army	1965-66 1967-69 1970-71
Primary military occupational specialty (MOS) ^a	Tactical Other
Enlistment status	Draftee Enlistee
General technical (GT) test score ^b	40-89 90-109 110-129 130-160

^a The job for which the man was trained in the Army. Tactical operations includes jobs such as infantryman, armored vehicle crewman, artillery crewman, and combat engineer.

^b A general aptitude test taken at entry into the service.

experience and for which adjustment may not be appropriate (e.g., discharge rank, type of discharge, length of service). Adjusting for these types of variables could result in indirectly adjusting for the "exposure" under study (i.e., military service experience).

For each of the individual analyses, we had to consider other covariates as potential confounders. Those under consideration varied, depending upon the particular condition or test being evaluated. The covariates most frequently included are listed in Table 2.3. Information on these variables was collected in the telephone interview (education), the medical history questionnaire administered at Lovelace (current alcohol and drug use), or the DIS (current marital status). Since these variables reflect current behavior or cumulative experiences to the present, differences in the values of these variables between Vietnam and non-Vietnam veterans could represent either differences (or a predisposition toward differences) that existed before military service or differences occurring as a result of military service. In the latter sense, they could be intervening variables in the causal chain for certain conditions. If risk estimates change appreciably after being adjusted for the variables, they must be carefully interpreted. Suppose, for instance, that estimates from crude analyses indicate that memory problems are more common among Vietnam veterans than among non-Vietnam veterans, but that the effect is not evident after the estimates have been adjusted for current alcohol use. We would not interpret the adjusted estimate as indicating that there are no differences in memory problems between Vietnam and non-Vietnam veterans. Rather, we would interpret it as suggesting that Vietnam veterans have more memory problems than non-Vietnam veterans, but that the difference is explained by their increased use of alcohol.

2.9 STATISTICAL METHODS

Because of the large number of conditions and tests evaluated, we developed a uniform strategy for statistical analysis. Statistical analysis consisted of basic comparisons of the prevalences (for dichotomous outcomes) or differences in the means (for continuous measures) between the two cohorts. Multiple regression was used to test hypotheses and account for potential confounding and effect modification associated with selected covariates. Two basic statistical models were used for regression analyses; these are referred to as Model 1 and Model 2. Model 1 consisted of variables defining the exposure groups and the six selected primary covariates described in Section 2.8, as well as all significant

Table 2.3 Selected Secondary Covariates and Associated Categorizations Employed in Multivariate Analyses

Variable	Categories for Analysis
Current alcohol consumption, drinks/month	0-29 30-89 ≥90
Current illicit drug use	None Marijuana only Other (including marijuana)
Marital status	Never married Married Widowed, separated, or divorced
Education, years completed ^a	0-11 12-15 ≥16

^a Highest grade or year of regular schooling attained at time of telephone interview.

interaction terms between the exposure variable and each covariate. Model 2 included all variables in Model 1 and other covariates selected as potential confounders or effect modifiers for a particular condition or test, as well as all significant interaction terms between the exposure variable and each covariate. The additional covariates included in the Model 2 analyses are described in footnotes to the tables. Stepwise multiple regression (using a combination of forward stepping followed by backward elimination with $p=0.01$ to enter and $p=.011$ to remove) was used to test for significant interactions (Dixon and Jennrich, 1983; Engelman, 1983). Significant interaction terms, along with all main effects of the covariates, were included in the final statistical model. This model was used to compute estimates and 95% confidence intervals (CIs).

For dichotomous outcomes, multiple logistic regression was used for statistical modelling (Kleinbaum *et al.*, 1982). The extent of modelling for each outcome was based on the number of cases observed in the combined exposure groups. Guidelines, given in Table 2.4, were determined after the stability of the regression coefficient associated with the exposure variable was examined at different levels of analysis. The results of logistic regression are presented as odds ratios (ORs) and 95% CIs (Kleinbaum *et al.*, 1982). For instance, an OR of 1.3 between the Vietnam and Non-Vietnam cohorts can be interpreted as follows: The odds of having the condition is 30% higher for Vietnam veterans than for non-Vietnam veterans. Suppose that the 95% CIs about that estimate are 1.1 and 1.5. This interval implies that with 95% probability the true value of the OR falls between 1.1 and 1.5. As a general approximation, an OR whose 95% CI excludes 1.0 can be considered statistically significant (*i.e.*, $p<0.05$).

When significant interaction terms were present in the final model, ORs and CIs limits were standardized across strata defined by the covariate involved in the interaction (Flanders and Rhodes, 1987; Wilcosky and Chambless, 1985). Standardized values were estimated by using a single model with appropriate interaction terms. The following example illustrates how standardized ORs were calculated:

Suppose there was a significant interaction between race and cohort status. Using the model, an odds was estimated for each of three categories of race (white, black, and other) within Vietnam and non-Vietnam cohorts. Each odds was

Table 2.4 Levels of Analysis Performed To Compute Odds Ratios for Dichotomous Outcomes, by Number of Cases Observed

Number of Cases ^a Observed	Variables Included In Analysis		
	Unadjusted Analysis	Multivariate Analysis	
		Model 1	Model 2
0-9	N ^b	N	N
10-24	P ^c	N	N
25-49	P	M ^d	N
50-99	P	M	M
100-149	P	I ^e	M
≥150	P	I	I

^a Total number of persons with particular condition in the combined cohorts.

^b N = analysis not done.

^c P = place of service only.

^d M = main effects only, no interaction terms.

^e I = main effects with interaction terms.

then multiplied by a weight based on the proportion of veterans in each racial group for the combined cohorts. (In this case, the stratum weights would be .82 for whites, .11 for blacks, and .07 for other races.) These products were summed across strata for each cohort to yield weighted average odds for each cohort. The ratio of these odds for Vietnam versus non-Vietnam veterans is the standardized OR.

Results of the MMPI and the neuropsychological tests were in the form of continuously distributed data. The statistical methods for the analysis of these continuous variables are described in Chapters 5 and 7. For the MMPI and neuropsychological data that were continuously distributed, we also compared the proportions of participants in the two cohorts who had scores in the upper (or lower) tail of the distribution. The values of the cut point used to define the upper (or lower) tail of a distribution for a particular test are provided in the appropriate chapter. For each measure, a dichotomous outcome was defined by dividing the participants into two groups (*i.e.*, those with values above and below the cut point), and logistic regression was used for modelling this outcome.

These approaches to statistical analysis were consistently used to evaluate psychiatric or psychological conditions and test results. Any alternate methods that were used are described in the methods section of the appropriate chapters.

CHAPTER 3

Description of Examination Participants

3. DESCRIPTION OF EXAMINATION PARTICIPANTS

In this chapter we describe in detail the participation rates for the Vietnam Experience Study (VES) medical examination and factors that may have influenced participation in the two study cohorts. We then compare the examination participants in the two cohorts on the basis of such factors as characteristics at entry into the Army, Army service characteristics, current demographic and socioeconomic characteristics, satisfaction with personal relationships, and social support.

3.1 PARTICIPATION RATES AND FACTORS INFLUENCING PARTICIPATION

Achieving high participation rates is an essential element of any epidemiologic study. High rates are needed to assure that study participants accurately represent the entire study population and to minimize the possibility that differential participation may have influenced the study findings. Much effort went into maximizing rates of participation in the VES medical examinations. At the inception of the study, however, we realized that achieving very high rates of participation might be difficult for two main reasons. First, we anticipated that the men would be difficult to locate because of the long time, up to 20 years, that had elapsed since they had been in the Army. Second, we realized that, of the men who were located and interviewed, many would be unwilling to take the time away from their families and their work to travel to the examination facility. Given these constraints, in the study protocol we set a goal of achieving an overall 60% rate for all eligible veterans selected to participate in the examinations.

The study did achieve a 60% rate. As previously indicated (Chapter 2), out of the approximately 18,000 veterans eligible for the telephone interview, a random sample was selected to participate in the examination component of the study. Overall, of the 7,448 veterans selected, 4,462 (60%) participated (Table 3.1). The rates for the Vietnam and non-Vietnam cohorts, however, were different. Sixty-six percent (2490/3745) of the Vietnam veterans participated, whereas only 53% (1972/3703) of the non-Vietnam veterans participated. In both groups, telephone interview participation rates were high — 85% for the Vietnam cohort and 84% for the non-Vietnam cohort. Most of the loss in participation and the greatest differential between the two groups occurred at the telephone interview-to-examination step.

Given the overall participation rate and the differential participation rates between the two groups, factors that may have influenced participation in the two groups need to be carefully evaluated. Fortunately, much information is available from the military records and the telephone interviews that allows us to consider how examination participants may have differed from the entire eligible sample of potential participants.

Table 3.1 Examination Participation Among Vietnam and Non-Vietnam Veterans at Various Stages From Selection to Examination

	Vietnam		Non-Vietnam		Total	
	No.	%	No.	%	No.	%
Selected for examination	3745	100	3703	100	7448	100
Participated in telephone interview	3317	89	3126	84	6443	87
Participated in examinations	2490	66	1972	53	4462	60

One way to evaluate factors that influenced participation in the examinations is to examine the reasons for not participating. The reasons for not obtaining a telephone interview were similar in both study groups (Table 3.2). Half of those not interviewed simply could not be located. Of those who were located but not interviewed, the main reason was that they refused the interview. Only a few participants in each group were incapable of participating in the interview because of a health-related reason. Ten veterans, four Vietnam and six non-Vietnam, had died after December 31, 1983, the date chosen for terminating vital status ascertainment in the mortality component of the VES. Twelve of the Vietnam veterans and 14 of the non-Vietnam veterans were in jail during the time the VES interviews were being conducted and thus were not eligible to participate. Four Vietnam and four non-Vietnam veterans were unable to be interviewed because of a mental handicap or because they were placed in a mental institution.

Among those interviewed by telephone but not undergoing the medical examination, reasons for not participating were similar in the two groups (Table 3.3). The most common reasons were work related. Examples include the following: the veteran could not get leave with pay from his job; the veteran was self-employed and could not afford to leave his job; the veteran was newly employed and could not jeopardize his job. The next most frequent reason for nonparticipation was having no interest in the study. Responses included the following: the veteran did not believe participation would benefit him; the veteran did not care about any benefits the study might have for veterans in general; and the veteran could not be bothered, was too busy, or felt the study was a waste of time. Personal reasons were also a leading cause for nonparticipation. This category included these reasons: the veteran did not like to travel; the veteran was suspicious of physicians, the government, the Army, the Veterans Administration, and the like; the veteran felt some bitterness regarding his Army service; and the veteran had a fear of undergoing a physical examination. Only a few veterans in either group gave health-related reasons for not participating. Two participants in each group died after the telephone interview and before being able to participate in the examination.

Another way to evaluate factors that influenced participation is to compare participation rates according to various military history characteristics and selected items from the telephone interview. We made these comparisons to determine if specific characteristics were associated with substantial differences in rates of participation between the two groups and to determine what influence the differences may have had on the characteristics of the examination participants compared with all potential participants.

Table 3.2 Reasons for Not Participating in Telephone Interview Among Vietnam and Non-Vietnam Veterans Selected for Examinations

Reason	Vietnam		Non-Vietnam	
	No.	%	No.	%
Unable to contact	250	58	337	58
Refused	157	37	215	37
Prison	12	3	14	2
Deceased after 12/31/83	4	—	6	—
Mental handicap	3	—	4	—
Physical handicap	1	—	1	—
Mental institution	1	—	0	—
Total	428	100	577	100

Table 3.3 Primary Reasons for Not Participating in Examinations Among Vietnam and Non-Vietnam Veterans Interviewed by Telephone

Reason	Vietnam		Non-Vietnam	
	No.	%	No.	%
Work-related	295	36	453	39
No interest	299	37	441	38
Personal reasons	185	22	200	17
Illness	31	4	31	3
Deceased	2	—	2	—
Active military duty	4	—	2	—
Unknown	11	1	25	2
Total	827	100	1154	100

Military history information, derived from military records completed during active duty in the Army, was available on all veterans who were selected to participate in the medical examination. Differences in participation rates according to the military history characteristics were, for the most part, not large, and the distributions of military history characteristics for examination participants compared with all veterans selected for examination were similar (Table 3.4). Even for those variables that had the greatest influence on participation rates (type of discharge, discharge rank, general technical score), the distributions among the examination participants differed little from those among all veterans selected for examination.

A great deal of additional information is available from the telephone interviews for use in determining how the examination participants may have differed from the sample of veterans selected for examination. Although telephone interviews were not obtained from all veterans selected for examination, they were obtained for over 85%. Since the biggest loss in partic-

Table 3.4 Comparison of Characteristics^a of Vietnam and Non-Vietnam Veterans Selected for Examination With Those of Veterans Undergoing Examination

Characteristic	Proportion (%) With Characteristic			
	Vietnam		Non-Vietnam	
	Selected (N = 3745)	Examined (N = 2490)	Selected (N = 3703)	Examined (N = 1972)
Race, White	87	82	87	81
Age at Entry, 16-19 Years	52	52	47	45
Enlistment Status, Drafted	63	62	67	65
Primary MOS, Tactical	34	34	27	25
Enlistment GT Score				
0-89	26	23	23	21
90-109	33	32	32	29
110-129	30	32	32	34
130-160	9	10	13	15
Year of Entry				
1965-66	34	33	37	37
1967-69	56	56	39	38
1970-71	10	10	25	25
Pay Grade at Discharge, E4-E5	89	91	81	84
Discharge, Honorable	97	98	91	93

^a Information obtained from military records completed during active duty.

ipation occurred at the telephone interview-to-medical examination step, much is known about the characteristics of most veterans who did not participate in the examinations.

The modest influence of most of the demographic, socioeconomic, and lifestyle characteristics on participation rates in both cohorts is reflected in the similar distributions of these characteristics among those examined relative to the entire sample of telephone interview participants selected for examination (Table 3.5). The distribution of educational levels was not markedly different, even though with this variable, participation rates for the two cohorts differed most. The effect was largest in the most highly educated (16 or more years of education) non-Vietnam veteran category, but the increase was only 4% – from 21% for the interview participants to 25% for the examination participants. The prevalence of current

Table 3.5 Comparison of Demographic, Socioeconomic, and Lifestyle Characteristics^a of Vietnam and Non-Vietnam Veterans Selected for Examination and Interviewed by Telephone With Those of Veterans Undergoing Examination

Characteristic	Proportion (%) With Characteristic			
	Vietnam		Non-Vietnam	
	Interviewed (N = 3317)	Examined (N = 2490)	Interviewed (N = 3126)	Examined (N = 1971)
Race				
White	83	82	82	81
Black	11	11	11	12
Other	6	6	7	7
Age at Interview				
30-34	8	9	15	16
35-39	74	74	61	60
≥40	17	17	23	23
Married	75	73	75	74
Education (Years)				
0-11	15	14	12	10
12-15	68	67	67	65
16-18	17	19	21	25
Unemployed	9	10	9	9
Income (\$1,000)				
<10	9	10	9	10
10-30	46	46	44	44
30-50	32	32	32	32
>50	10	10	13	12
Current Residence				
Midwest	28	29	29	29
Northeast	18	16	17	16
South	34	33	33	33
West	19	20	19	20
Foreign	1	1	1	2
Cigarette Smoker	45	45	43	42
Alcohol Use (Avg. Drinks/Mo.)				
0-29	54	53	58	57
30-89	27	28	26	27
≥90	18	18	14	15
Illicit Drug Use (Past Year)				
None	88	86	91	89
Marijuana only	10	10	7	9
Other	2	3	1	1

^a Information obtained from telephone interview.

cigarette smokers was essentially the same in the interview sample and the examination sample. Reported use of alcohol and illicit drugs was similar among examination participants and all telephone interview participants selected for the examination.

In general, in both study cohorts some increase in participation rates was associated with most of the health conditions reported in the telephone interview. The higher participation rates among those reporting certain medical conditions, however, did not markedly alter, in either cohort, the prevalence of these conditions among those examined compared with those selected for examination and interviewed by telephone (Table 3.6). Most of the conditions tended to increase on the order of 1 or 2 percentage points at the most. More importantly, prevalence ratios for the Vietnam group relative to the non-Vietnam group were not appreciably changed in the examination sample compared with the interview sample. For nearly all the conditions, the prevalence ratio remained the same or changed only by 0.1. For example, the prevalence ratio of fair-to-poor perceived health was 1.7 for the interview participants and 1.8 for the examination participants. Similarly, the ratio for any hospitalization remained at 1.1 for those interviewed and those examined, whereas the ratio for any physical impairment only changed from 1.2 to 1.1. Those conditions that had the largest change in prevalence ratios were relatively rare. For any malignancy, the prevalence ratio

Table 3.6 Comparison of Medical History Characteristics^a Among Vietnam and Non-Vietnam Veterans Selected for Medical Examination and Interviewed by Telephone With Those Among Veterans Undergoing Examination

Medical History Characteristic	Proportion (%) With Characteristic				Prevalence Ratio	
	Vietnam		Non-Vietnam		Vietnam/Non-Vietnam	
	Interviewed (N=3317)	Examined (N=2490)	Interviewed (N=3126)	Examined (N=1972)	Interviewed	Examined
Perceived health status fair or poor	19	20	11	11	1.7	1.8
Hospitalized in Army	44	45	32	34	1.4	1.3
Hospitalized since discharge	50	52	46	49	1.1	1.1
Counseling for drug, alcohol, emotional problem (past year)	12	13	8.4	9.8	1.4	1.3
Treatment for drug, alcohol, emotional problem (past year)	3.3	3.8	2.5	2.8	1.3	1.4
Any physical impairment	26	27	22	24	1.2	1.1
Current medication use	19	20	17	18	1.1	1.1
Hypertension	26	26	22	22	1.2	1.2
Malignant cancer (since discharge)	1.6	1.9	1.4	1.4	1.1	1.4
Benign growths (since discharge)	20	21	18	20	1.1	1.0
Diabetes	1.7	1.9	1.4	1.5	1.2	1.3
Any skin condition (since discharge)	32	34	21	23	1.5	1.5
Chloracne	1.7	1.9	0.4	0.4	4.3	4.8
Gastric or peptic ulcer	11	12	10	10	1.1	1.2
Hepatitis or jaundice	6.1	6.4	4.7	5.4	1.3	1.2
Liver cirrhosis	0.7	0.7	0.5	0.6	1.4	1.2
Urinary condition (since discharge)	16	17	14	16	1.1	1.1
Fertility difficulties	21	22	16	16	1.3	1.4

^a Information obtained from telephone interview.

increased from 1.1 for the interview sample to 1.4 for the examination sample, and the ratio for history of chloracne increased from 4.3 to 4.8. Even for these conditions, the changes were not great, and since the conditions are rare, the changes should have very little effect on other examination findings.

As part of the telephone interview, participants were asked a series of questions on neuromuscular symptoms that they might have experienced during the 4 weeks before the interview. The prevalences for all the symptoms were similar for the examination sample compared with the entire sample of telephone interview participants selected for examination, with only a slight increase in prevalence among those examined (Table 3.7). All the prevalence ratios were essentially the same.

For both cohorts, we found an association between experiencing certain psychological symptoms during the 6 months before the telephone interview and participating in the examinations. The symptoms were related primarily to stress, anxiety, depression, memory, and concentration. For all psychological symptoms, the prevalence of participants in whom symptoms occurred frequently was higher for the examination sample than for the interview sample in both cohorts, but the amount of increase was modest, about 1 to 3 percentage points at the most (Table 3.8). The prevalence ratios for most of the symptoms were virtually unchanged. The largest changes were for memory problems and for feelings that life is meaningless, for which the prevalence ratios decreased from 2.0 to 1.8 or 1.7.

Attitudes, feelings, and memories regarding the Army were associated with differential participation rates. In both groups, participation rates tended to be higher for veterans with negative or unpleasant feelings or memories about the Army. Even though those with the least favorable attitude toward or memories of the Army were more likely to participate, the representation of such veterans in the examination sample was only a little different from that in the interview sample (Table 3.9). For the most part there was less than a one percentage point increase in the prevalence of participants with such feelings in either study cohort.

Results of an analysis of responses to questions asked only of Vietnam veterans indicated that the distribution of men with different reported characteristics or experiences unique to service in Vietnam was similar in the examination and interview samples (Table 3.10). These characteristics included having volunteered to serve in Vietnam, the reported level of combat experienced, having been wounded, self-perceived exposure to herbicides while in Vietnam, and the belief of having health problems as a consequence of having been exposed to Agent Orange while in Vietnam.

Table 3.7 Comparison of Reported Neuromuscular Symptoms^a Among Vietnam and Non-Vietnam Veterans Selected for Medical Examination and Interviewed by Telephone With Those Among Veterans Undergoing Examination

Symptom ^b	Proportion (%) With Symptom				Prevalence Ratio Vietnam/Non-Vietnam	
	Vietnam		Non-Vietnam		Interviewed	Examined
	Interviewed (N=3317)	Examined (N=2490)	Interviewed (N=3126)	Examined (N=1972)		
Headaches	21	22	13	15	1.6	1.5
Muscle twitching	16	17	8	9	2.0	1.3
Dizziness	17	18	10	11	1.7	1.3
Numbness	30	31	20	22	1.5	1.4
Weakness	21	24	14	16	1.5	1.5
Soreness	34	35	26	28	1.3	1.3
Ringings in ears	27	28	18	19	1.5	1.5

^a Information obtained from telephone interview.

^b Occurring during the 4 weeks preceding telephone interview.

Table 3.8 Comparison of Reported Psychological Symptoms^a Among Vietnam and Non-Vietnam Veterans Selected for Examination and Interviewed by Telephone With Those Among Veterans Undergoing Examination

Symptom ^b	Proportion (%) With Symptom				Prevalence Ratio	
	Vietnam		Non-Vietnam		Vietnam/Non-Vietnam	
	Interviewed (N=3317)	Examined (N=2490)	Interviewed (N=3126)	Examined (N=1972)	Interviewed	Examined
Difficulty sleeping	31	33	19	22	1.6	1.5
Problems concentrating	19	21	9	10	2.1	2.1
Memory problems	18	20	9	11	2.0	1.8
Short-tempered	35	35	20	20	1.8	1.8
Loss of interest	20	22	11	12	1.8	1.8
Felt life meaningless	12	12	6	7	2.0	1.7

^a Information obtained from telephone interview.

^b Occurring frequently during the 6 months preceding telephone interview.

Table 3.9 Comparison of Reported Memories and Attitudes^a Concerning Prior Army Service Among Vietnam and Non-Vietnam Veterans Selected for Examination and Interviewed by Telephone With Those Among Veterans Undergoing Examination

Army Memories and Attitudes ^b	Proportion (%) With Memory or Attitude			
	Vietnam		Non-Vietnam	
	Interviewed (N=3317)	Examined (N=2490)	Interviewed (N=3126)	Examined (N=1972)
Avoid Army reminders	15	16	4	5
Painful Army memories	11	12	3	4
Felt shame about Army	8	8	2	3
Felt anxious about Army	8	9	3	3

^a Information obtained from telephone interview.

^b Occurring frequently.

3.2 CHARACTERISTICS OF EXAMINATION PARTICIPANTS

In this section we compare the characteristics of the veterans who participated in the examinations according to cohort status. The two groups are compared on the basis of military history, demographic and socioeconomic characteristics, reported childhood behavior problems, and social support and satisfaction with personal relationships.

The Vietnam and non-Vietnam veterans' characteristics at entry into the Army and selected military service characteristics are compared in Table 3.11. The racial distributions in the two groups were virtually the same. Vietnam veterans tended to be younger at entry into the Army, and they were more likely to have entered the service during the years 1967 to 1969, to have had a tactical military occupational specialty (MOS), and to have volunteered for military service. The distribution of enlistment general technical (GT) scores was somewhat higher for non-Vietnam veterans. The biggest differences between the two cohorts were in discharge rank and type of discharge, with more non-Vietnam veterans having lower ranks at discharge and other than honorable discharges.

Reported childhood behavior problems were similar in the two cohorts (Table 3.12). Behavioral problems in childhood may be an indicator of psychological problems in adult life. On the basis of information reported during the Diagnostic Interview Schedule (DIS)

Table 3.10 Comparison of Reported Army Service-Related Characteristics^a of Vietnam Veterans Selected for Examination and Interviewed by Telephone With Those Among Vietnam Veterans Undergoing Examination

Characteristic	Proportion (%) Reporting Characteristic	
	Interviewed (N = 3317)	Examined (N = 2490)
Volunteered for Vietnam	21	22
Reported Combat Experience		
Minimal	25	24
Low	25	25
Moderate	23	23
High	25	25
Wounded	8	9
Perceived Herbicide Exposure		
None	44	42
Indirect	31	31
Direct	26	27
Health Problems Believed to be Agent Orange-Related	16	18

^a Information obtained from telephone interview.

Table 3.11 Comparison of Selected Demographic and Military Service Characteristics^a Among Vietnam and Non-Vietnam Veterans Undergoing Examination

Characteristic	Proportion (%) With Characteristic	
	Vietnam (N = 2490)	Non-Vietnam (N = 1972)
Race		
White	82.5	81.1
Black	11.5	12.1
Other	6.0	6.8
Age at Entry		
16-19	52.3	45.4
20-33	47.8	54.6
Year of Entry		
65-66	33.3	36.8
67-69	56.2	37.7
70-71	10.5	25.5
General Technical Score		
40-89	23.2	21.3
90-109	32.4	28.9
110-129	32.4	34.2
130-160	10.3	15.3
Primary MOS		
Tactical	34.0	25.3
Other	66.0	74.7
Type of Enlistment		
Drafted	61.7	64.9
Enlisted	38.3	35.1
Pay Grade at Discharge		
E1-E3	9.4	16.4
E4-E5	90.6	83.6
Vpe of Discharge		
Honorable	98.2	93.5
Other	1.9	6.5

^a Information obtained from military records completed during active duty, except for race designation for which information from the telephone interview was used.

Table 3.12 Comparison of Reported Childhood Behavior Problems^a Among Vietnam and Non-Vietnam Veterans Undergoing Examination

Reported Problem	Proportion (%) With Characteristic	
	Vietnam (N=2490)	Non-Vietnam (N=1972)
Poor grades	14.0	13.0
Expelled or suspended	10.6	12.5
Trouble due to fighting at school	16.3	16.0
Ran away from home ^b	2.4	3.3
Arrested as a juvenile	6.3	5.8

^a Information obtained from the Diagnostic Interview Schedule, refers to problems that occurred when veteran was <15 years old.

^b More than one time.

interview, Vietnam veterans did not differ from non-Vietnam veterans in the number of behavioral problems in childhood or adolescence, including expulsions or suspensions from school, running away from home, or arrests.

The current demographic and socioeconomic characteristics of the Vietnam cohort examination participants were generally similar to those of the non-Vietnam cohort (Table 3.13). The age at examination was slightly different, with about three quarters of the Vietnam group being in the 35- to 39-year category compared with only 60% of the non-Vietnam group. One of the larger differences was in education: the educational level tended to be higher in the non-Vietnam group. The income categories tended to be the same for the two groups, except that a slightly higher proportion of non-Vietnam veterans were in the greater-than-\$50,000-per-year category. Marital status and region of residence were virtually the same in the two cohorts. More non-Vietnam veterans were employed in executive, managerial, or administrative positions or had a professional specialty. Except for this difference, current occupation was the same for the two cohorts.

Use of alcohol or illicit drugs and having received counseling or treatment for an alcohol or drug problem were reported at similar frequencies in the two groups (Table 3.14). Just over 60% of Vietnam and non-Vietnam veterans reported consuming alcoholic beverages. About 13% of Vietnam veterans and 11% of non-Vietnam veterans reported heavy use of alcohol (≥ 90 drinks per month). Slightly more Vietnam (43%) than non-Vietnam veterans (40%) also reported having had five or more drinks on one occasion during the month before examination (binge drinking). A similar proportion (14%) of men in both reported cohorts having driven after having had too much to drink on at least one occasion during the previous month. About three-quarters of the men in each cohort reported no use of illicit drugs during the year before examination, and among those who reported using drugs, most had used marijuana only. Counseling or treatment for an alcohol or drug problem during the year before examination was reported by about 1 in 10 veterans in each group.

Indicators of social support were also similar for the two cohorts (Table 3.15). The marital status distributions were virtually the same, with about three-quarters of the men being currently married, 17% separated or divorced, and 9% never married. About two-thirds of Vietnam and non-Vietnam veterans had been married only once. The two groups of veterans also had similar numbers of children living with them and similar numbers of immediate family members and friends living near them. Over 90% of veterans in each group expressed

Table 3.13 Comparison of Selected Current Demographic Characteristics^a Among Vietnam and Non-Vietnam Veterans Undergoing Examination, by Place of Service

Characteristic	Proportion (%) With Characteristic	
	Vietnam (N = 2490)	Non-Vietnam (N = 1972)
Age at Exam		
30-34	6.5	13.1
35-39	72.4	59.4
40-48	21.1	27.5
Education		
0-11	13.7	10.1
12-15	67.4	64.9
16-18	18.9	25.0
Income (\$1,000)		
< 10	9.8	9.8
10-30	46.2	44.3
30-50	32.3	31.8
> 50	9.8	12.2
Marital Status		
Married	73.8	73.6
Other	26.2	26.4
Current Residence		
Midwest	29.2	29.2
Northeast	16.4	15.6
South	33.4	33.3
West	19.8	20.3
Foreign	1.2	1.7
Occupation		
Executive, managerial	18.3	20.9
Professional specialty	10.7	14.3
Office, clerical, sales	7.9	7.7
Service, transportation	12.5	10.7
Precision production, craft, repair	21.9	20.9
Operators, laborers	16.2	14.5
Farming, foresters, fishermen	3.0	2.2
Unemployed	9.3	8.6

^a Information obtained from telephone interview and medical history at examination.

some satisfaction with their family and friend relationships, although more non-Vietnam (53%) than Vietnam (49%) veterans said they were very satisfied. The extent to which the veterans felt that they could rely on family and friends was similar in the two cohorts.

3.3 CONCLUSIONS

The study met its overall goal of a 60% examination participation rate, but participation rates for the two cohorts differed (66% for the Vietnam cohort versus 53% for the non-Vietnam cohort). The degree of nonparticipation and the differing participation rates raise questions about how representative the examination participants were of the veterans selected for examination and about selection bias. However, detailed analyses of the reasons for not participating and the characteristics that influenced participation did not reveal any markedly different characteristics or health histories among examination participants compared with all veterans selected for examination.

The reasons for not participating and the characteristics that influenced participation were similar for both groups. The biggest loss to participation and the largest differential in

Table 3.14 Reported Current Use of Alcohol and Illicit Drugs^a by Vietnam and Non-Vietnam Veterans Undergoing Examination

Behavior	Vietnam		Non-Vietnam	
	%	No.	%	No.
Cigarette Smoking				
Never	24.9	619	27.5	543
Ex-smoker	28.7	715	29.3	577
Current	46.4	1156	43.2	352
Alcohol Use				
Drinks per month				
0-29	60.9	1516	62.6	1235
30-89	25.5	634	26.1	514
≥90	13.2	328	10.5	207
Binge drinking ^b	43.3	1079	40.4	797
Drink and drive ^c	14.3	356	13.8	273
Illicit Drug Use, Past Year				
None	74.0	1843	72.9	1438
Marijuana only	14.1	351	16.4	324
Other	11.7	292	10.5	207
Counseling or Treatment For Drug or Alcohol Problem	11.0	273	9.5	187

^a From the medical history questionnaire administered during the medical examination.

^b Had five or more drinks on at least one occasion in the previous month.

^c Drove after having had too much to drink on at least one occasion in the previous month.

participation rates occurred during the interview-to-examination step. For the most part, reasons for not participating in the telephone interview or the medical examinations were not health related. The nonparticipation in the examinations was mainly related to an inability or unwillingness to take time away from work or having no interest in the study. Among the military history characteristics, those that had the largest influence on participation rates were type of discharge, discharge rank, and general technical (GT) score; nonetheless, the distribution of these characteristics was not markedly different in the examination sample compared with the entire sample of men selected for examination.

Telephone interview information indicates that similar factors affected participation rates for both cohorts. In both groups, participation rates increased with education, rates for those with more education were higher, but this trend was more pronounced in the non-Vietnam cohort.

In both groups participation rates for veterans who reported a history of several specific health problems tended to be higher than rates for veterans who did not report such histories. However, the higher participation rates among these veterans did not appreciably change the prevalence of reported medical conditions for either examination group. For the most part, the prevalence of each condition increased only 1 or 2 percentage points in the examination sample relative to the interview sample. The presence of psychological symptoms related to stress, anxiety, and depression had a similar effect upon participation. In both cohorts those who reported frequently experiencing these symptoms were more likely to participate. This trend, however, did not result in a large increase in the frequency of the symptoms among those examined. More importantly, since the increased participation associated with the medical and psychological variables was similar in both groups, the prevalence ratios for these conditions remained the same for the examination sample and the interview sample.

Table 3.15 Extent of Social Support Among Vietnam and Non-Vietnam Veterans

Characteristic	Vietnam		Non-Vietnam	
	%	No.	%	No
Marital Status				
Married	73.8	1837	73.7	1452
Widowed	0.4	10	0.6	12
Separated	3.5	86	3.4	67
Divorced	13.7	342	13.8	273
Never married	8.6	215	8.5	163
Number of Marriages				
0	8.6	215	8.5	163
1	67.3	1675	66.9	1320
2	19.2	478	20.8	409
≥3	4.9	122	3.8	75
Number of Children < 18 Years of Age Living With Veteran				
0	29.4	733	30.3	593
1-2	49.4	1229	49.2	970
3-4	19.6	488	18.4	362
≥5	1.6	40	2.1	42
No. Immediate Family Members Living Within One Hour Drive of Home				
0	20.4	508	22.9	451
1-4	45.6	1136	44.8	883
5-9	25.4	633	23.8	470
≥10	8.6	213	8.6	163
No. Immediate Family Members Living Over One Hour Drive of Home				
0	26.7	664	24.8	490
1-4	49.6	1235	51.3	1011
5-9	17.5	436	17.8	350
≥10	6.2	155	6.1	121
No. Friends Living Within One Hour Drive of Home				
0	8.1	203	7.6	150
1-4	44.1	1097	44.0	863
5-9	24.8	617	23.2	453
≥10	23.0	573	25.2	493
How Often Are Friends and Relatives Seen?				
Too often	3.2	79	3.7	73
About right amount	68.5	1705	67.0	1322
Not often enough	28.4	706	29.3	577
How Satisfied With Family and Friend Relationships?				
Very satisfied	48.7	1213	52.6	1033
Somewhat satisfied	44.9	1118	40.5	793
Somewhat dissatisfied	5.4	134	5.9	113
Very dissatisfied	1.0	24	1.0	19
How Often Can at Least Some of Friends and Family Be Counted on in Times of Trouble?				
Most of the time	86.0	2141	88.2	1743
Some of the time	10.9	271	9.3	183
Hardly ever	3.1	77	2.5	49

The characteristics at entry into the Army were generally similar among the Vietnam and non-Vietnam examination participants, although the Vietnam veterans tended to be younger at entry and had somewhat lower GT scores. The racial distribution of the two cohorts was

nearly the same. In addition, Vietnam and non-Vietnam veterans reported childhood behavior problems, which may have been predisposing factors for psychological problems later, with similar frequency.

The two cohorts differed somewhat in the military history characteristics of the veterans who underwent examination. Most of these differences can be related to the strategic and personnel requirements of the Vietnam conflict. Therefore, it is not surprising that the Vietnam group had a higher proportion of men with a tactical MOS or that more of the Vietnam veterans entered the Army in 1967-1969, a period of military buildup in Southeast Asia.

Contrary to the differences in military history characteristics, the current demographic and socioeconomic characteristics of the two cohorts were similar. The groups were essentially the same with regard to several important demographic and socioeconomic characteristics, except that the educational level of the non-Vietnam group tended to be somewhat higher. This may partially reflect the greater role educational level seems to have played in determining participation by non-Vietnam veterans, as well as the non-Vietnam veterans' somewhat higher enlistment GT scores. Vietnam and non-Vietnam veterans also reported similar social support characteristics and similar satisfaction with relationships with family members and friends.

In conclusion, we did not identify any factors related to participation that would be expected to have a large influence on findings concerning the psychological status of the two cohorts. Compared with those who were selected for examination, those who participated tended to be slightly better educated and more frequently reported certain medical or psychological conditions. Nonetheless, these increased participation rates had little effect on the prevalence rates of the conditions among the examination participants compared with the interview participants or on the prevalence ratios for these conditions. Some of the differences between the cohorts in military history characteristics were not unexpected. As noted in Chapter 2, we anticipated differences in these characteristics and, therefore, included them as potential confounders in all multivariate analyses. The similarities in the current demographic and socioeconomic characteristics of the two cohorts are encouraging and indicate that these characteristics should not have much influence on the relative findings for the two cohorts.

CHAPTER 4

Diagnostic Interview Schedule Results

