Published in final edited form as:

Psychol Med. 2006 October ; 36(10): 1405–1415. doi:10.1017/S0033291706008348.

First psychiatric hospitalizations in the US military: the National Collaborative Study of Early Psychosis and Suicide (NCSEPS)

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Abstract

Background—Military samples provide an excellent context to systematically ascertain hospitalization for severe psychiatric disorders. The National Collaborative Study of Early Psychosis and Suicide (NCSEPS), a collaborative study of psychiatric disorders in the US Armed Forces, estimated rates of first hospitalization in the military for three psychiatric disorders : bipolar disorder (BD), major depressive disorder (MDD) and schizophrenia.

Method—First hospitalizations for BD, MDD and schizophrenia were ascertained from military records for active duty personnel between 1992 and 1996. Rates were estimated as dynamic incidence (using all military personnel on active duty at the midpoint of each year as the denominator) and cohort incidence (using all military personnel aged 18–25 entering active duty between 1992 and 1996 to estimate person-years at risk).

Results—For all three disorders, 8723 hospitalizations were observed in 8 120 136 person-years for a rate of 10·7/10 000 [95% confidence interval (CI) 10·5–11·0]. The rate for BD was 2·0 (95% CI 1·9–2·1), for MDD, 7·2 (95% CI 7·0–7·3), and for schizophrenia, 1·6 (95% CI 1·5–1·7). Rates for BD and MDD were greater in females than in males [for BD, rate ratio (RR) 2·0, 95% CI 1·7–2·2; for MDD, RR 2·9, 95% CI 2·7–3·1], but no sex difference was found for schizophrenia.

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†Dr Richard J. Wyatt, Chief of the Neuropsychiatry Branch at NIMH, where this study was conducted, passed away on 7 June 2002. We dedicate this paper to him.

DECLARATION OF INTEREST

None.

Blacks had lower rates than whites of BD (RR 0.8, 95% CI 0.7–0.9) and MDD (RR 0.8, 95% CI 0.8–0.9), but a higher rate of schizophrenia (RR 1.5, 95% CI 1.3–1.7).

Conclusions—This study underscores the human and financial burden that psychiatric disorders place on the US Armed Forces.

INTRODUCTION

Because of the size and relative youth of their cohorts, military samples provide an opportunity to systematically ascertain hospitalization for severe psychiatric disorders during the peak period of incidence for these disorders. Several international studies have examined military cohorts to explore risk factors for the development of psychiatric disorders (Allebeck & Allgulander, 1990; David *et al.* 1997; Davidson *et al.* 1999; Gunnell *et al.* 2002; Wyatt *et al.* 2003; Ang & Tan, 2004; Gheorge *et al.* 2004).

Although many recent studies have explored the significant human and financial burden that mental disorders place on the US military (Hoge *et al.* 2002, 2004, 2005; Cigrang *et al.* 2003; Friedman, 2004), few hospitalization studies of these disorders have been conducted in US military samples. Nevertheless, the US Armed Forces does collect information that can be used to study hospitalization for major psychiatric illnesses. Because demographic, occupational, and health data are kept for all US soldiers in electronic records, the military environment allows for thorough ascertainment of cases. Moreover, few populations offer such accurate denominator data (Hoge *et al.* 2003, 2005). Active duty personnel usually receive their in-patient medical care from military facilities – only 2% of military personnel are treated in civilian facilities (Hoge *et al.* 2002) – and serious psychiatric disorders typically are identified early and treated by hospitalization (Hoge *et al.* 2005). In addition, military medical personnel use standard diagnostic criteria for psychiatric disorders. Rates of first hospitalization using US military data are thus more likely to ascertain cases of severe psychiatric disorders than community hospital samples. Finally, treatment in this context is less likely to be racially biased than in other settings (Taylor *et al.* 1997; Dominitz *et al.* 1998; Farley *et al.* 2001; Deswal *et al.* 2004; Greenberg & Rosenheck, 2004).

The National Collaborative Study of Early Psychosis and Suicide (NCSEPS) is a project conducted by the National Institute of Mental Health – National Institutes of Health (NIMH-NIH) in conjunction with the US Department of Defense (DoD) and the Department of Veterans Affairs (VA). The project aims to assess mental illness and disability in the US Armed Forces and focuses on three major disorders : bipolar disorder (BD), (non-bipolar) major depressive disorder (MDD) and schizophrenia. This paper reports rates of first hospitalization for these disorders and their sociodemographic correlates in the US Armed Forces between 1992 and 1996. During the years of interest for this study, the US was involved in several peace-keeping missions, but not in any large-scale military efforts, and the annual number of soldiers joining the military remained relatively constant (Department of Defense High School News Service, 2002).

METHOD

Sample

The cases of interest in this study are persons in military service who were hospitalized for BD, MDD or schizophrenia while on active duty (i.e. in full-time military service) between 1992 and 1996 in any of the US military service branches (Army, Navy, Marines or Air Force). During this period, military service in the US Armed Forces was voluntary. Most recruits enlist between the ages of 18 and 22; a typical tour of duty lasts 2 to 6 years (Department of Defense High School News Service, 2002). Enlistees are given a brief mental status examination at entrance, and individuals with serious preexisting psychiatric illness are prohibited from enlisting (United States General Accounting Office, 1997).

The Patient Administration Systems and Biostatistics Activity (PASBA, Fort Sam Houston, TX, USA), provided hospital discharge diagnoses and dates of hospitalization for all US military hospitals worldwide. Individuals who received a first diagnosis for BD, MDD or schizophrenia in these years comprise the numerator for the rates presented here. The Defense Manpower Data Center (DMDC, Monterey, CA, USA) provided demographic information such as sex and ethnicity, as reported at entry, for these patients. The data required to estimate person-years at risk since entry to the military were also provided by the DoD.

Approval for this project was granted by the NIMH Institutional Review Board (IRB) for the NCSEPS and by the IRB of the Walter Reed Army Medical Center (WRAMC) for the reliability study (described below). To maintain confidentiality in assembling and analyzing these data, all information about the patients was processed using newly assigned codes unrelated to any personal identifiers.

Measures

Psychiatric disorders—For the purpose of this study, *primary diagnosis* refers to one of the three severe psychiatric disorders that form the sampling scheme: BD, MDD and schizophrenia. It represents the diagnosis given in the last hospital discharge in the military for each individual. If a patient had multiple hospital admissions with differing diagnoses, the last was selected as the best measure of psychiatric status. Date of hospitalization is the date when the patient was first hospitalized in the DoD for one of the three primary diagnoses regardless of whether the patient had previous in-patient hospitalizations, including any for medical diagnoses, substance abuse or other psychiatric disorders.

DSM-III-R and DSM-IV diagnostic criteria (APA, 1987, 1994) were used by military hospitals during the study years. Patients receiving DSM diagnostic codes 296-0, or 296-4 through 296-8, were classified as having BD; those with codes 296-2 and 296-3 were classified as having MDD; and those with codes 295-0 through 295-9 (which includes schizophreniform and schizo-affective disorders) were classified as having schizophrenia. Individuals who received a diagnosis of Mood Disorder NOS (296-9), Brief Psychotic Disorder (298-8) or Psychotic Disorder NOS (298-9) were not included in this study.

Diagnostic reliability was determined by an independent review of Medical Boards for 71 patients who had psychiatric hospitalizations at WRAMC[†]. The findings of the WRAMC Medical Board usually mirror the last hospital discharge diagnosis. There was complete agreement between our review and the discharge diagnoses from WRAMC. The Department of Defense diagnoses were compared with the consensus diagnosis of two non-military psychiatrists blind to the Medical Board diagnosis. Patients were given a diagnosis of BD, MDD, schizophrenia, or 'other' according to DSM-IV criteria (APA, 1994). Inter-rater reliability between the masked diagnosis and the last hospital diagnosis was excellent ($\kappa=0.84$), thus justifying the use of last hospitalization diagnosis in this study.

Rates of first hospitalization in the military—Rates of first hospitalization were computed in two ways: using dynamic incidence and cohort incidence. As described below, the denominators (the source populations) and numerators (the hospitalizations) differ between the two methods.

Dynamic incidence—For the calculation of dynamic incidence, the source population (the denominator) was defined as the annual active duty military population for each of the 5 years of interest (1992–1996) assessed on July 1 of each calendar year. This population total provides an estimate of the number of individuals at risk throughout the year and excludes those on reserve status[‡]. The numerators comprised patients who were on active duty and were hospitalized for their primary diagnosis between 1992 and 1996. A total of 8723 patients met these criteria. Age, sex and ethnicity information was available for the numerator at the individual level, but for the denominator, this information was available only at the aggregate level. Thus, the demographic information needed to estimate specific rates of hospitalizations by age category, sex and ethnicity *simultaneously* was not available for this analysis. We were, however, able to compute sex-specific and ethnicity-specific incidence rates for the 18–25 age group. This method has the advantage of being comparable to other incidence studies in the literature. Studies that ascertain all new cases in a defined community over a specified time period are generally of this type.

Cohort incidence—Cohort incidence was introduced as a check on the results obtained in the dynamic incidence analysis. The source population (the denominator) was defined as the military recruits who began active duty between 1 January 1992 and 31 December 1996. Because complete demographic data were available for each military recruit, this method allowed us to compute incidence rates for age, sex and ethnicity simultaneously, and incidence rates could be compared by ethnicity and sex. The data for recruits did not, however, allow us to distinguish between those on active duty and those on reserve status.

The source population for cohort incidence was estimated by drawing a 2% random sample of recruits entering in each of the 60 months of the research period. Each recruit contributed a number of person-years at risk to the denominator, calculated as the time from entry into active duty until hospitalization, discharge or the end of the study period. The sum of

[†]The military convenes a medical board on a case-by-case basis to evaluate whether active duty personnel with physical or psychiatric disabilities should be discharged from the service or reassigned. For individuals with psychiatric disorders, medical board reports are based on a patient interview and chart review, and reflect the consensus diagnosis of three psychiatrists.

[‡]Reservists are members of the Armed Forces who are not on active duty, but who can be called to active duty at any time.

person-years for the 2% sample was then multiplied by 50 to approximate the total person-years in the cohort. Thus, if an individual went on active duty in January 1992 and remained on active duty until the end of 1996, that individual contributed 5 person-years at risk. If an individual went on active duty later than January 1992 or was discharged prior to the end of 1996, that individual contributed fewer than 5 person-years at risk.

Because an unknown number of individuals in the cohort incidence denominator were on reserve status (and therefore ineligible for admission to a military hospital), cohort incidence rates presented here probably underestimate the true rates of these disorders. Nevertheless, by adjusting for age and by assuming that the issue of reservists affected all groups equally, it is possible to use the cohort incidence measure to assess the relative rates (RRs) of these disorders by sex and ethnicity.

The results shown here are restricted to recruits who entered between ages 18 and 25. A total of 1780 patients were identified among these recruits.

Statistical analysis

Rates were computed for both the dynamic and cohort incidence analyses. Dynamic incidence was calculated for each of the 5 years (1992–1996) and then averaged. The incidence rates were stable and therefore not weighted. Cohort incidence was calculated across the 5 years (1992–1996) together. Ninety-five per cent confidence intervals (95% CIs) were obtained using the normal approximation to the binomial distribution (Fisher & van Belle, 1993).

For the dynamic incidence analysis, as noted above, only age-stratified, group-level data on sex and, separately, on the distribution of ethnicity were available; we were nevertheless able to compute sex-specific and ethnicity-specific incidence rates for the 18–25 age group. For the cohort incidence analysis, the availability of individual-level data on demographic characteristics enabled us to compute age-standardized incidence rates. Age-standardized rates in women and blacks were computed using the age distribution of men and whites respectively as standards (i.e. applying direct standardization).

Age at the time of primary hospitalization was calculated for 7920 patients for whom all admission data were available. Differences among age at hospitalization across the index groups were estimated using a one-way analysis of variance (ANOVA).

All analyses were conducted using NCSS (Number Cruncher Statistical Systems 2000).

RESULTS

Total hospitalizations for the three index disorders and estimated person-years at risk are presented in Table 1. In 8 120 136 person-years, 8723 hospitalizations for the index disorders were reported (10.7/10 000 person-years, 95% CI 10.5–11.0).

The results of both analyses are presented in Table 2. Dynamic incidence rates for BD, MDD and schizophrenia for 1992–1996 were 2.0 (95% CI 1.9–2.1), 7.2 (95% CI 7.0–7.3) and 1.6 (95% CI 1.5–1.7) per 10 000 person-years respectively. The incidence of

hospitalization for BD and MDD was greater in females than in males (RR 2.0 for BD, 95% CI 1.7–2.2; RR 2.9 for MDD, 95% CI 2.7–3.1) but no sex difference was found for schizophrenia. Blacks had a lower rate of BD (RR 0.8, 95% CI 0.7–0.9) and MDD than whites (RR 0.8, 95% CI 0.8–0.9) but a higher rate of schizophrenia (RR 1.5, 95% CI 1.3–1.7).

Restricting the dynamic incidence sample to ages 18–25 yielded a similar pattern of results. Incidence rates were 1.9 (95% CI 1.9–2.1), 5.3 (95% CI 5.1–5.5) and 1.9 (95% CI 1.7–2.0) per 10 000 person-years for BD, MDD and schizophrenia respectively. Females had higher rates of BD than males (RR 1.5, 95% CI 1.3–1.9), and blacks had higher rates of schizophrenia (RR 1.5, 95% CI 1.3–1.8).

Cohort incidence rates were 2.4 (95% CI 2.2–2.7), 6.1 (95% CI 5.8–6.8) and 2.2 (95% CI 2.0–2.5) per 10 000 person-years for BD, MDD and schizophrenia respectively (Table 2). The pattern of results was similar to that obtained through the dynamic incidence method, with females exhibiting higher hospitalization rates of affective disorders than males, and blacks exhibiting a higher rate of schizophrenia than whites. The relative rates for sex (female:male, standardized for age) were 1.6 (95% CI 1.4–1.8) for BD, 2.3 (95% CI 2.1–2.5) for MDD and 1.0 (95% CI 0.9–1.2) for schizophrenia. The relative rates for ethnicity (black:white, standardized for age) were 0.7 (95% CI 0.6–0.9) for BD, 0.7 (95% CI 0.6–0.7) for MDD and 1.4 (95% CI 1.2–1.7) for schizophrenia.

Although there was wide variability in age at primary hospitalization within the patient groups, the mean age (years) differed significantly across the patient groups: 26.8 (95% CI 26.4–27.2) for BD, 29.6 (95% CI 29.4–29.8) for MDD and 25.5 (95% CI 25.2–25.8) for schizophrenia [$F(2, 7920)$, $p < 0.001$].

DISCUSSION

This study underscores the contribution of psychiatric disorders to illness and disability in the US Armed Forces. Concerns about prevention and treatment for psychiatrically ill US military personnel predate World Wars I and II (Cruvant, 1943; Halloran & Farrell, 1943; Hitschman & Yarrell, 1943; Berlien, 1954; Steinberg & Durell, 1968; Jones *et al.* 2003; Rona *et al.* 2005), and recent studies suggest that psychiatric problems are among the most common reasons that individuals leave the military (Klein *et al.* 1991; Pullen & Labbate, 1992; Cigrang *et al.* 1998, 2003; Talcott *et al.* 1999; Hoge *et al.* 2002, 2003, 2004; Englert *et al.* 2003). These disorders place a heavy burden – both human and financial – on the afflicted individuals and the military health-care system.

This paper reports rates of first hospitalization for major psychiatric disorders in the US Armed Forces. For schizophrenia and BD, these first hospitalization rates may provide reasonable approximations to incidence rates because, in the US Armed Forces, psychiatric disorders are very likely to be quickly detected and, when severe, are usually treated through in-patient hospitalization (Hoge *et al.* 2005). For MDD, rates of first hospitalization probably underestimate incidence, because milder cases may be either missed or treated on an out-patient basis.

Some of the key findings of this NCSEPS study are similar to those reported by other studies in the US and abroad. For example, the female to male ratio was higher in MDD than in schizophrenia, and the age at admission for this disorder was older than the age at admission for schizophrenia or BD. One less-established finding was that the incidence rate of schizophrenia was higher in blacks than in whites. A more surprising finding was that incidence rates of BD in this sample were higher in females than in males. These findings may shed light on risk factors for major psychiatric disorders, and may inform the planning of mental health services both in the military and following military discharge. Nevertheless, as discussed below, these findings require cautious interpretation.

Hospitalization rates

Few studies of first hospitalization rates exist in large samples with nearly complete ascertainment of cases. Furthermore, these vary widely in their source populations and methods. Although a few studies have looked at rates in military populations, including at least one that looked at rates in the US military, the results of these studies are not comparable to those obtained here. For example, they were limited to new cases appearing in the first few weeks (Beighley *et al.* 1992) or months of service (Cheok *et al.* 2000). Below, we compare dynamic NCSEPS incidence rates for affective disorders and schizophrenia, respectively, with rates from several other studies.

Bipolar disorder

There is a dearth of studies examining rates for BD. Much of this work explores prevalence rather than incidence, and some studies that assessed incidence did not separate BD specifically from affective disorders overall (Goodwin & Jamison, 2006). For males, the NCSEPS BD rate (1.8/10 000 person-years) is generally consistent with that found by other studies. A summary of three European studies found a rate for males between 0.9 and 1.5/10 000 person-years (Goodwin & Jamison, 1990), and a summary of four European studies found rates ranging from 0.2 to 2.2/10 000 person-years (Boyd & Weissman, 1981).

NCSEPS females had a higher rate of BD than males (3.5 v. 1.8/10 000 person-years), a rate that was also higher than that found in most studies of BD. This is inconsistent with other incidence and prevalence studies, where the female to male ratio for BD is close to 1 (Goodwin & Jamison, 1990; Tohen & Goodwin, 1995). One possible explanation is that a greater proportion of high-risk women choose to become members of the Armed Forces, or, once enrolled, are more susceptible to the stress associated with military service (Hourani & Yuan, 1999; Rosen *et al.* 1999).

Major depressive disorder

Incidence rates in studies of non-military populations vary considerably due to variations in population, case ascertainment and diagnostic methods. Few provide rates for the young age groups that predominate in the NCSEPS sample. Nevertheless, one recent long-term study provides a useful point of reference for the NCSEPS data. The 40-year follow-up of the 1952 cohort of the Stirling County Study (Murphy *et al.* 2000) used diagnoses based on a lay-administered structured interview. Rates for participants younger than age 45 (the

youngest age group for whom separate rates are reported) were 46.0/10 000 person-years for females and 28.0 for males.

The rates of MDD in the NCSEPS (7.2/10 000 person-years overall, 5.9 for males, and 16.9 for females) were lower than those reported by the Stirling County Study. One factor that may partly explain the rate differences is age. Patients in the NCSEPS sample are mostly younger than 25, but the median age of onset for MDD is considerably older. The Baltimore Epidemiologic Catchment Area follow-up study, for example, reported that the peak age of onset for MDD is 40 for males and 30 for females (Eaton *et al.* 1997). In addition, as noted above, the NCSEPS sample might have been limited to more severe cases of MDD because all were hospitalized.

Schizophrenia

Comparing incidence rates for schizophrenia with the NCSEPS findings is difficult because of the dearth of dynamic incidence studies using DSM-III-R or DSM-IV diagnostic criteria and the restricted age of the NCSEPS sample (Bresnahan *et al.* 2000). McGrath *et al.* (2004), in a meta-analysis of 55 studies conducted in 25 nations, found that the incidence of schizophrenia varied from 0.77 to 4.3/10 000, with a median value of 1.52/10 000. However, that study concluded that there is substantially more variation in the incidence of schizophrenia than previously believed; factors such as sex, urbanicity and migrant status were all found to significantly impact the distribution of schizophrenia (McGrath *et al.* 2004). The NCSEPS rate of 1.6/10 000 person-years is similar to the median of this meta-analysis, as well as to that of an earlier comprehensive review of incidence studies of schizophrenia (Eaton, 1999).

The most comprehensive data on the incidence of schizophrenia come from the benchmark World Health Organization (WHO) Ten Country Study (Jablensky *et al.* 1990), which investigated six industrialized sites and reported incidence for narrow and broad definitions of schizophrenia under the CATEGO system[†]. Rates of narrowly defined schizophrenia in the WHO study ranged from 1.0 to 3.5/10 000 for men aged 20–24. The NCSEPS dynamic incidence rate for men – 1.6/10 000 – is in keeping with these narrowly defined rates.

The Nottingham Study (Brewin *et al.* 1997) also reported rates for both narrowly (ICD-10) and broadly (schizophrenia and related psychotic disorders) defined schizophrenia. The rate for NCSEPS males (1.6/10 000) was close to that for the 20–29-year-old Nottingham narrowly diagnosed males (2.4/10 000); the rate for NCSEPS females (1.8/10 000) was higher than that for 20- to 29-year-old Nottingham females (0.9/10 000). Overall rates of schizophrenia, however, were almost identical (1.6 v. 1.7/10 000 for NCSEPS and Nottingham 20- to 29-year-olds respectively). At least some recent studies have suggested that the rate of schizophrenia is higher in males than in females; however, these studies have also noted substantial variation in rates depending on the source population (Aleman *et al.* 2003; McGrath *et al.* 2004).

[†]The CATEGO system is an algorithm that classifies Present State Examination (PSE) symptoms, regardless of where in the world they were conducted. The PSE looks at most of the symptoms likely to be experienced by people with functional psychotic disorders in a flexible, but standardized, clinical interview.

In agreement with many prior studies of the ethnic distribution of schizophrenia (Robins & Regier, 1991; Kendler *et al.* 1996; Cannon *et al.* 2000; Mueser & McGurk, 2004; Minsky *et al.* 2003), blacks had a higher rate of schizophrenia than whites in the NCSEPS study. This rate cannot be explained by younger age at entry or by higher turnover of blacks, as there were no differences in age at entry or turnover between whites and blacks in the NCSEPS sample (data not shown). At least one earlier study of US military personnel also obtained a similar result (Dlugosz *et al.* 1999).

One possible explanation for this difference is diagnostic bias (Mukherjee *et al.* 1983; Neighbors *et al.* 1989; Strakowski *et al.* 1996; Minsky *et al.* 2003; Sohler & Bromet, 2003). If black patients with schizophrenia and BD in the NCSEPS sample are added together, their total annual incidence (3.8/10 000 person-years) is similar to the incidence of those two diagnostic categories in whites (3.6/10 000 person-years). However, most studies of both military and VA hospitals have found that, unlike civilian hospitals, their hospital environments are relatively free from racial bias in the treatment of patients (Taylor *et al.* 1997; Dominitz *et al.* 1998; Farley *et al.* 2001; Deswal *et al.* 2004; Greenberg & Rosenheck, 2004). Analyzing a subgroup of NCSEPS patients who sought care through the VA after DoD discharge found few changes in diagnosis for patients with schizophrenia (data not shown). Although more patients received a diagnosis of schizophrenia in the VA than in the DoD, this change was not affected by ethnicity.

Another possible explanation is that schizophrenia has a different presentation in blacks than whites. This could lead to a different degree of case ascertainment or to diagnostic misclassification, thereby producing artefactual differences in incidence for the two groups. Limited evidence does exist that clinicians may have more difficulty diagnosing black patients (Sohler & Bromet, 2003).

Socio-economic status (SES) and other unmeasured characteristics may be confounders in this analysis, although current occupation (but not rank) of all subjects was by definition the same. Nevertheless, available evidence does not suggest either a strong or a consistent association between the SES of the family of origin and risk of schizophrenia (Goldberg & Morrison, 1963; Castle *et al.* 1993; Jones *et al.* 1994; Makikyro *et al.* 1997; Harrison *et al.* 2001; Mulvany *et al.* 2001; Samele *et al.* 2001; Parrott & Lewine, 2005). Finally, these findings may reflect a real difference in the incidence of schizophrenia between blacks and whites.

Strengths and limitations of the study

This study has several limitations. Military subjects are younger and healthier than the general US population and differ from non-military populations in many other ways. Therefore, the results reported here cannot be generalized to the larger population without some caveats.

Although ascertainment of cases in this study was thorough for active duty personnel, it is possible that some early, non-medical discharges from the military are due to incipient psychiatric problems that are either undetectable or not severe enough to require hospitalization. The first few weeks of basic training may serve as an extension of military

screening, in that recruits can more easily receive an administrative discharge. Estimates suggest that between 1% and 6% of new recruits are referred for out-patient mental health evaluations during the first few weeks of basic training (Beighley *et al.* 1992; Cigrang *et al.* 1998; Englert *et al.* 2003), and that approximately 33% to 45% of these individuals receive an administrative discharge from the military (Carbone *et al.* 1999; Cigrang *et al.* 2000). This loss of cases, however, would only be likely to occur very early in training. The majority of psychiatrically ill individuals are discharged after the Armed Forces have made a considerable investment in their training; thus they are likely to be part of this sample (Cigrang *et al.* 2003). Although we have no reason to believe that, after their initial training, a substantial number of psychiatrically ill individuals are discharged before they are diagnosed, this possibility suggests that the rates reported here may slightly underestimate true rates.

Both methods for calculating incidence rates have some limitations. The main limitation of the dynamic incidence estimate is that demographic data were available only at the aggregate level and were not cross-classified by age, sex and ethnicity. However, the cohort incidence estimate was limited because that sample did not take into account individuals on reserve status, thus slightly inflating the denominator and underestimating the incidence rate. Despite these shortcomings, these complementary analyses obtained compatible results for sex and ethnicity, suggesting that the limitations did not distort the main findings.

Despite these limitations, the NCSEPS has several major strengths. It provides unique access to a large population of young people undergoing a relatively uniform set of psychosocial and physical stressors; individuals are screened for the absence of major psychiatric disorders; military medical care appears to be less racially biased than civilian medical care; diagnoses are assigned using the standard DSM criteria; and hospitalization for these disorders can be established in a defined population over a set period of time.

A key feature of the NCSEPS sample is that ascertainment of cases is relatively complete; active duty individuals with serious psychiatric disorders receive immediate medical attention in military facilities. The performance of active duty personnel is much more carefully monitored than that of most civilians, especially early in their careers. Although many mental disorders are treated on an out-patient basis within the US military, individuals with a serious psychiatric disorder – particularly schizophrenia or BD – are almost always hospitalized rather than treated as out-patients (Pullen & Labbate, 1992; Hoge *et al.* 2003, 2005). Severe cases of MDD, including those with psychosis or with the possibility of self-harm, are similarly hospitalized. Although it is likely that some proportion of mentally ill individuals receive a rapid administrative discharge from the military during their first few weeks of service (Beighley *et al.* 1992; Cigrang *et al.* 1998; Englert *et al.* 2003), for this population and these serious psychiatric disorders, hospitalization may be a better proxy for onset of illness than it is in other contexts (Menninger, 1948; Hoge *et al.* 2005), and usually represents the first formal recognition of illness[†].

[†]Between 10% and 25% of psychiatric patients hospitalized in the military are believed to have some form of prior psychiatric history (G. G. Grammer *et al.* unpublished observations). Prior psychiatric history is a broad category that could include in-patient hospitalization, out-patient treatment, counseling/therapy (including seeing a school counselor), a prior suicide attempt, or treatment for substance abuse.

To our knowledge, these findings represent the most comprehensive estimate of incidence for these serious psychiatric disorders in US Armed Forces personnel, and underscore the heavy burden that these disorders place in both human and financial terms on the US military. Furthermore, studies have shown that although the rate of some disorders, including post-traumatic stress disorder (PTSD), anxiety disorders and some depressive disorders, increase after military deployment (Hoge *et al.* 2006), the annual rate of new cases of severe psychotic illnesses remains relatively constant in the military, with only mild or negligible increases in the rate of psychosis during wartime (Glass & Bernucci, 1966; Group for the Advancement of Psychiatry, 1967; Hayes, 1969; Jones, 1995). Thus these rates are likely to remain consistent despite current US involvement in Iraq and Afghanistan.

Acknowledgments

This research was supported by the Intramural Research Program of the NIH, NIMH. This project could not have been undertaken without the help and support of a great number of individuals. At the NIMH, our colleagues Ivory Baker, Tim Barton, Kenneth Morel and Anita Slusarcick provided substantial research assistance. Debbie Heath and Evan DeRenzo helped in numerous ways. Micheline Bresnahan provided helpful scientific advice. Our work would not have been possible without the data and advice of Mike Dove and Andrea Dettner at DMDC, and of Emma Jane Frazier, Frances Mandell, Bobby Drake and FrancieMcQueeney at PASBA. Past and present members of the NCSEPS Advisory Board, including Joseph Chozinski, Kay Jamison, Tom Horvath, Larry Lehmann, Jeff Lieberman, David Orman and Harold Sackeim gave generously of their time and wisdom. Mark Paris and E. Cameron Ritchie consistently helped us obtain the answers and the data we needed.

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Table 1

Number of total hospitalizations for bipolar disorder, major depressive disorder, and schizophrenia, person-years at risk, and rates per 10 000 person-years (95% CI) in the NCSEPS sample^a

	Person-years	First hospitalizations for index disorders	Rate per 10 000 person-years (95% CI)
Total	8 120 136	8723	10.7 (10.5–11.0)
Age (yr)			
17–25 ^b	3 605 523	3231	9.0 (8.7–9.3)
26–29	1 331 172	2217	16.7 (16.0–17.4)
30–34	1 408 095	1833	13.0 (12.4–13.6)
35–39	1 072 144	824	7.7 (7.2–8.2)
40–44	501 320	514	10.3 (9.4–11.2)
45	201 882	104	5.2 (4.2–6.2)
Sex			
Male	7 130 383	6532	9.2 (8.9–9.4)
Female	989 753	2191	22.1 (21.2–23.1)
Ethnicity			
White	5 684 649	6336	11.1 (10.9–11.4)
Black	1 588 685	1628	10.2 (9.8–10.8)
Hispanic	450 264	419	9.3 (8.4–10.2)
Other	396 538	340	8.6 (7.7–9.5)

CI, Confidence interval.

^aPerson-years represent the active duty military population counted on 1 July 1992–1996 and summed over the 5 years.

^bAge data obtained from the DoD included individuals aged 17; in this study, however, there were no hospitalizations in the 17-year-olds.

Table 2

Average yearly (dynamic) incidence (per 10 000 persons-years) and cohort incidence (per 10 000 person-years) (95% CI) for bipolar disorder, major depressive disorder, and schizophrenia, 1992–1996

Diagnosis	Dynamic incidence ^a (all ages)		Cohort incidence ^b (18–25 years)	
	Hospitalizations	Rate (95% CI)	Hospitalizations	Rate (95% CI)
Bipolar disorder				
Total	1618	2.0 (1.9–2.1)	399	2.4 (2.2–2.7)
Sex				
Male	1272	1.8 (1.7–1.9)	311	2.2 (2.0–4.2)
Female	346	3.5 (3.1–3.9)	88	3.4 (2.7–4.2)
Ethnicity ^c				
White	1227	2.2 (2.0–2.3)	289	2.5 (2.2–2.8)
Black	262	1.7 (1.4–1.8)	64	2.0 (1.5–2.5)
Hispanic	63	1.4 (1.1–1.7)	—	—
Major depressive disorder				
Total	5796	7.2 (7.0–7.3)	1010	6.1 (5.8–6.8)
Sex				
Male	4133	5.9 (5.6–6.0)	722	5.2 (4.8–5.6)
Female	1663	16.9 (16.0–17.6)	288	11.2 (10.0–12.5)
Ethnicity ^c				
White	4298	7.7 (7.3–7.8)	750	6.6 (6.1–7.1)
Black	1024	6.5 (6.1–6.8)	157	5.0 (4.1–5.6)
Hispanic	261	5.8 (5.1–6.5)	—	—
Schizophrenia				
Total	1309	1.6 (1.5–1.7)	371	2.2 (2.0–2.5)
Sex				
Male	1127	1.6 (1.5–1.7)	315	2.3 (2.0–2.5)
Female	182	1.8 (1.6–2.1)	56	2.2 (1.6–2.8)
Ethnicity ^c				
White	811	1.4 (1.3–1.5)	224	2.0 (1.7–2.2)
Black	342	2.1 (1.9–2.4)	95	2.9 (2.3–3.5)
Hispanic	95	2.1 (1.7–2.5)	—	—

CI, Confidence interval.

^a The numerator is the number of patients hospitalized each year between 1992 and 1996 with the index diagnoses. Five-year totals are given in the table. The denominator is the number of active-duty military personnel at the midpoint of each year 1992–1996. The rates are the average of the 5-yearly rates.

^b Incidence rates were calculated for the 3 disorders at each age of entry between 18 and 25. Incidence for the Hispanic group could not be calculated due to small numbers.

^c ‘Other’ ethnicities were omitted due to small numbers leading to unstable estimates.