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MENTAL DISORDER HOSPITALIZATIONS AMONG SUBMARINE  
PERSONNEL IN THE US NAVY(U) NAVAL HEALTH RESEARCH  
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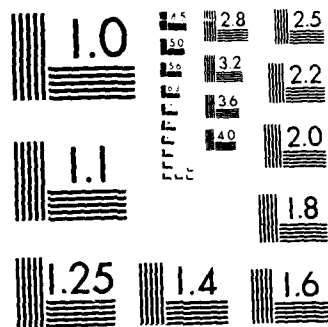
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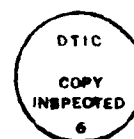


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Mental Disorder Hospitalizations among  
Submarine Personnel in the U.S. Navy



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## SUMMARY

### Problem

→ U.S. Navy submarine duty exposes personnel to a stressful environment that could have adverse mental health effects. The effects of the submarine environment on mental health need to be evaluated to ensure future successful submarine missions.

### Objectives

→ The objective of this study was to determine mental health risks associated with submarine duty in the U.S. Navy by comparing hospitalization rates of submariners with surface-ship personnel in the diagnostic category of mental disorders.

### Approach

The Service History file maintained by the Naval Health Research Center in San Diego was searched for all personnel during 1974-1979 who had served aboard nuclear- and diesel-powered submarines (n=68,475). A random sample of enlisted personnel who had served aboard surface ships of similar crew size as submarines was selected as a comparison group (n=77,541). Age-adjusted hospital admission rates for the mental disorders diagnostic category and for all hospitalizations were calculated and compared for submarine and surface-ship personnel. Relative risks were calculated; and 95 percent confidence intervals were computed to determine significant differences in hospitalization rates.

### Results indicated that

→ Submarine personnel had significantly lower hospitalization rates for all mental disorders combined than surface-ship personnel (RR=.58,  $p < .05$ ). Submariners were also statistically significantly lower in hospitalization rates for alcohol abuse (RR=.40,  $p < .05$ ), drug abuse (RR=.52,  $p < .05$ ), and personality disorders (RR=.69,  $p < .05$ ), and all ICDA-8 diagnoses (RR=.74,  $p < .05$ ).

### Conclusions

→ Submarine duty does not appear to adversely affect the mental health of U.S. Naval personnel. Results also show that submariners have a lower total hospitalization rate than personnel of surface ships with a similar crew size. Several factors may account for these results including stringent

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screening of submariners, higher levels of education among submariners, difficulty of evacuation from a submarine, and the healthy-worker effect.

#### Recommendations

Future research should assess the contribution of psychological screening on the decrease in mental disorder hospitalization rates observed in this study. Mental disorder hospitalization rates for personnel screened and accepted for submarine service, but who never served aboard a submarine, could be determined. A comparison of this group with submariners may help to separate the contribution of screening in decreasing risk of mental disorder hospitalization.

## Mental Disorder Hospitalizations among Submarine Personnel in the U.S. Navy

Submarine personnel in the U.S. Navy are challenged to live and work for an extended period in relative isolation. Many Navy submarine missions require 60 to 90 days of continuous submergence and a number of studies have found biochemical influences (Tappan, Jacey, Heyder, and Tansey, 1975; Tappan, Jacey, Heyder, and Harvey, 1979), metabolic effects (Messier, Hayder, Braithwaite, McCluggage, Peck, and Schaefer, 1979), disruption of circadian cycles (Mills, 1966; Schaefer and Clegg, 1966; Schaefer, Kerr, Buss, and Haus, 1979; Beare, Bondi, Biersner, and Naitoh, 1981), lack of physical activity (Bennett and Bondi, 1981; Vickers, Conway, Hodgdon, and Duett, 1982; Bondi, 1983), and mental disorders (Serxner, 1968; Tansey, Wilson, and Schaefer, 1979; Weybrew and Noddin, 1979a, 1979b).

Tansey and his colleagues (1979) compared the health of submariners with surface-ship personnel between 1963-1973. They reported that submariners had higher illness rates for neuropsychiatric illnesses than was found in a surface-ship comparison group. Biersner (1987), however, reported that the rate of mental disorders among U.S. Navy submarine personnel was very low. Biersner noted that between 1963-1967 there were no cases of mental disorders severe enough among submariners to require a medical evacuation at sea; and that between 1968-1973 there were only three cases severe enough to require evacuation at sea.

Gunderson (1976) also reported low submariner mental disorder rates using Navy medical records of mental disorders requiring hospitalization. Gunderson's data for the period of 1965-1971 showed that inpatient admission rate among Navy ballistic missile nuclear submarine personnel was approximately one-third that of surface-ship personnel. Gunderson also presented mental disorder incidence rates for auxiliary diesel-electric submariners and attack nuclear submariners that were less than one half that of their surface-ship counterparts.

The present study assesses the mental health of submariners as compared with surface-ship personnel between 1974-1979 using mental-disorder hospitalizations. The objective of this study was to determine if there are mental health risks associated with submarine duty in the U.S. Navy.

#### METHODS

The Naval Health Research Center in San Diego, California, maintains computerized Service History and Medical Inpatient files for active-duty Naval enlisted personnel. The Service History file was searched for all personnel who had served aboard nuclear- or diesel-powered submarines or both during the period 1974-1979. A comparison group, consisting of a random sample (approximately 50%) of enlisted personnel who had served aboard surface ships of approximately the same crew size as submarines during the same period, also was identified from the Service History file. Ship types represented in the control group included: Destroyer, Guided Missile Destroyer, Frigate, and Guided Missile Frigate.

In order to control for the potential confounding influence of sex and race on hospital admission rates and because of the few personnel represented in some groups (e.g., female, black, hispanic), only white males were selected for examination in this study.

Diagnoses were coded in accordance with the International Classification of Disease, Adapted for Use in the United States, Eighth Revision. Hospitalization rates were expressed as the number of hospital admissions per 100,000 person-years.

Age-adjusted hospital admission rates were calculated using the direct method of adjustment (Lilienfeld, 1980). The total hospitalization rate is affected by both the age-specific hospitalization rates and the age distribution of the population. Direct age-adjustment was used to remove the influence of the differences in the age distributions of the study populations by use of a standard population. The standard population selected was the sum of the two groups; this provided the number of hospitalizations expected in the standard

population when the age-specific rates of the two study groups were applied to the standard population. This value was then used to calculate age-adjusted rates.

The age-adjusted rates for submariners and surface-ship personnel were compared using relative risks. Relative risks were computed by dividing the submariner age-adjusted hospitalization rates by the surface-ship age-adjusted hospitalization rates. This computation gives a measure of the likelihood, relative to the surface-ship group, that a member of the submariner group will acquire a certain disease. Ninety-five percent confidence intervals were used to assess statistical significance of observed differences in hospitalization rates (Lilienfeld, 1980). T-tests were used to assess statistical significance of differences in descriptive variables (McNemar, 1969).

## RESULTS

A search of the Service History file identified 68,475 white male enlisted submarine personnel and 77,541 white male enlisted surface-ship personnel who served during 1974-1979. Personnel in the submarine group averaged 43,541 per year and the number of personnel in the comparison group averaged 45,151 per year. The submarine group and surface-ship personnel were compared on several characteristics as shown in Table 1. Personnel in the submarine group were older and had a higher education level and paygrade than the surface-ship comparison group.

Table 1. Comparison of Submariners and Surface-Ship Personnel by Age, Education, and Paygrade.

| <u>Characteristic</u> | <u>Submariners</u>   |             |                           | <u>Surface-Ship Personnel</u> |             |                           |
|-----------------------|----------------------|-------------|---------------------------|-------------------------------|-------------|---------------------------|
|                       | <u>N<sup>+</sup></u> | <u>Mean</u> | <u>Standard Deviation</u> | <u>N<sup>+</sup></u>          | <u>Mean</u> | <u>Standard Deviation</u> |
| Age                   | 68,448               | 28.0*       | 6.45                      | 77,519                        | 26.7        | 6.84                      |
| Education             | 68,475               | 12.1*       | .94                       | 77,522                        | 11.7        | 1.05                      |
| Paygrade              | 68,450               | 5.5*        | 1.48                      | 77,526                        | 4.7         | 1.65                      |

\* Significant at the  $p < .001$  level.

+ Number varies because some personnel had missing data.



During the study period, submariners had 16,092 hospital admissions in Navy medical facilities, surface-ship personnel accounted for 23,156 hospital admissions. Table 2 shows the age-adjusted mental-disorder hospitalization rates for submarine and surface-ship personnel and estimates of relative risks for submarine personnel. Also shown in the table are total hospital admission rates for submariner and surface-ship groups.

**Table 2. Age-Adjusted Mental-Disorder Hospitalization Rates per 100,000 Person-Years and Relative Risks Among White Male Enlisted Submarine and Surface-Ship Personnel.**

| Diagnostic Category<br>and Selected diagnoses          | Submarine Personnel<br>(261,248 Person-years) |        |                          |        | Surface-Ship Personnel<br>(270,906 Person-years) |        |                          |        | Relative<br>Risk |
|--------------------------------------------------------|-----------------------------------------------|--------|--------------------------|--------|--------------------------------------------------|--------|--------------------------|--------|------------------|
|                                                        | N                                             | Rate   | 95% Confidence<br>Limits |        | N                                                | Rate   | 95% Confidence<br>Limits |        |                  |
|                                                        |                                               |        | Lower                    | Upper  |                                                  |        | Lower                    | Upper  |                  |
| <b>MENTAL DISORDERS</b> (total)                        | 1859                                          | 713.4  | 639.3                    | 787.5  | 3364                                             | 1236.1 | 1145.6                   | 1326.6 | 0.58*            |
| Alcohol Abuse                                          | 630                                           | 242.1  | 199.6                    | 284.6  | 1645                                             | 607.3  | 540.6                    | 674.0  | 0.40*            |
| Drug Abuse                                             | 103                                           | 40.0   | 25.2                     | 54.8   | 215                                              | 76.8   | 56.6                     | 96.9   | 0.52*            |
| Psychophysiological<br>Disorders                       | 26                                            | 9.9    | 3.5                      | 16.3   | 45                                               | 16.3   | 7.5                      | 25.0   | 0.61             |
| Schizophrenias                                         | 95                                            | 36.0   | 24.6                     | 47.3   | 152                                              | 56.1   | 40.4                     | 71.7   | 0.64             |
| Other and Unspecified<br>Psychoses                     | 41                                            | 15.6   | 0                        | 40.7   | 55                                               | 20.5   | 10.3                     | 30.6   | 0.76             |
| Affective Disorders                                    | 23                                            | 8.8    | 0.5                      | 17.1   | 28                                               | 10.3   | 1.6                      | 19.0   | 0.85             |
| Neuroses                                               | 215                                           | 82.4   | 59.3                     | 105.4  | 226                                              | 83.4   | 51.3                     | 115.5  | 0.99             |
| Personality<br>Disorders                               | 354                                           | 136.6  | 111.1                    | 162.0  | 547                                              | 198.9  | 167.8                    | 230.0  | 0.69*            |
| Sexual Deviation                                       | 5                                             | 1.9    | 0                        | 5.2    | 4                                                | 1.5    | 0                        | 4.2    | 1.26             |
| Physical Disorder of<br>Presumed Psychogenic<br>Origin | 29                                            | 11.3   | 0                        | 36.3   | 21                                               | 7.7    | 1.4                      | 13.9   | 1.47             |
| Transient Situational<br>Disturbances                  | 298                                           | 113.8  | 87.4                     | 140.2  | 367                                              | 135.8  | 108.6                    | 162.9  | 0.84             |
| Nervousness and<br>Debility                            | 16                                            | 6.0    | 0                        | 14.6   | 16                                               | 5.8    | .4                       | 11.2   | 1.03             |
| Special Symptoms<br>Not Elsewhere<br>Classified        | 24                                            | 9.2    | 2.6                      | 15.7   | 43                                               | 15.8   | 6.1                      | 25.5   | 0.58             |
| <b>ALL HOSPITAL<br/>ADMISSIONS</b>                     | 16092                                         | 6248.8 | 6019.0                   | 6478.6 | 23156                                            | 8448.7 | 8217.0                   | 8680.5 | 0.74*            |

\* Significant at the  $p < .05$  level.

Submariners had statistically significantly lower hospitalization rates than surface-ship personnel for total mental disorder hospitalizations. Submariners also had statistically significantly lower hospitalization rates for alcohol abuse, drug abuse, and personality disorders. The rate for total mental disorders for submarine personnel was approximately one-half the hospitalization rate for surface-ship personnel. When the groups were compared on total hospitalizations for all diagnostic categories the rate for submariners (6,248.8 per 100,000 person-years) was significantly less than the rate of total hospitalizations for surface-ship personnel (8,448.7 per 100,000 person-years).

#### DISCUSSION

Submarine personnel were found to have lower hospitalization rates for total mental-disorder hospitalizations and for nearly all mental diagnoses examined. Similar results were found in a related study in which Naval personnel who experienced prolonged isolation associated with winter-over duty in the Antarctic had a lower rate of mental-disorder hospitalizations than a control group of personnel who were screened and accepted for such duty but who were assigned elsewhere (Palinkas, 1986). The prolonged isolation associated with submarine duty does not appear to adversely affect the mental health of submarine personnel.

The results of this study are in agreement with previous research which concluded that submariners are a relatively healthy group (Burr and Palinkas, 1987; Herman, 1982; Tappan, Jacey, Heyder and Harvey, 1979; Tansey et al., 1979). Most of the individuals in the submarine group have served on nuclear-powered submarines during their Naval careers. These individuals must undergo stringent psychological and medical screening prior to assignment aboard a nuclear submarine because of the relatively long periods of isolation during deployment. It appears that this screening eliminates many individuals at high risk for illness. Support for this hypothesis is derived from the observation that submarine personnel exhibited significantly fewer hospital admissions for personality disorders, alcohol abuse, and drug abuse. These conditions have been related to poor performance in the Navy in previous studies (c.f., Arthur, 1966; Clum and Hoiberg, 1970), and individuals who are

diagnosed as having these conditions are typically separated from the Navy. A study by Plag and his associates (1970) indicated that 88 percent of patients admitted to the sick list for these conditions were given medical discharges or returned to their command with a recommendation for administrative separation from service. Gunderson and Arthur (1967) also reported that character and behavior disorders such as personality and substance-use disorders were negatively correlated with restoration to duty upon discharge from a psychiatric inpatient ward. Gunderson, Arthur and Richardson noted that these individuals are typically identified only upon hospital admission which they characterize as "delayed psychiatric screening." They go on to comment that "presumably with more careful or thorough initial psychiatric screening, many of these men would not have been accepted for military duty" (1968, p. 548). Individuals with these disorders, therefore, are more likely to be identified and discharged from service prior to entering the submarine service than prior to assignment on a surface ship because of the screening program for submarine personnel. The screening program would also be more likely to weed out individuals at risk (i.e., young, less educated, junior enlisted personnel) for personality and substance-use disorders than individuals at risk for other kinds of psychiatric disorders.

Another factor that may contribute to lower hospitalization rates is that submarine personnel may tend to be better educated in order to qualify for many of the rates on board nuclear submarines (Burr and Palinkas, 1987; Weybrew and Noddin, 1979). In this study, the submarine personnel had a mean of 12.1 years of education, while the control group had a mean of 11.7 years of education. Among Naval personnel, there is a negative linear relationship between education and the incidence of mental disease and illness (Gunderson and Arthur, 1966; Gunderson, 1971). Because hospital admission rates among Naval personnel are known to be affected by occupation (Gunderson and Colcord, 1982), occupational differences in the submariner and control groups may also account for a portion of the observed differences in hospitalization rates.

Finally, long periods of deployment may preclude submarine personnel on active duty from being admitted to hospital facilities on an inpatient basis for relatively minor conditions. Rather, these individuals may receive treatment from medical personnel aboard ship. A study by Nice (1984) found

that the rates of medical evacuations from submarines are among the lowest of all Naval ships, suggesting both that serious medical events rarely occur aboard submarines during deployment and that minor medical events are treated by available medical personnel.

In contrast to the Tansey study which found higher rates of illness in submariners for neuropsychiatric illnesses, the present study did not support these results; submarine personnel had significantly lower illness rates for mental disorders. A possible explanation for this discrepancy is that Tansey's submarine illness data were obtained from medical sections and from medical patrol reports for submarines, and those illnesses occurring at sea that resulted in at least one sick day lost from duty were included. Tansey's surface-ship mental-disorder data were provided from a study conducted at the Naval Health Research Center in which ship corpsmen filled out a sick-call card for each sick-call visit during a 7-8 month deployment. This form had major headings for respiratory, skin, and gastrointestinal problems but did not have mental disorders as a major heading. "Behavioral/psychiatric problems" was listed as a subheading under the "Other" category and this could account for Tansey's low rate of mental disorders among surface-ship personnel. The fact that Tansey's results were based on the comparison of data from two separately conducted studies, collected under different conditions and with different instructions given to the participating corpsmen, may render such illness rate comparisons inappropriate. Another important difference between the Tansey study the present study is the use of hospitalizations rather than shipboard sick-call reports. Illness rates based on hospitalizations provide a more stringent and less variable measure for comparison of morbidity differences between submarine and surface-ship personnel.

There are a number of limitations of the present study. Outpatient data were not available. Hospital admissions among submariners may not completely reflect their health status. Evacuations from submarines are discouraged for two reasons: first, the logistical difficulty, and, second, reluctance to disclose position when on a mission.

Another potential confounding factor that may affect the hospitalization rates among submariners is the healthy-worker effect (Kelsey, Thompson and

Evans, 1986). Naval personnel are required to maintain an acceptable level of physical fitness and mental well-being in order to remain submariners. Personnel who become ill are likely to be transferred from submarine duty and assigned elsewhere.

In summary, the age-adjusted rate of mental disorder hospitalizations among submarine personnel is 58 percent of the age-adjusted rate of mental disorder hospitalizations among surface-ship personnel. Only rarely did hospitalization rates among submarine personnel exceed rates among the surface-ship personnel and in no instances did excesses reach statistical significance. Psychological and medical screening procedures, higher levels of education among submarine personnel, and medical practices associated with long periods of isolation during deployment, difficulty of evacuation from a submarine, and the healthy-worker effect may account for these differences.

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## REPORT DOCUMENTATION PAGE

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| 17. COSATI CODES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                                                 | 18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)             |                                                        |                               |
| FIELD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | GROUP | SUB-GROUP                                       | Submarine Mental disorders                                                                    |                                                        |                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |                                                 | Surface ships Relative risk                                                                   |                                                        |                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |                                                 | Hospitalizations Illness rates                                                                |                                                        |                               |
| 19. ABSTRACT (Continue on reverse if necessary and identify by block number)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |       |                                                 |                                                                                               |                                                        |                               |
| <p>This study evaluated mental-health risks associated with U.S. Navy submarine duty by comparing mental-disorder hospitalization rates of submariners with surface-ship personnel. Using age-adjusted hospitalization rates, submarine personnel showed statistically significantly lower relative risks (RR) for hospitalizations for total mental disorders (RR = .58). Submariners were also significantly lower in hospital admissions for alcohol abuse (RR = .40), drug abuse (RR = .52), and personality disorders (RR = .69). Overall, hospitalization rates for mental disorders for submarine personnel were about one-half the rate for surface-ship personnel. Reasons for lower mental-disorder hospitalization rates may be stringent screening of submariners, higher levels of education among submariners, difficulty of evacuation from a submarine, and the healthy-worker effect.</p> |       |                                                 |                                                                                               |                                                        |                               |
| 20. DISTRIBUTION/AVAILABILITY OF ABSTRACT<br><input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                                                 | 21. ABSTRACT SECURITY CLASSIFICATION<br>UNCLASSIFIED                                          |                                                        |                               |
| 22a. NAME OF RESPONSIBLE INDIVIDUAL<br>Ralph G. Burr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                 | 22b. TELEPHONE (Include Area Code)<br>(619) 553-8389                                          |                                                        | 22c. OFFICE SYMBOL<br>Code 30 |

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