INCIDENCE OF PSYCHIATRIC DISORDERS AFTER EXTENDED RESIDENCE IN ANTARCTICA

ABSTRACT

Objectives. The incidence of psychiatric disorders and depressive symptoms was examined in a cohort of American men and women who spent an austral winter at two different research stations in Antarctica to determine whether extended residence of nonindigenous inhabitants in a polar region is associated with psychiatric morbidity.

Study Design. Debriefings interviews with 220 men and 93 women were conducted by 3 psychiatrists and 1 clinical psychologist at McMurdo Station and South Pole Station at the end of the austral winter between 1994 and 1997. Crewmembers were assigned a DSM-IV diagnosis if they satisfied diagnostic criteria. Debriefed crewmembers also completed the Structured Interview Guide for the Hamilton Depression Inventory – Seasonal Affective Disorders version (SIGH-SAD).

Results. Thirty-nine (12.5%) crewmembers presented with symptoms that met the criteria for one or more DSM-IV disorders. After weighting the prevalence to account for the low participation rate of civilian personnel, the incidence of DSM-IV disorders was 5.2%. Mood disorders were the most common diagnoses, accounting for 30.2% of all diagnoses, followed by adjustment disorders (27.9%), sleep-related disorders (20.9%), personality disorders (11.6%), and substance-related disorders (9.3%). Depressive symptoms as measured by the SAD-SIGH were significantly associated with female gender, military occupation, station, year of expedition, and DSM-IV diagnosis.

Conclusion. Differences in the distribution of symptoms and diagnoses by demographic and expedition characteristics suggests that the social environment may be a more powerful determinant than the physical environment of psychiatric disorders in a polar region. (Int J Circumpolar Health 2004;63(2):157-168)

Key words: mental disorders, polar regions, epidemiology, Antarctica, environmental stress
INTRODUCTION

Although seasonal variation in mood and behavior has been observed and reported since antiquity, it has only been in the past decade that the clinical sequelae of this variation has been examined and treated in a systematic fashion. In 1984, Rosenthal and colleagues described Seasonal Affective Disorder (SAD) as a cyclical disturbance of mood characterized by symptoms of depression, increased appetite, weight gain, craving for carbohydrates, hypersomnia, fatigue, and decreased sociability (1). Although these symptoms usually manifest themselves in fall or winter with remission during spring or summer, a variety of SAD with manifestation of depressive symptoms in summer months has also been reported (2). Five years later, Kasper and colleagues described sub-syndromal SAD (S-SAD) as a condition in which individuals who do not meet criteria for major affective disorder nevertheless experience mild dysfunction and vegetative symptoms similar to those found in SAD (3-4).

Success in treating the winter varieties of SAD and S-SAD with light therapy have supported the hypothesis that restricted access to bright light contributes to the etiology of the disorder (5-6), although the precise mechanism remains to be identified. Support for this hypothesis is also derived from community surveys, which have found a positive correlation between the prevalence of SAD and geographic latitude (7-8), with relatively high rates reported in northern latitudes (9-11). However, other studies have concluded that the prevalence of SAD and other forms of mental distress is unrelated to latitude (12-14). Studies of people of Icelandic descent living in Iceland (15) and Northern Canada (16) have found the prevalence of SAD to be significantly lower than in the continental United States. In addition, most studies of seasonal variation in depressed mood in the general population have relied upon cross-sectional or retrospective designs (4,8-12,14-18). These studies provide no independent, baseline assessment of depression or depressed mood in participants, no assessment of the changes in depressed mood over the course of a year, and are limited by the potential for recall bias, and bias within the screening instruments (4, 18). Moreover, they fail to distinguish between indigenous, lifelong residents and short-term, transient residents of these environments. Such a distinction is im-
portant because the former group may have developed behavioral or physiological adaptations to living in high latitude polar environments that are not present in the latter group.

High latitude environments are also characterized by seasonal variations in temperature as well as in the diurnal photoperiod. Cold-induced alterations in thyroid hormone function similar to those reported by Reed and colleagues during the austral winter in Antarctica (19,20) are also known to be associated with increased depressive symptomatology (21). Known as the Polar T3 Syndrome, these alterations share many of the same characteristics of subclinical hypothyroidism (SCH), including elevated thyrotropin-stimulating hormone (TSH) levels and/or enhanced TSH response to thyrotropin-releasing hormone (TRH) stimulation. Recent investigations in Antarctica suggest that alterations in thyroid hormone levels precede increases in depressive symptoms, tension-anxiety and confusion, and that daily administration of 50 μg thyroxine results in a significant reduction in symptoms of fatigue and confusion and a significant improvement in cognitive performance, during the austral winter (22).

In the Arctic, studies of the environmental determinants of psychiatric morbidity are limited by the potential confounding influence of social factors such as high rates of rapid sociocultural change (23-25), and differences in length of residence (26). In contrast, the Antarctic offers an opportunity to examine the influence of the physical (prolonged exposure to darkness and cold temperatures) and social (prolonged isolation and confinement) in a population with no prior history of psychiatric morbidity. American scientists and support personnel who spend an entire year living and working in Antarctica undergo psychiatric screening by psychiatrists and clinical psychologists. Individuals with pre-existing psychiatric conditions are ineligible to spend the austral winter in Antarctica. Nevertheless, many individuals experience varying degrees of depressed mood, lack of concentration, insomnia, and irritability or hostility during the austral winter. In a psychiatric debriefing of the winter-over personnel of one station in 1989, 64.1% reported difficulty falling asleep or staying asleep, 51.5% reported difficulty concentrating or remembering things, 62.1% reported feelings of sadness and depressed affect, and 47.6% reported feelings of irritability and hostility at some point during the winter (27). Referred to as the "winter-over syndrome" (28), these symptoms exhibit some similarities to subsyndromal seasonal
affective disorder (29). Although the incidence of clinically significant symptoms by the end of the winter has been estimated to be approximately 6% in this previously asymptomatic population (30), no study to date has examined the incidence of symptoms that satisfy commonly accepted diagnostic criteria such as the International Classification of Diseases (31) or the Diagnostic and Statistical Manual for Mental Disorders (32).

We assessed the incidence of psychiatric disorders as defined by the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition in 313 American men and women who spent an austral winter at two different research stations in Antarctica to address two important questions: 1) what proportion of a non-psychiatric population will experience psychiatric morbidity subsequent to an extended period of isolation and confinement in a polar environment; and 2) are certain individuals or groups of individuals more likely than others to experience such morbidity?

METHODS

Subjects
Subjects for this study were 313 military and civilian personnel who spent an austral winter at South Pole Station (90°S) or McMurdo Station (78°51’S), Antarctica over a four-year period. All members of one winter-over crew at South Pole and four crews at McMurdo were invited to participate in a debriefing conducted by a U.S. Navy psychiatrist or clinical psychologist. Twenty-six of the 27 (96.3%) crewmembers at South Pole and 111 of the 112 (99.1%) of the military crewmembers at McMurdo agreed to participate. Only 176 of the 702 (25.1%) civilian winter-over crew members at McMurdo Station agreed to participate. The lower response rate among civilians at McMurdo was due to the voluntary nature of the debriefing process. Many choose not to undergo debriefing for a variety of reasons, including mistrust of psychologists whose findings might interfere with prospects of continued employment with the United States Antarctic Program, a perceived lack of need for psychological support, or inconvenience of scheduling an appointment during a period of increased activity in preparation for the austral summer season. In contrast, military personnel are required to undergo psychological debriefing
as a condition of their service in the U.S. Navy. However, no significant differences were found in the distribution of civilian participants and nonparticipants at McMurdo by age, gender, ethnicity, or education, which suggests that the sample was generally representative of the winter-over crew at this station.

**Procedure**

All winter-over crewmembers were required to undergo a medical and psychological evaluation prior to their deployment to Antarctica. The psychological evaluation consisted of an interview with a U.S. Navy psychiatrist and clinical psychologist and completion of a battery of standardized clinical assessments, including the Minnesota Multiphasic Personality Inventory (MMPI) (33), the 16-Personality Factor Test (16-PF) (34) and the Michigan Alcoholism Screening Test (MAST) (35). Study subjects arrived in Antarctica between late August and January of the following year. Arrival date of participants varied by station (late August to January at McMurdo, and November to late January at South Pole). All subjects remained in Antarctica for approximately 12 months. Informed consent was obtained from each participant after the study objectives and data collection procedures had been fully explained.

Psychological debriefings were conducted during the month of September at McMurdo Station and November at South Pole Station. Each clinician used a standardized protocol for conducting the debriefing. The protocol includes completion of a questionnaire by the crewmember describing his or her experiences over the winter, a brief interview by the clinician to address any issues that may have arisen over the course of the winter, and administration of the Structured Interview Guide for the Hamilton Depression Rating Scale, Seasonal Affective Disorders version (SIGH-SAD) (36). The SIGH-SAD contains two components, the 21-item Hamilton Depression Rating Scale (HDRS) (36) and an 8-item scale that measures symptoms associated with Seasonal Affective Disorder. Debriefings lasted between 30 and 60 minutes per crew member. Based on responses to the SAD-SIGH, clinicians further questioned crew members to determine if they satisfied criteria for one or more DSM-IV diagnoses. A specific diagnosis was assigned if the crew member reported symptoms that met DSM-IV (32) criteria.
Statistics
To adjust for the low participation rate among the civilian personnel at McMurdo, a conversion factor of 1.167 was used to account for civilians who may have had an undiagnosed psychiatric disorder but failed to attend the debriefing. This was based on previous research indicating that one out of every six individuals in this population with clinically significant symptoms goes undiagnosed (38). This produced a weighted incidence rate for the entire crews of both stations during the study period (n = 841). Chi square tests were used to compare incidence rates by demographic characteristics (age, sex, occupation, education, and prior winter-over experience) and characteristics of the expedition (station, year overwintered). Significant differences were further examined using univariate logistic regression analyses. One-way analysis of variance was used to compare differences in three SAD-SIGH measures (21-item HDRS scale, 8-item SAD scale, and full 29-item scale) by crew member demographic and expedition characteristics, as well as by presence or absence of a DSM-IV diagnosis. Comparisons of SAD-SIGH scores by DSM-IV diagnosis were further stratified by debriefing clinician to assess clinician comparability in assigning diagnoses. All analyses were conducted using SPSSPC version 10.0.

RESULTS
Thirty-nine (12.4%) of the 313 men and women who participated in the psychiatric debriefings conducted at the end of an austral winter in the Antarctic presented with symptoms that met the criteria for a DSM-IV disorder. Thirty-five (89.7%) crewmembers were assigned one diagnosis and four crewmembers (10.3%) were assigned two diagnoses. The weighted and unweighted incidence of these disorders among those who participated in the debriefing is described in Table I below. After weighting the prevalence to account for the low participation rate of civilian personnel, the incidence of DSM-IV disorders was 5.2%. Mood disorders were the most common diagnoses, accounting for 30.2% of all diagnoses, followed by adjustment disorders (27.9%), sleep-related disorders (20.9%), personality disorders (11.6%), and substance-related disorders (9.3%).
All of the DSM-IV disorders were identified in personnel who overwintered at McMurdo Station. Military personnel were 3.70 (95% C.I. = 1.83 – 7.42) times as likely to have a DSM-IV disorder as civilians. The incidence of DSM-IV disorders was unrelated to age, sex, year, level of education, and prior winter-over experience (Table II). As expected, mean Hamilton Depression Rating Scale and SIGH-SAD scores were significantly associated with a DSM-IV diagnosis. These differences were found to persist when the comparisons were stratified by debriefing clinician, indicating comparability in assigning diagnoses. Military personnel had significantly higher mean scores than civilians; women had significantly higher mean scores than men; and personnel at McMurdo had significantly higher scores than personnel at South Pole. SIGH-SAD scores also varied significantly by year with the highest scores occurring in 1996. Scores on the 8-item SAD subscale of the SIGH-SAD were significantly associated with low education and lack of prior winter-over experience.

### Table I. Prevalence (per 100 persons debriefed) of DSM-IV Disorders among United States Antarctic Program winter-over personnel at end of an austral winter.

| Code     | Diagnosis                                      | Number of cases | Rate per 100 debriefed | Weighted Rate per 100 |
|----------|------------------------------------------------|-----------------|------------------------|-----------------------|
| 296.2    | Major depressive disorder, single episode      | 6               | 1.9                    | 0.8                   |
| 296.3    | Major depressive disorder, recurrent           | 2               | 0.6                    | 0.3                   |
| 300.4    | Dysthymic disorder                             | 1               | 0.3                    | 0.1                   |
| 311.0    | Depressive disorder NOS                        | 4               | 1.3                    | 0.5                   |
|          | Personality Disorders                          | 5               | 1.6                    | 0.5                   |
| 301.2    | Schizoid personality disorder                  | 2               | 0.6                    | 0.3                   |
| 301.6    | Dependent personality disorder                 | 2               | 0.6                    | 0.3                   |
| 301.9    | Personality disorder NOS                       | 1               | 0.3                    | 0.1                   |
|          | Substance-Related Disorders                    | 4               | 1.3                    | 0.5                   |
| 303.9    | Alcohol dependence                             | 2               | 0.6                    | 0.3                   |
| 304.3    | Cannibus abuse                                 | 1               | 0.3                    | 0.1                   |
| 305.0    | Alcohol abuse                                  | 1               | 0.3                    | 0.1                   |
|          | Sleep Disorders                                | 9               | 2.9                    | 1.1                   |
| 307.45   | Circadian rhythm sleep disorder                | 9               | 2.9                    | 1.1                   |
|          | Adjustment Disorders                            | 12              | 3.8                    | 1.6                   |
| 309.0    | Adjustment disorder with depressed mood        | 6               | 1.9                    | 0.8                   |
| 309.24   | Adjustment disorder with anxiety               | 2               | 0.6                    | 0.3                   |
| 309.4    | Adjustment disorder with mixed emotion/conduct | 2               | 0.6                    | 0.3                   |
| 309.9    | Adjustment disorder unspecified                | 2               | 0.6                    | 0.3                   |
|          | Total DSM-IV Disorders                         | 39              | 12.5                   | 5.2                   |
DISCUSSION

All of the individuals in this study underwent psychiatric screening prior to deployment. Many (n=86) who had previous winter-over experience had been screened more than once. Nevertheless, 12.5% of those who participated in the debriefings at the end of winter and an estimated 5.2% of the entire population experienced symptoms that satisfied criteria for a DSM-IV diagnosis. This incidence may be attributed, in part, to a failure of screening. This is suggested by the fact

| Year | DSM-IV (rate per 100) | HDRS 21 Mean (S.D.) | SAD 8 Mean (S.D.) | SIGH 29 Mean (S.D.) |
|------|------------------------|---------------------|-------------------|---------------------|
| 1994 (n=98) | 5.8 | 2.9 (3.9) | 1.6 (2.8) | 4.5 (6.3) |
| 1995 (n=54) | 5.5 | 4.0 (4.6) | 2.3 (2.6) | 6.3 (6.5) |
| 1996 (n=81) | 6.6 | 4.9 (3.4) | 3.9 (3.0) | 8.8 (5.5) |
| 1997 (n=80) | 2.0 | 3.0 (2.5)** | 1.9 (1.8)*** | 4.9 (3.5)*** |
| Age† | | | | |
| < 35 years (n=177) | 6.0 | 3.4 (3.3) | 2.4 (2.8) | 5.8 (5.5) |
| 35+ years (n=130) | 4.5 | 3.7 (4.0) | 2.3 (2.7) | 6.0 (6.0) |
| Sex | | | | |
| Men (n=220) | 5.4 | 3.2 (3.3) | 2.1 (2.7) | 5.3 (5.2) |
| Women (n=93) | 5.0 | 4.7 (4.6)** | 3.1 (2.7)*** | 7.8 (6.7)*** |
| Occupation | | | | |
| Military (n=111) | 13.5 | 4.0 (3.9) | 2.8 (2.8) | 6.8 (6.1) |
| Civilian (n=202) | 4.0*** | 3.0 (3.1)* | 1.6 (2.5)*** | 4.6 (5.0)*** |
| Station | | | | |
| South Pole (n=26) | 0.0 | 3.3 (3.4) | 2.2 (2.5) | 5.5 (5.3) |
| McMurdo (n=287) | 5.4 | 7.3 (4.3)*** | 4.3 (4.1)** | 11.6 (7.7)*** |
| Education† | | | | |
| < 14 years (n=133) | 6.6 | 4.2 (4.0) | 2.8 (2.9) | 7.0 (6.2) |
| 14+ years (n=146) | 4.4 | 3.2 (3.5) | 2.2 (2.6)* | 5.7 (5.1) |
| Prior winter-over† | | | | |
| No (n=196) | 6.5 | 4.0 (4.4) | 3.0 (2.7) | 7.0 (6.4) |
| Yes (n=86) | 3.5 | 3.7 (3.3) | 2.3 (2.8)** | 6.0 (5.4) |
| DSM IV Diagnosis | | | | |
| No (n = 39) | 3.1 (3.2) | 2.1 (2.5) | 5.3 (5.1) |
| Yes (n=274) | 7.2 (5.1)*** | 4.2 (3.6) | 11.4 (7.5)*** |

* p < 0.05, ** p < 0.01, *** p < 0.001
† These variables have missing data.
that personality disorders are often manifested early (32), and screening procedures to assess substance abuse based on self-reports are often unreliable (35). Another possibility is that these disorders are seasonal in nature. The mood and sleep disorders diagnosed in this population may indicate the presence of Seasonal Affective Disorder and Subsyndromal Seasonal Affective Disorder (S-SAD) (1, 3). Two of the personnel debriefed satisfied the criteria for Seasonal Affective Disorder (DSM-IV Code 296.3). A previous study of Antarctic winter-over personnel by Palinkas and colleagues found a significant increase in the prevalence of S-SAD over the source of the winter (29). However, this study found no significant difference between those with and those without a DSM-IV diagnosis with respect to the component of the SIGH-SAD instrument designed to assess symptoms of Seasonal Affective Disorders (SAD-8). In addition, the SAD-8 were significantly higher at McMurdo Station (78°51’ S) than they were at South Pole Station (90°S). This difference was also reported in the earlier study (29) and suggests that factors other than the harsh physical environment account for the incidence of psychiatric disorders in Antarctica. In particular, the prolonged isolation from family and friends and confinement with a relatively small group of individuals may be sufficiently stressful to precipitate the occurrence of a mood or adjustment disorder (30,39,40), and may exacerbate a pre-existing condition such as a personality disorder or substance abuse disorder (28). The fact that these symptoms and disorders varied significantly by year provides further evidence that the social environment may be a more powerful determinant than the physical environment of psychiatric disorders in a polar region.

Our results further indicate that certain individuals or groups of individuals are more likely than others to experience these disorders. Consistent with previous studies of polar expeditioners (30) and Arctic residents (26), women reported significantly more depressive symptoms than men. Also consistent with previous studies (41), military personnel reported significantly higher SIGH-SAD scores and incidence of DSM-IV disorders than civilians. Military personnel generally have less experience in isolated and confined environments than civilians, and their organizational structure may be less suited than the civilian administrative structure to providing the independence and autonomy necessary to cope with these con-
ditions (27). The higher rate of DSM-IV disorders and higher SIGH-SAD scores at McMurdo may also be attributed to the military presence at this station, which is absent at South Pole Station.

Nevertheless, caution must be exercised when interpreting these findings. Efforts to weight the incidence of psychiatric disorders based on data collected during the debriefings may have led to an underestimation of DSM-IV disorders in civilians. However, each of the debriefing clinicians made an active effort to debrief all crewmembers identified as having manifested clinically significant symptoms by the winter-over physician of each station, thereby reducing the likelihood of undiagnosed cases. In addition, there were no cases of DSM-IV disorders among the civilians at South Pole despite almost complete participation rates (96.3%). Finally, the weighted incidence of 5.2 percent reported in this study is comparable to the 6.0 percent prevalence of clinically significant depressive symptoms found in an earlier study (30). It is also possible that individual clinician differences in assigning DSM-IV diagnoses might account for differences by year and by station. However, the SIGH-SAD scores were significantly higher in all crewmembers assigned a DSM-IV diagnosis than in those not assigned a diagnosis, independent on the clinician who assigned the diagnosis.

In summary, extended residence in Antarctica was associated with a 5.2 percent incidence in DSM-IV psychiatric disorders. Differences in the distribution of symptoms and diagnoses by demographic and expedition characteristics suggests that the social environment may be a more powerful determinant than the physical environment of psychiatric disorders in a polar region.

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