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(U) The relationship between perceived sleep quality and career effectiveness was studied in Navy corpsmen. Two samples of Naval School of Health Sciences students were asked, "Overall, what kind of sleeper are you?" Based on responses, 506 "good" sleepers and 109 "poor" sleepers were selected for longitudinal study and followed for 6 years. For replication, Sample 2, consisting of 1,024 good and 188 poor sleepers, was identified in 1978—1979 and followed

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20. ABSTRACT (continued)

for 2 years. At enlistment, there were no differences between good and poor sleepers on measures used as predictors of career effectiveness, i.e., age, education, AFQT, and SCREEN score.

Compared to good sleepers, poor sleepers were less effective sailors. As a group, poor sleepers received fewer promotions during their careers and thus remained in lower paygrades, were less frequently recommended for reenlistment, and their attrition rate was higher. The poor sleeper was also more likely to be hospitalized during his tour of duty. Three possible factors could be related to the less effective performance of poor sleepers: (a) shorter total sleep time leads to a chronic sleep debt, (b) the sleep of poor sleepers is of poorer quality, or (c) poor sleep is one of the complaints that characterize people with chronic psychological problems. The third factor appears to be most important.

QUALITY OF SLEEP AND PERFORMANCE IN THE NAVY: A LONGITUDINAL STUDY OF GOOD AND POOR SLEEPERS

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Quality aspect of sleep

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REPORT NO. 82-8

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QUALITY OF SLEEP AND PERFORMANCE IN THE NAVY: A LONGITUDINAL STUDY OF GOOD AND POOR SLEEPERS

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SUMMARY

Data were collected over a 6-year period to examine the relationship of perceived quality of sleep to performance in the Navy. As part of a larger study, two samples of Naval School of Health Sciences students were asked, "Overall, what kind of sleeper are you?" Based on responses, 506 "good" or "very good" sleepers and 109 "poor" or "very poor" sleepers were selected for longitudinal study and followed for 6 years. For replication, Sample 2, consisting of 1,024 good or very good and 188 poor or very poor sleepers, was identified in 1978–1979. Career performance data included number of promotions, highest paygrade, attrition, type of reenlistment recommendation, type of discharge, number of demotions, and number of unauthorized absences. Hospitalization data were also obtained.

At enlistment, there were no differences between good and poor sleepers on measures used as predictors of career effectiveness, i.e., age, education, AFQT, and SCREEN score. Length of service was similar for both samples of good and poor sleepers. At no time during follow-up did the good and poor sleepers differ in number of demotions, unauthorized absences, or dishonorable or undesirable discharges.

Compared to good sleepers, poor sleepers were less effective sailors. On all measures used as indices of Navy performance, poor sleepers performed significantly less effectively. As a group, poor sleepers received fewer promotions during their careers and thus remained in lower paygrades, were less frequently recommended for reenlistment, and their attrition rate was higher. The poor sleeper was also more likely to be hospitalized during his tour of duty. Three possible factors could be related to the less effective performance of poor sleepers: (a) shorter total sleep time leads to a chronic sleep debt, (b) the sleep of poor sleepers is of poorer quality, or (c) poor sleep is one of the complaints that characterize people with chronic psychological problems. The third factor appears to be most important.

Sleep quality? – factors – findings

INTRODUCTION

Does the quality of nighttime sleep affect daytime performance? Specifically, do poor sleepers perform less effectively than good sleepers? Certainly, poor sleepers fear that their perceived loss of sleep will cause impaired performance the next day. In an extensive report on "Sleeping Pills, Insomnia and Medical Practice,"[14] the Institute of Medicine Panel observed that no study has demonstrated a clear relationship between amount of sleep actually obtained by insomniacs and daytime performance. The only study to address this question[11] compared the tracking and reaction times of diagnosed insomniacs with those of normal subjects who were tested in a previous study. Linnoila and his colleagues[11] reported that the baseline performance of the insomniac patients was poorer. Only one study[3] made a direct comparison of an untreated young adult group of 12 poor sleepers (sleep-onset insomniacs) with 12 matched good sleepers. In this study, the early morning performance of the two groups did not differ on the digit symbol substitution, choice reaction time, and digit span tasks.

There are few studies that have related sleep quality or total sleep time to performance outside the sleep laboratory. Webb & Friel[15] compared a group of natural short and natural long sleepers and found no differences in their academic performance. In a study of 104 fourth-year medical students, Johns *et al.*[6] also found no relationship between total sleep time and academic performance. They, however, did find a significant relationship (r = .23) between perceived quality of sleep and academic scores and also reported that students who got up earlier in the morning earned higher test scores.

Johns and his colleagues have published a series of reports on the subjective assessment of sleep.[5,7,8] Their description of the poor sleeper's sleep complaints and psychological profile is very similar to that reported by Monroe[12] for a young adult sample. The poor sleeper usually reports trouble falling asleep, more awakenings, less total sleep time, and a feeling of being less rested upon awakening, and some poor sleepers complain of bad dreams or nightmares. Poor sleepers also have more elevated scores on the MMPI and other psychological inventories. The problems of the young untreated poor sleeper are similar to, although less severe than, those of older diagnosed and treated chronic insomniacs. Recently, Healey *et al.*[4] reported that insomnia is associated with a life-long history of more illness and somatic complaints, beginning with more childhood illnesses and more childhood problems related to eating and sleeping.

In this study, we have capitalized upon the opportunity to obtain subjective sleep data from a large pool of subjects and to identify two samples of good and poor sleepers for longitudinal study. Because of the Navy's record-keeping system, we have had access to detailed information regarding performance evaluations, career progress, and health histories of good and poor sleepers. We have utilized our unique setting to examine the relationship of sleep quality to performance effectiveness.

METHOD

Subjects

The data were collected over a 6-year period, 1976–1981, and involved a total of 2,929 subjects. The subjects were predominantly male, 99%, with an age range of 17 to 34, mean 20.5 ± 2.62, at the time of initial data collection. The subjects were students at the San Diego Naval School of Health Sciences (corps school) during the initial data collection period. Sample 1 (N = 1,043) was obtained during 1976–77, and the initial data from Sample 2 (N = 1,886) were collected during 1978–79. Subjective sleep data were obtained using a 35-item sleep questionnaire which asked about present and past sleep schedules, sleep problems, and attitudes toward sleep. Some subjects also completed the Profile of Mood States (POMS). Over the 6-year period, additional data such as class grades, EEG sleep data, measures of performance in the fleet, and hospitalization statistics were obtained from subsamples

(groups) of the total subject pool. These groups of subjects did not differ from the total sample or from each other with respect to age, general educational or intellectual level. Because of the variation in the type of data collected, the Ns for the specific group analyses and comparisons to be described will vary. Because of the small number of women, N = 43, analyses for sex differences were not done.

Identification of Good and Poor Sleepers

Item 21 on the sleep questionnaire asked, "Overall, what kind of sleeper are you?" and gave five alternatives: 1 - very good, 2 - good, 3 - average, 4 - poor, and 5 - very poor. If subjects asked about the meaning of the question or about how to answer it, they were told to respond in terms of their overall feeling about their usual sleep quality.

Longitudinal Performance and Hospitalization Data

The follow-up data were obtained from personal service history and medical data files maintained by the Naval Health Research Center. These files contain information on all enlisted naval personnel who were or have been in the Navy since 1965, identified by name and Social Security Number. In addition to basic demographic data, these tapes include personnel actions such as promotions, disciplinary actions, recommendations for reenlistment, transfers, duty stations, and, if separated from service, the reason for separation. These personal service history files are periodically updated.

The hospitalization files also date from 1965 and include number of hospitalizations and, for each hospitalization, report such variables as age at time of hospitalization, primary and other diagnoses, length of stay, and disposition.

RESULTS

Subjective Quality of Sleep. On the sleep questionnaire, 21% of the sailors in Sample 1 described themselves as "very good" sleepers, 31% as "good," 36% "average," 11% "poor," and .8% "very poor." The pattern of reported sleep quality was very similar for the 1,886 subjects in Sample 2. Fifty-five percent said they were "good" or "very good" sleepers, 35% "average," and 10% "poor" or "very poor." In both samples, poor sleep had been a problem for over 6 months and, for many poor sleepers, had existed for several years. Some reported that their mothers said they were poor sleepers as children. Only 1% of the poor sleepers reported that they "often" and 7% said they "sometimes" used "something" to help them sleep.

Questionnaire Sleep Data of Good and Poor Sleepers. For this analysis, the responses of subjects who described themselves as good or very good sleepers were contrasted with those who described themselves as poor or very poor sleepers. Because of the large number of comparisons, four separate groups were compared to provide four replications. To reduce the possibility of committing a Type I error, only those items that were significantly correlated with sleep quality in all four groups are listed in Table 1, with their correlation values and the N for each group.

Not unexpectedly, the items that were significantly correlated with subjective estimates of sleep quality were those associated with (a) trouble falling asleep, (b) trouble staying asleep, and (c) complaint of nightmares. The poor sleepers were also more likely to feel less rested in the morning and to describe themselves as more sleepy (higher score on the Stanford Sleepiness Scale) and to have trouble getting up in the morning. Poor sleepers also described themselves as "light sleepers," indicating that they were more easily awakened by noise.

TABLE 1

Correlates of Subjective Good/Poor Sleep

Questionnaire Item	Group 1 N = 352	Group 2 N = 351	Group 3 N = 138	Group 4 N = 137
Minutes to fall asleep?	.43	.50	.41	.49
Do you have trouble falling asleep?	.62	.59	.59	.60
Trouble falling asleep - How often?	.58	.61	.60	.56
Trouble falling asleep - How long does it take to get to sleep?	.44	.38	.20	.43
How many times do you wake up during the night?	.36	.36	.34	.23
How many nights a week do you wake up during the night?	.31	.37	.20	.30
How long does it take to go back to sleep during the night?	.34	.35	.25	.19
Do you awake too early, cannot go back to sleep?	.32	.33	.23	.33
Awake too early - How many days per week?	.37	.32	.23	.31
Do you have disturbing dreams or nightmares?	.34	.36	.40	.34
Do you feel well-rested when you first wake up?	.37	.44	.47	.45
Stanford Sleepiness Scale - Workdays	.32	.34	.21	.45
Stanford Sleepiness Scale - Days off	.27	.21	.17	.33
Difficulty getting out of bed	.25	.31	.30	.27
Are you easily awakened by noises?	.18	.33	.27	.20

For the good sleepers, mean reported sleep latency was less than 20 minutes for all four groups. For poor sleepers, mean sleep latency was over 60 minutes. On workdays, most good sleepers reported usual total sleep times of 7 to 8 hours, while poor sleepers reported that they slept 5 to 7 hours. On days off, both good and poor sleepers reported they slept 8 to 9 hours.

Profile of Mood States (POMS). POMS scores and sleep questionnaire data were available on 278 sailors. These data are presented in Table 2 for the five quality of sleep categories, along with F values. The F values were significant for all POMS scales, indicating a significant relationship between subjective estimates as to kind of sleeper a person was and his subjective evaluation of mood. There is a clear linear relationship between these two estimates on all of the scales. For example, on Confusion, the mean score for very good sleepers was 6.1, for good 7.6, for average 9.6, for poor 10.5, and, for the sailors who described themselves as very poor sleepers, the mean score was 12.8, which is twice as high as for the very good sleepers.

TABLE 2

POMS Data by Type of Sleeper

Subscales	Very Good N = 66 $\bar{X}$ ($\pm$ sd)	Good N = 98 $\bar{X}$ ($\pm$ sd)	Average N = 86 $\bar{X}$ ($\pm$ sd)	Poor N = 24 $\bar{X}$ ($\pm$ sd)	Very Poor N = 4 $\bar{X}$ ($\pm$ sd)	F
Tension	8.56 (5.69)	10.89 (6.25)	12.51 (6.05)	15.83 (7.33)	15.75 (10.24)	7.83
Depression	6.52 (6.56)	9.73 (7.06)	12.86 (9.93)	15.13 (13.33)	26.00 (17.64)	9.91
Anger	5.95 (5.32)	8.70 (6.65)	10.35 (8.06)	10.63 (5.81)	16.75 (14.73)	5.60
Vigor	21.42 (5.52)	17.95 (5.66)	15.07 (6.41)	15.79 (8.07)	13.25 (8.06)	11.16
Fatigue	5.09 (5.03)	7.41 (4.79)	9.76 (6.14)	9.92 (6.41)	16.50 (7.85)	10.27
Confusion	6.12 (3.95)	7.64 (4.33)	9.59 (4.32)	10.54 (6.92)	12.75 (9.46)	8.22

EEG Sleep Data. Some of the sailors were asked to volunteer for several nights of study in the sleep laboratory. Twenty-four subjects (12 poor and 12 good sleepers) from Sample 1 were recorded as part of a flurazepam study.[3,9] EEG sleep recordings were obtained on 2 screening nights to insure that subjects met laboratory criteria for good and poor sleep. In addition to a subjective report of poor sleep, the 12 poor sleepers were required to have an EEG-recorded sleep latency (stage 2) of greater than 30 minutes on both screening nights. Sixty-four percent of the group who said they were poor sleepers, and reported an estimated sleep latency of at least 45 minutes on 4 or more nights each week, fell asleep in the laboratory within 30 minutes. For the qualified poor sleepers, EEG sleep latency was 38 minutes, far shorter than their estimated 91 minutes. The 12 good sleepers' estimated sleep latency was 8 minutes, and their EEG-recorded latency was 13 ± 8 minutes.

The reported sleep patterns of these EEG-identified good and poor sleepers were very similar to the larger subjectively identified groups. The items that significantly differentiated the EEG-identified good and poor sleepers are listed in Table 3. More nightmares were reported by the poor sleepers, but the P value for this size sample was between $P < 0.10$ and $P < 0.05$. The POMS scores for the EEG-sleep-identified good and poor sleepers in Sample 1 are presented in Figure 1. The pattern of scores is exactly the same as that for the larger sample (Table 2), but, due to smaller N, the scores for Depression and Anger did not reach statistical significance.

EEG Qualified and Disqualified Poor Sleepers

To better understand the EEG-identified poor sleepers and those disqualified poor sleepers, we examined their EEG sleep patterns, questionnaires, and POMS scores. In one study of subjects in Sample 1, we contrasted 17 disqualified poor sleepers (EEG sleep latency less than 30 minutes) with the 12 qualified poor sleepers and with the EEG-sleep-qualified good sleepers.

EEG Sleep. Except for differences in sleep latency, there was no difference in any of the EEG sleep measures for qualified and disqualified poor sleepers. The disqualified poor sleepers did not differ significantly from good sleepers in sleep latency or any sleep measure.

TABLE 3

NHRC Sleep Questionnaire - Subjective Estimates of Sleep Quality
EEG-Identified Good and Poor Sleepers

Variable	Good Sleepers N = 12		Poor Sleepers N = 12	
	$\bar{X}$	(sd)	$\bar{X}$	(sd)
Estimated sleep latency (minutes)	8.0	(3.6)	91.3	(35.3)
Do you have trouble falling asleep? (never = 1, always = 4)	1.3	(.5)	3.4	(.8)
How often? (never = 0, 5 times/week = 6)	1.5	(1.1)	5.5	(.7)
Estimated sleep latency when sleep is troubled (minutes)	26.0	(22.0)	66.0	(5.0)
Estimated number awakenings/night	.3	(.6)	1.5	(1.4)
How often does this happen? (days/week)	.3	(1.0)	2.8	(2.1)
Estimated sleep latency after nocturnal arousals (minutes)	3.0	(3.0)	13.0	(9.0)
Naps: Sleep latency (minutes)	8.0	(7.0)	26.0	(22.0)
Sleep rating (very good = 1, very poor = 5)	1.3	(.5)	4.1	(.3)
Do you feel well-rested when you awaken? (always = 1, never = 4)	2.4	(.9)	3.5	(.5)
Do you have difficulty getting out of bed? (never = 1, always = 4)	1.6	(.5)	3.0	(1.0)

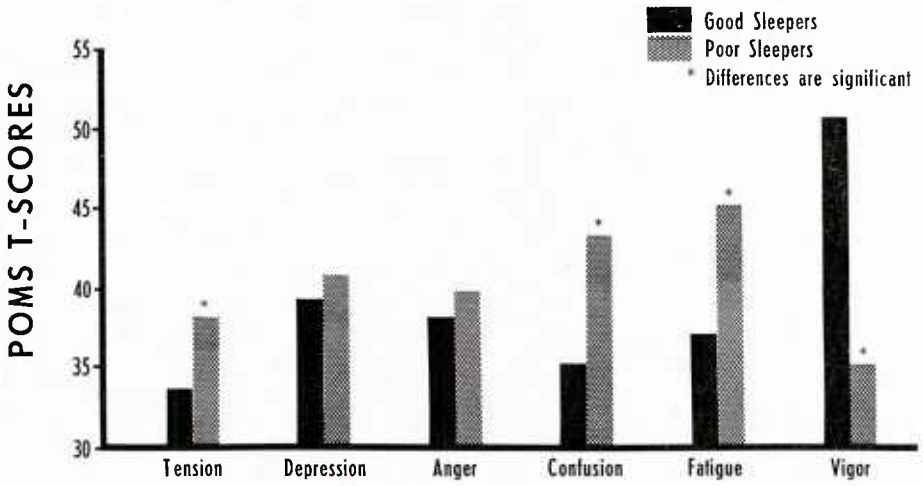

Fig. 1. Mean POMS subscale scores for laboratory-qualified good (N = 12) and poor (N = 12) sleepers. Asterisk (*) denotes significant differences, $P < 0.05$.

Sleep Questionnaire and POMS. The disqualified and qualified poor sleepers from Sample 1 did not differ significantly in their responses on the sleep questionnaire or in their POMS scale scores. This finding was replicated on a second sample of 30 qualified and 30 nonqualified poor sleepers. In this second sample, the EEG sleep latency for the qualified poor sleepers was 51 ± 27.8 minutes and that for the 30 nonqualified poor sleepers was 15 ± 6.1 minutes.

When the 17 disqualified poor sleepers were compared to the 12 good sleepers, the pattern of differences was exactly that found when these good sleepers were contrasted with qualified poor sleepers. Thus, except for differences in sleep latency, our disqualified and qualified poor sleepers were homogenous, and both groups differed from good sleepers.

Performance Correlates of Good and Poor Sleep

We are currently monitoring the career history of good and poor sleepers from Samples 1 and 2. Sample 1 includes 506 sailors who classified themselves as "very good" or "good" sleepers and 109 who reported being "poor" or "very poor" sleepers when corps school students during 1976 and 1977. Sample 2 includes 1,024 "good" or "very good" sleepers and 188 "poor" or "very poor" sleepers who were students during 1978–79.

Navy Predictors. Our first analysis was the comparison of our good and poor sleepers on demographic and aptitude scores that have been found to be predictive of success in the Navy. These comparisons are listed in Table 4. The SCREEN score is a composite weighted predictor that includes age, education, AFQT, and marital status. Though length of service is not a predictor at enlistment, it is highly correlated with a number of performance measures such as promotions and paygrades. There were no significant differences on any of these variables between good and poor sleepers in Sample 1 or Sample 2.

School Performance. Our good and poor sleepers from Sample 1 did not differ in school performance. School performance data were not collected from Sample 2. There was no significant correlation between type of sleep nor any other sleep measure and final class grades. We also tabulated the number of sick calls made by each sailor during corps school and compared this number with subjective estimate of sleep quality. Again, no significant relationship was found.

TABLE 4

Predictors of Navy Performance

	Sample 1		Sample 2	
	Good $\bar{X}$ ($\pm$ sd)	Poor $\bar{X}$ ($\pm$ sd)	Good $\bar{X}$ ($\pm$ sd)	Poor $\bar{X}$ ($\pm$ sd)
Age*	22.9 (2.7)	23.04 (3.4)	21.9 (3.1)	21.6 (3.1)
Years of education	12.5 (1.3)	12.3 (1.3)	12.3 (1.2)	12.0 (1.2)
AFQT	72.2 (16.2)	69.6 (16.6)	63.2 (16.4)	60.9 (14.2)
SCREEN score	86.8 (5.2)	85.8 (5.0)	84.0 (7.0)	81.4 (7.3)
Years in service*	2.5 (1.0)	2.5 (2.3)	1.4 (1.0)	1.2 (0.7)

*At time of first follow-up

Similarly, school performance and number of sick calls for the 12 EEG-identified good sleepers and the 12 EEG-identified poor sleepers were not significantly different. There were also no differences between these two groups on AFQT and educational level or SCREEN score.

Longitudinal Data

Longitudinal data were obtained for Sample 1 in December 1978, September 1980, and December 1981, and for Sample 2, in September 1980 and December 1981. Measures of career performance for good and poor sleepers included number of promotions, highest paygrade obtained, attrition rate, type of reenlistment recommendation, type of discharge, number of demotions, and number of unauthorized absences (UAs)/absences without leave (AWOLs). At no point did good and poor sleepers differ in number of demotions, UAs and AWOLs, or in dishonorable or undesirable discharges.

Performance Effectiveness - Promotions. Promotion in the Navy, as in civilian occupations, is a major criterion of effectiveness. The number of promotions obtained by poor sleepers was significantly lower in 1980 (χ^2 = 15.39, df = 6, $P < 0.02$) and in 1981. As illustrated in Figure 2, by December 1981, 32.1% of the poor sleepers had received zero or only one promotion while only 16.0% of good sleepers received zero or one promotion. In contrast, 84% of good sleepers had received two or more promotions while a smaller percentage of poor sleepers, 67.9%, had received two or more promotions during their Navy careers. Promotions come more slowly for poor sleepers.

Paygrade. Closely related to number of promotions is paygrade and, as expected, poor sleepers remained in lower grades during the period of follow-up. As early as 1978, poor sleepers were significantly (χ^2 = 20.09, df = 4, $P < 0.001$) more likely to be in the lower paygrades of E1 (Recruit) and E2 (Apprentice) than good sleepers. Three years later, 20.2% of the poor sleepers were still in the lower two paygrades of E1 and E2; 33.9% of poor sleepers were in the lowest three paygrades, E1, E2, and E3 (Nonrated). For good sleepers, the corresponding percentages are 8.9% and 20.8% (Table 5).

Recommendations for Reenlistment. Whether a sailor is permitted to reenlist depends heavily upon the recommendation he receives from his superiors. Poor sleepers were less frequently recommended for reenlistment. At the time of the 1981 follow-up, reenlistment recommendations had been prepared for 340 good and 87 poor sleepers. Sixty percent of the poor sleepers compared to 80.0% of the good sleepers (χ^2 = 14.40, df = 1, $P < 0.001$) received positive reenlistment recommendations.

Attrition. Based upon the afore-described differences between good and poor sleepers in number of promotions, highest paygrade, and recommendations for reenlistment, it is not unexpected that good and

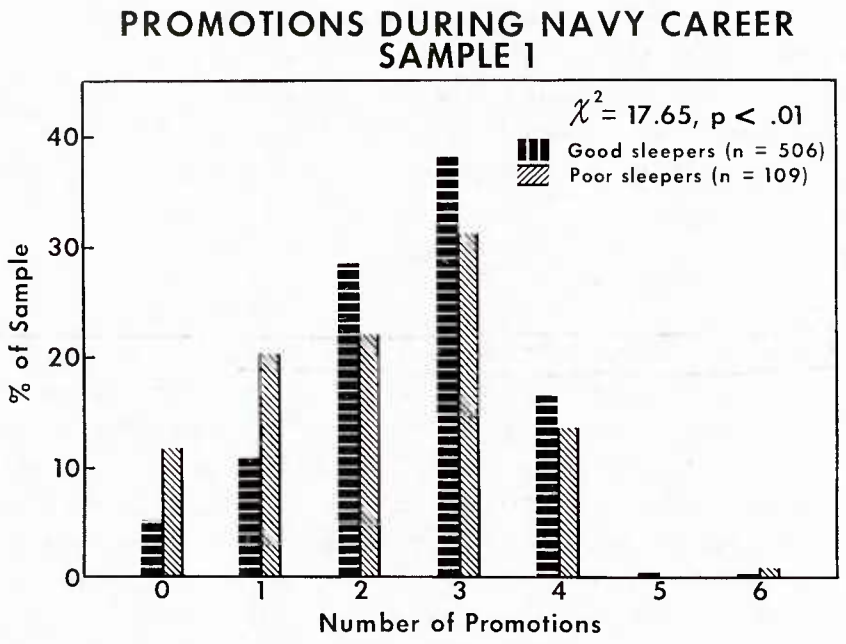

Fig. 2. Percent of good and poor sleepers receiving 0—6 promotions as of December 1981.

TABLE 5

Highest Paygrade - Sample 1 (1981)

	Paygrade						
	E1 %	E2 %	E3 %	E4 %	E5 %	E6 %	E7 %
Good sleepers	2.77	6.13	11.86	45.85	32.61	0.79	0
Poor sleepers	9.17	11.01	13.76	40.37	22.02	2.75	0.92

poor sleepers would also differ in attrition rate. In the 1978 follow-up, attrition rate was significantly higher in the poor sleeper group, with 84.1% of good sleepers still in service compared to 64.8% of poor sleepers (χ^2 = 19.94, df = 1, $P < 0.001$). Three years later, 1981, 32.4% of good sleepers were still in service, compared to 20.2% of the poor sleepers (χ^2 = 5.79, df = 1, $P < 0.02$).

Hospitalizations. Hospitalization data were available for Sample 1 subjects up to December 1979. Two hundred and two good sleepers (39.9%) had one or more hospitalizations during their Navy careers compared to 58 poor sleepers (53.2%) (χ^2 = 5.96, df = 1, $P < 0.02$). A larger percentage of poor sleepers, 24.8%, had two or more hospitalizations than good sleepers, 14.2% (χ^2 = 6.86, df = 1, $P < 0.01$). Good and poor sleepers did not differ in the number of psychiatric diagnoses associated with hospitalizations, length of hospitalizations, or in the number of medical discharges related to these hospitalizations.

Replication, Sample 2. Longitudinal data for Sample 2 were collected to provide replication of the findings from Sample 1. In December 1981, 87.5% of the good sleepers and 84.0% of the poor sleepers in Sample 2 were still on active duty, and so, at the present time, poor sleepers of Sample 2 are not showing the early, higher rate of attrition compared to good sleepers as found in Sample 1.

However, all other performance measures which differentiated good and poor sleepers in Sample 1 are also differing between good and poor sleepers of Sample 2. Poor sleepers have had significantly fewer promotions ($\chi^2 = 15.63$, df = 5, $P < 0.01$) (Table 6) and remain in lower paygrades ($\chi^2 = 20.83$, df = 4, $P < 0.001$) (Table 7). Reenlistment recommendations have been written for 123 good and 30 poor sleepers in Sample 2; 90.0% of the poor sleepers were not recommended for reenlistment compared to 69.1% of good sleepers ($\chi^2 = 4.36$, df = 1, $P < 0.05$).

DISCUSSION

Compared to good sleepers, poor sleepers are less effective sailors. On all measures used as indices of Navy performance, poor sleepers performed less effectively. As a group, poor sleepers received fewer promotions during their careers and thus remained in lower paygrades, were less frequently recommended for reenlistment, and their attrition rate was higher. These significant performance differences evolved during their Navy tour, even though these good and poor sleepers did not differ at the time of their enlistment on the variables that are predictors of success in the Navy, including age, educational level, AFQT, and the composite SCREEN score, and they also did not differ in length of service time. While more ineffective as sailors, poor sleepers were not disciplinary problems. The two groups showed no difference in number of desertions, unauthorized absences, court martials, and dishonorable or bad conduct discharges. The poor sleeper, however, was more likely to be hospitalized during his tour of duty. Three possible factors could be related to the less effective performance of poor sleepers: (a) shorter total sleep time leads to a chronic sleep debt, (b) the sleep of poor sleepers is of poorer quality, or (c) poor sleep is one of the complaints that characterize people with chronic psychological problems.

Differences in total sleep time would appear to be the least important contributing factor. First, though our poor sleepers report subjectively shorter total sleep, over 60% of them showed no significant reduction in sleep when compared to good sleepers in the sleep laboratory. Also, on days off, the

TABLE 6

Promotions - Sample 2 (1981)

	Number of Promotions					
	0 %	1 %	2 %	3 %	4 %	5 %
Good sleepers	10.25	35.35	36.62	17.19	0.49	0.10
Poor sleepers	19.15	27.66	38.83	14.36	0	0

TABLE 7

Highest Paygrade - Sample 2 (1981)

	Paygrade				
	E1 %	E2 %	E3 %	E4 %	E5 %
Good sleepers	8.50	17.19	31.74	40.14	2.44
Poor sleepers	16.49	15.96	38.83	27.66	1.06

good and poor sleepers' reported total sleep time did not differ significantly. Thus, if the poor sleepers were in need of more sleep, this lost sleep was not "made up" on non-duty days when bed time is not restricted.

Attempts to find significant correlates of total sleep time have generally been disappointing in laboratory and nonlaboratory studies. As noted in the introduction, Webb & Friel[15] found no performance differences between their short and long sleepers. Also, as noted in the introduction, Johns *et al.*[6] did not find total sleep time to be predictive of medical school grades. We, likewise, found no significant relationship between either estimated or EEG-recorded total sleep time and academic performance in Navy corps school students and in 303 college students studied by the senior author. In any case, it is difficult to argue that a fixed amount of sleep is necessary for effective awake behavior, considering the wide range of individual differences in sleep length found in numerous surveys and laboratory studies.

Could there be a difference in sleep quality? Before answering this question, our classification of good and poor sleepers should be discussed. We were aware of the shortcoming of subjective estimates of sleep quality and particularly of the tendency of insomniacs to overestimate their sleep latency and underestimate their total sleep time.[2] We, thus, compared our subjective estimates of sleep quality with recorded EEG sleep data. Our EEG sleep laboratory study of a group of good and poor sleepers was consistent with those reported by Carskadon *et al.*[2] However, these EEG-defined good and poor sleepers' subjective sleep habits and POMS scores were very similar to our good and poor sleepers defined by subjective estimates of sleep quality. This similarity in the objectively and subjectively defined good and poor sleepers thus allows us to have confidence that we are dealing with reliable group differences in our follow-up samples.

Since over 60% of our poor sleepers do not meet EEG criteria for sleep-onset insomnia, a reasonable question is whether these laboratory-disqualified poor sleepers, whom some call pseudo-insomniacs, differ from the qualified poor sleepers. Our analysis of two groups of qualified and disqualified poor sleepers indicated that they did not. In the group from Sample 1, when we compared our disqualified poor sleepers with the good sleepers, the pattern of differences on the sleep questionnaire and POMS scores were identical to those found when the qualified poor sleepers and good sleepers were contrasted. In both Sample 1 and Sample 2, the sleep questionnaire and POMS scores for EEG-qualified and disqualified poor sleepers were very similar. Aside from sleep latency, qualified and disqualified poor sleepers' sleep measures did not differ. Similarly, after sleep onset, the sleep measures for good sleepers were similar to that for qualified and disqualified poor sleepers. From the above comparisons, it appears reasonable to hypothesize that individuals who classify themselves as good and poor sleepers differ in important ways irrespective of laboratory sleep findings. But the EEG-sleep-qualified and disqualified poor sleepers appear to be similar except for EEG sleep latency.

Then does the quality of sleep for good and poor sleepers differ? We must answer "yes" based upon the subject's report, but the stated reason for the poor quality will vary from one poor sleeper to another. Though we were unable to find EEG sleep measures aside from sleep latency which support the claim of poorer quality sleep, we must not rule out the possibility that such indicators will be found in the future.

It is our belief that our third factor is the most important. We believe that the complaint of poor sleep has to be viewed with respect to the total psychological state or well-being of the person. We believe that this complaint or poor sleep is significant, irregardless of whether this complaint is verified by our current EEG sleep measures. It is well accepted that insomnia is best thought of as a

symptom. The sleep disorders nomenclature promulgated by the Association of Sleep Disorders Centers clearly attests to this fact.[1] Under the disorders of initiating and maintaining sleep (DIMS), 8 major categories and, under these, 16 sub-categories (events, states, or conditions) are listed that may be associated with DIMS. Our sample of poor sleepers would appear to be most similar to those classified as psychophysiological persistent, although, for many, there would be no objective EEG findings. Our poor sleepers most often reported the essential features of persistent psychophysiological DIMS, *i.e.*, "Persistent psychophysiological DIMS is a sleep-onset and intermediary sleep maintenance insomnia that develops as a result of the mutually reinforcing factors of chronic, somatized tension-anxiety and negative conditioning to sleep" (p.24). Our poor sleepers showed evidence of a persistent sleep problem, reported feelings of anxiety and tension, and their increased number of hospitalizations attests to their higher number of somatic problems. It is our hypothesis that it is this "psychological excess baggage," if you will, that accounts for the poor sleep and also contributes to their ineffective performance in the Navy. Putting it another way, poor sleepers have poor coping skills.

This psychological profile of the poor sleeper is consistent with the recent report of Healey *et al.*,[4] in which good and poor sleepers were compared on the role of life-stress events and on psychological factors. Healey *et al.* noted that "The chronic insomniacs were, as a group, largely characterized by feelings of inferiority, self-doubt, and depression" (p.448). For Healey *et al.*, "the development of insomnia can be seen as a primary manifestation of their maladaptation syndrome" (p.448). Another similarity between the poor sleepers studied by Healey *et al.* and those in our sample is apparent in the hospitalization data. Their poor sleepers reported more hospitalizations on a Health Questionnaire, and our medical records revealed that significantly more poor sleepers were hospitalized. Even though there are marked psychological differences between good and poor sleepers, we, like Healey *et al.*, found that poor sleepers did not have a significantly larger number of hospitalizations for psychiatric reasons.

Some may wonder why these psychological factors and their potential interaction with poor sleep did not result in lower academic performance and more sick calls while in corps school. We, of course, have no definitive answer but we believe several factors are important. First, corps school is a well-structured setting in which a good deal of individual support is available if needed. Second, the students are very motivated to do well because failure could mean chipping paint at sea, and higher scores are associated with more desirable post-school assignments. A third factor is that the corps school program is a 10-week fixed time period and thus the end is always in sight.

Other Navy assignments usually do not offer these coping aids, and the chronic self-doubt, tension, and anxiety with its associated subjective poor sleep begin to take their toll. It is our belief that these relatively young poor sleepers, as they grow older, are the insomniac patients seen in the sleep disorders centers and by family practitioners. As they age and lose some of their youthful vigor, they will become more dissatisfied with their daytime feelings of fatigue and dysphoria, as well as their lowered performance. It is at this time that they will seek a sleeping pill, for, as is typical with these patients, they have minimal insight into the cause of their insomnia and believe that all they need is a good night's sleep.

Over the past 20 years, the Navy has conducted extensive research in an effort to identify predictors of effective performance in the Navy.[13] The SCREEN score is the current set of predictors used in evaluating potential naval effectiveness. Particular attention has been given to determining predictors of effective academic performance by corpsmen, with minimal success.[10] Data on predictors of performance by corpsmen in the fleet are unavailable. Our data suggest a simple 5-response question -- What kind of sleeper are you -- should be added as a useful predictor. However, instead of using the

responses to reject or remove potential sailors and corpsmen, we believe those admitting to poor sleep should be provided special attention. Unlike the demographic variables such as age, education, and AFQT, poor sleep, as we conceive it, is a symptom. Though complex and varied, we suspect that the causal factors may be resolved by therapeutic intervention. For many, this intervention would consist of a brief course on good sleep hygiene. For others, short-term counseling might be added, and, for a few more, extensive psychiatric intervention might be necessary. Since over 60% of our poor sleepers will probably not have sleep-induction or sleep-maintenance problems, routine prescription of a sedative-hypnotic does not seem desirable. What is obvious from our results is that, when no attention is given to the complaint of poor sleep, the Navy pays the price of less effective performance, more hospitalizations, and early attrition. Finally, these data are from corpsmen. While we believe that poor sleep will be a correlate of ineffective performance in various Navy occupations, this hypothesis must be tested for personnel in other specialties.

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