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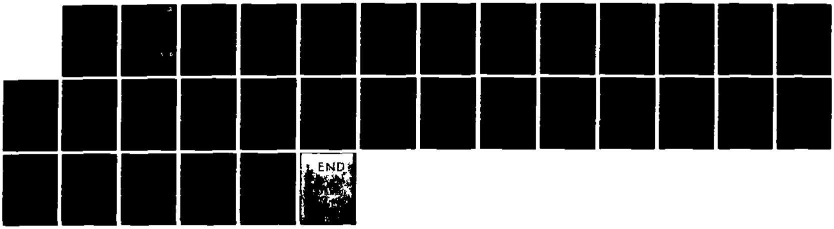

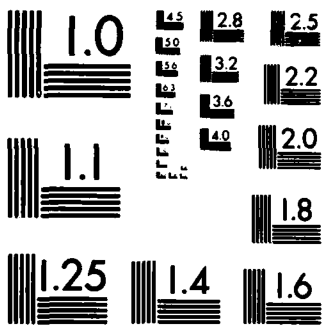

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NAVY COMPANY COMMANDERS: SERUM URIC ACID AND CHOLESTEROL VARIABILITY WITH JOB STRESS

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NAVY COMPANY COMMANDERS:

SERUM URIC ACID AND CHOLESTEROL VARIABILITY WITH JOB STRESS*

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ABSTRACT

Variability in both serum uric acid and cholesterol was measured in 46 Navy company commanders during their first experience leading recruits through boot camp training. In addition, 34 of these men were studied as they trained their second company; this allowed for investigation of uric acid and cholesterol variability during these men's initial and second experiences with identical job stresses.

Serum uric acid data revealed a significant elevation early in stressful training. This result was particularly evident during the first recruit company. Serum cholesterol showed a significant fall relatively late in training. A similar pattern for serum cholesterol was seen over both the first and second companies, but the observed fall was slightly greater during the first company. Within-person analyses indicated that the men's perceived job stress was a consistent psychological correlate of serum cholesterol, but not of serum uric acid. The different temporal patterns found for these two serum metabolites are discussed along with the possible health significances of psychobiological adaptation.

INTRODUCTION

This report is one in a series which presents findings for selected biological responses to job stress in U.S. Navy company commanders (CC). The complete study is based on our prior research model which traces the effects of environmental stress through several moderating variables in determining its ultimate effects on health (1,2). Hence, main effects investigated were the relationships between job stress and CC psychological and biological responses to stress, as well as relationships between job stress and health and performance (1). Intervening variables studied, which might influence these main effects, included selected biographical and developmental information, social support data, estimates of past and current job satisfactions, measures of psychological defenses and coping styles, and estimates of illness behavior (1). Our initial report details the complete study. The present report focuses on that portion of the data base dealing with CC serum uric acid and cholesterol variability in response to a repeated pattern of high and low job stress.

Navy CC are senior Navy enlisted personnel responsible for teaching new recruits military codes and standards during a highly structured 9-week period of "boot camp." These CC experience two distinct levels of job stress during a recruit training cycle; very high stress is encountered over the first two to three weeks of training while relatively low stress characterizes the remainder of the training cycle (1). By investigating Navy CC over their first and second recruit companies we were able to investigate psychobiological adaptation in these men exposed to two identical sets of job stresses in close succession.

Serum uric acid and cholesterol variability has been previously studied in men involved in substantial job stresses by several investigators (3-13). Most of these studies documented elevations in these two blood metabolites at the time of the investigated stressful life experience. However, rather specific temporal response patterns were observed. Serum cholesterol elevations were generally seen to develop during the stressful experience itself while serum uric acid elevations were usually found at the beginning of, or even immediately prior to, the life stress situation. U.S. Air Force and U.S. Army military academy cadets showed significantly elevated serum uric acid levels immediately prior to the start of their first academic year (3,4). Studies of medical students preparing for important final examinations found significantly elevated serum uric acid and serum cholesterol concentrations on the day of the exam (5,6). Factor workers experiencing imminent plant closure and resultant job loss showed a significant serum uric acid elevation prior to job termination and a significant serum cholesterol elevation once their period of unemployment began (7). At the Naval Health Resesarch Center we repeatedly observed dramatic elevations in serum uric acid in physically fit young men on the day prior to commencing demanding "frogman" training. Serum cholesterol elevations were seen in these men once they were into training, specifically during periods of acute job stress where failure was a likely outcome (8-10).

It has also been suggested that these two serum metabolites are associated with performance under stressful circumstances. For example, medical students' performances on critical academic examinations were found to be positively related to their serum uric acid levels and negatively related to their serum cholesterol concentrations determined just prior to the exams (11). In the job loss study, serum uric acid levels were highest in men who did not wait for plant closure to secure new employment but instead found new jobs before their old ones were terminated (7). A rough relationship was seen between serum uric acid level in men prior to job loss and the speed with which they obtained new employment (7). These serum uric acid data are consistent with the findings of a study of university professors in which their serum uric acid levels were correlated with psychological traits of leadership, achievement, and drive (12). Similarly, a significant relationship was observed in one of our Navy studies between the levels of trainees' serum uric acid and their motivation for upcoming arduous training (9,13).

Research Issues

Although previous studies have consistently reported that serum uric acid is often responsive to the challenges of a new job and that serum cholesterol elevations tend to occur later in the job stress situation, most of these studies have relied upon very few serum determinations per subject and have generally used a between-person research design. In the present study we included multiple serum measurements allowing for within-person analyses as well as the more common between-person comparisons. It was anticipated that the results from such a longitudinal study might add appreciably to our understanding of responsivity of these two serum metabolites to job stress (14).

The collection of repeated measures in this study enabled us to examine within-person biological responses to uniform and systematic variation in job stress, using each man as his own control. Furthermore, a subset of the study participants was followed throughout two training cycles which allowed us to examine the consistency of these responses and to determine whether adaptation occurred. Because perceived stress measures were gathered on each man along with the blood draws, it was possible to examine within-person covariation between serum uric acid and cholesterol levels and subjective stress. Finally, the relatively large number of measurements for each individual provided the capability of determining whether average trends in serum uric acid and cholesterol variation were accounted for by a subset of "responders" or could be generalized across all study participants.

Based on the above, we addressed the following research questions:

1. Do men's serum uric acid and cholesterol levels show significant and consistent variability across study days known to vary in job stress?

2. Do men's serum uric acid and cholesterol levels show adaptation (i.e., attenuated responses) upon their second exposure to identical job stresses?

3. Do men's serum uric acid and cholesterol levels at the beginning of Company Commander School predict their subsequent performances?

4. Do within-person analyses indicate that men's serum uric acid and cholesterol levels covary with job stress for only a subset of "responders" or for all persons studied.

METHODS

Participants

Sixty-four male senior petty officers, the complement of six consecutive classes of Company Commander School (CCS) at Naval Training Center, San Diego, volunteered to participate in the study. For various administrative reasons twelve of the original volunteers did not continue as company commanders during the course of this study; seven of these men were dropped from CCS for unsuitability. Six other men were relieved from duty while leading their first company. Although each of these six men were later followed through another company which they successfully led to completion, they were excluded from the primary analyses because their experiences were not entirely comparable to those who did not experience early failure. The remaining 46 successfully led their first company of recruits; 34 of these men were followed over their second company as well. These 34 individuals comprised the sample for analyses of adaptation to job stress.

The 46 men who successfully led their first company had an average age of 33 (SD = 4) years. These men had 11.9 (SD = 1.2) years of education and 14 (SD = 4) years of active military service. Thirty-two were Caucasians, eight were black, and six were of other racial origin. Forty men were married, one was separated, three were divorced, and two had never married. These 46 men did not differ significantly on any demographic dimension from the 18 men who originally volunteered but did not continue throughout the study. Similarly, the 34 who were followed through their second company did not differ on any demographic dimension from the 12 who were not followed beyond one recruit company.

Study Days and Measures

A detailed description of the 14 study days was presented in our first report (1). Briefly, volunteers were studied on their first and last days of CCS (designated CCS-1 and CCS-2, respectively) and on six days during each training cycle (designated I-1 through I-6 and II-1 through II-6, for the first and second companies, respectively). The six study days for one company represented two levels of job stress: high stress (study days 2, 3, and 4) and low stress (study days 1, 5, and 6). Also, CCS-1 and CCS-2 were found to be low job stress (1). The job stress measure used in this report was a rating of perceived work load, using a five-point Likert scale from "not much to do" [1] to "too much to do [5]. Participants rated their work load for all study days except CCS-1 (1).

In consideration of participants' rigorous training schedules, each man was met on a study day at his convenience, usually between 7 a.m. and 12 noon. Ten cubic centimeters of venous blood were drawn, allowed to clot, and usually returned within an hour to the laboratory for centrifugation and separation of the serum. Uric acid levels were determined using phosphotungstate reagent with a uricase-treated blank for each test (15). The procedure followed was that described by American Monitor, except that volumes were reduced to 50 percent. Absorbance was measured at 750 nanometers. Total serum cholesterol concentrations were determined by adding 0.013 milliliter of serum to 1.30 milliliters of "A-Gent" cholesterol reagent (16). Incubation was performed as described by Abbott Laboratories, and absorbance of standards and test serum was measured at 500 nanometers.

Statistical Procedures

Two analysis of variance (ANOVA) procedures for repeated measures were used to establish the average pattern of variability in serum uric acid and cholesterol across study days. For these analyses the sample was divided into age-matched halves to provide for cross-validation of significant trends (1). The "Groups" factor in the ANOVA procedures represented these halves of the sample and was composed of two subgroups of 23 men who successfully completed their first company. For analyses of the group of 34 men followed through two companies, two subgroups of 17 men were utilized.

The first ANOVA procedure was a 2 x 8 "Groups x Days" analysis with repeated measures for the "Days" factor. This analysis compared serum uric acid and cholesterol levels for the two groups of 23 CC on the two study days in CCS and the six study days in the first recruit training cycle (17). Significance levels were determined using a conservative estimate of degrees of freedom (18). The second ANOVA procedure was a 2 x 2 x 6 "Groups x Companies x Days" split-plot design with repeated measures for both "Companies" and "Days" (19). This procedure was used to examine the pattern of serum uric acid and cholesterol change over the first and second companies for the two groups of 17 men. "Days" in this analysis were limited to the six study days in each of the two training cycles. Significant effects for "Companies" or "Companies x Days" would indicate biological adaptation to the repeated exposure of identical job demands.

The research question dealing with prediction of performance from serum uric acid and cholesterol levels was addressed by comparing the group of 46 men who graduated from CCS and successfully led their first recruit company with the seven men who were dropped from CCS due to unsuitability. Mean levels of serum uric acid and cholesterol on CCS-1 for the two groups were compared by t-test.

Within-person analyses were run to determine the generality of trends across individuals. Individual Pearson product-moment correlations were computed between subjective job stress ratings and serum uric acid plus job stress ratings and serum cholesterol levels for each of the 34 men followed through two companies. Thirteen paired stress-biological response observations existed, which included measures from all study days except CCS-1. Average correlations for the sample were computed using an $\underline{r}$ to $\underline{z}$ transformation (20). Hays' $\underline{V}$ statistic was computed separately for uric acid and cholesterol to determine whether the individual correlations could be assumed to be drawn from a population with a common "true" correlation (21). A significant $\underline{V}$ statistic would indicate that the correlations were heterogeneous and represented two or more subsets of individuals with different "true" correlations. Finally, a binomial test was used to determine whether or not the number of significant individual correlations found exceeded what would have been expected by chance alone (22).

RESULTS

Table 1 presents mean serum uric acid levels for the 46 men followed throughout CCS and their first training company. The "Groups x Days" ANOVA showed significant variation across days ($F = 7.60$, $p<.01$) accounting for 4.5% of the total variance (14.9% of the within-person variance). Mean serum acid levels for study days CCS-1, I-1, and I-2 were significantly higher as a group than values on days I-3, I-4, I-5, and I-6. Although a significant "Groups" effect (F = 4.54, $p<.05$) was seen, this was likely a chance occurrence as no other significant groups effects were found in a total of seven biological response measures.

[Insert Table 1 about here]

Figure 1 shows the pattern of mean serum uric acid variability across study days for the 34 men followed throughout their first and second companies. It can be seen that the variability pattern was highly comparable across the two companies, except that uric acid values seen during the first company were generally higher compared to identical study days in the second company. Mean uric acid across study days I-1 through I-6 was 5.24 mg% compared to 5.04 mg% for study days II-1 through II-6.

[Insert Figure 1 about here]

The "Groups x Companies x Days" ANOVA tested for evidence of biological adaptation for the 34 CC with a repeated exposure to identical job stresses. A significant "Days" effect was found for serum uric acid ($F_{1,32} = 7.22$, $p<.05$) which accounted for 2.6% of the total variance (9.4% of the within-person variance). A significant "Companies" effect also was found ($F_{1,32} = 6.25$, $p<.05$), although it accounted for only 0.6% of the total variance (2.1% of the within-person variance).

As the mean serum uric acid levels on study days I-1 and I-2 were found to be significantly different from those on study days I-3 to I-6 (cf., Table 1),

TABLE 1. Ordering of Daily Means for Serum Uric Acid and Serum Cholesterol Across Study Days in CCS and the First Training Company (n = 46)

SERUM URIC ACID

Study Days	I-2†	CCS-1	I-1	CCS-2	I-4†	I-6	I-3†	I-5
Means (mg%)	5.64	5.61	5.59	5.26	5.07	5.06	5.04	5.00

SERUM CHOLESTEROL

Study Days	CCS-1	I-1	I-2†	CCS-2	I-6	I-5	I-3†	I-4†
Means (mg%)	211	206	205	202	197	188	176	166

NOTE: Daily means which share a common underline do not differ significantly when tested by the Tukey (a) procedure (cf., Winer, 1962, pp. 87–89).

†High stress days early in the recruit training cycle.

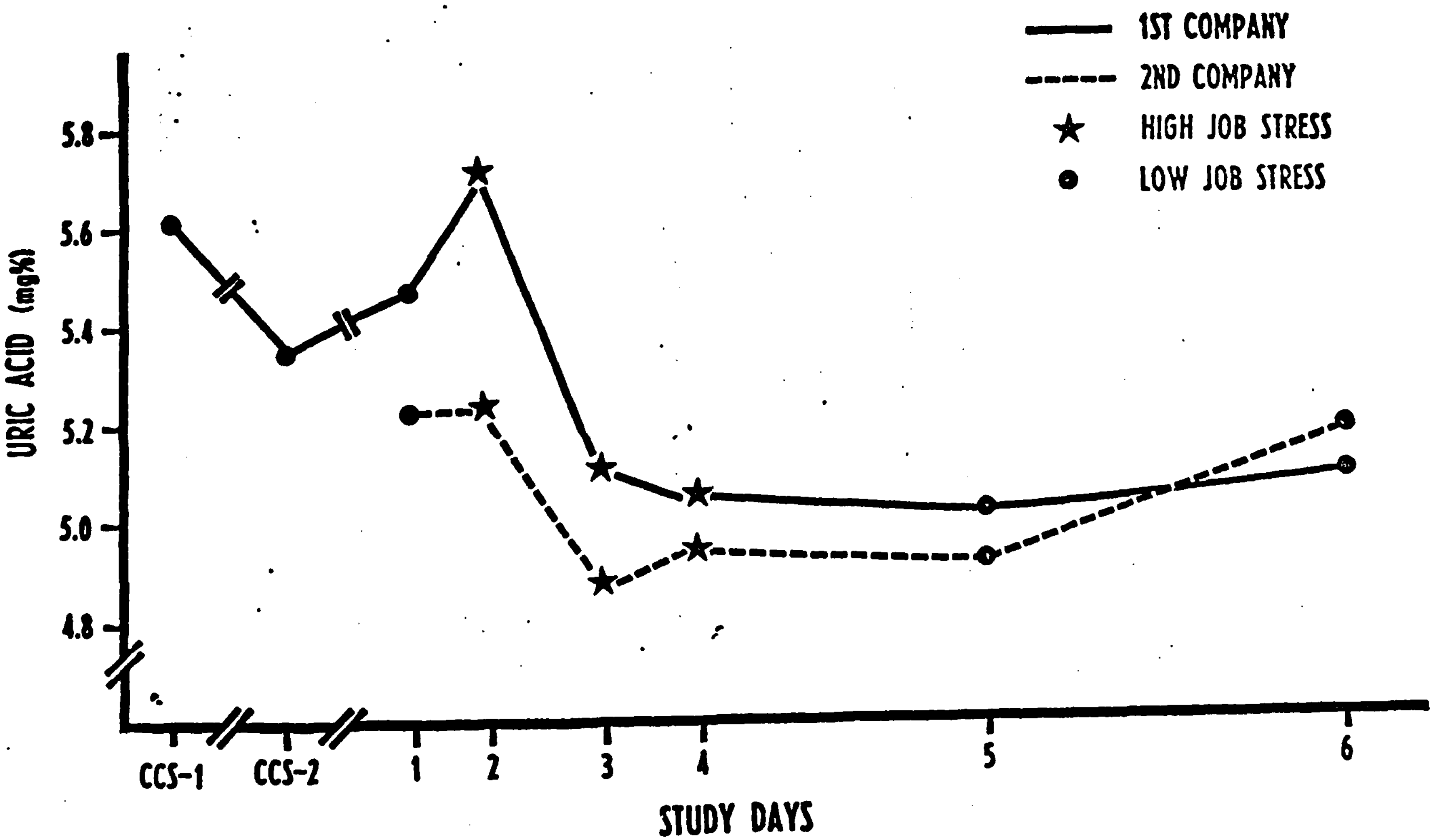

Figure 1. Pattern of mean serum uric acid levels for the 34 CC followed across all study days.

mean values were computed to represent the early serum uric acid elevation (average of study days 1 and 2) and "baseline" (average of study days 3, 4, 5, and 6) for each company. Paired t-test comparisons using the 34 men followed over two companies showed that the early elevation in mean serum uric acid (5.58 mg%) during the first company was significantly greater than the mean elevation (5.22 mg%) seen during the second company ($t = 2.48$, $p<.02$). There was no difference between the mean "baseline" values for the two companies.

Mean serum cholesterol levels for the 46 men followed through CCS and the first company are also presented in Table 1. Significant variation across "Days" was found ($F_{1,42} = 32.17$, $p<.01$) accounting for 12.4% of the total variance (42.7% of the within-person variance). Serum cholesterol concentrations tended to fall over the course of the high stress days (I-2, I-3, and I-4) with a recovery to near initial values by the end of the training cycle (I-6).

Figure 2 shows the pattern of variability for serum cholesterol across all study days for the 34 men followed over two companies. It can be seen that the pattern of change within a training cycle was very similar over both companies. However, during the second company the fall seen in cholesterol during the high stress period was slightly less pronounced than it was for the first company. The mean serum cholesterol concentration across study days I-1 through I-6 was 186 mg% compared to 192 mg% for study days II-1 through II-6.

[Insert Figure 2 about here]

The "Groups x Companies x Days" ANOVA showed a significant "Days" effect ($F_{1,32} = 42.16$, $p<.01$) which accounted for 10.4% of the total variance (37.6% of the within-person variance). There was also a significant "Companies" effect ($F_{1,32} = 6.25$, $p<.05$) which accounted for only 0.5% of the total variance (1.8% of the within-person variance). The "Companies" effect indicated

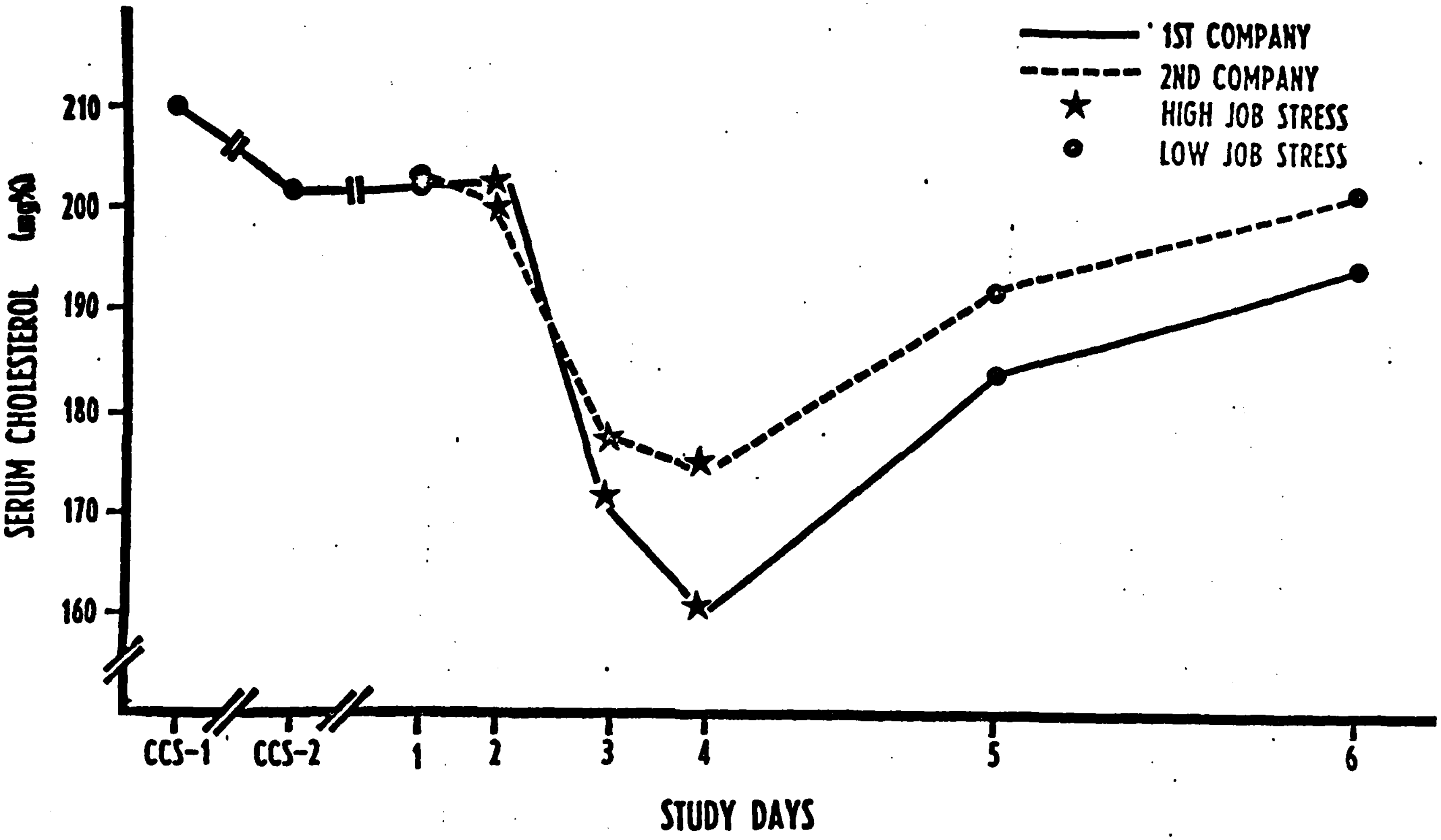

Figure 2. Pattern of mean serum cholesterol levels for the 34 CC followed across all study days.

that mean serum cholesterol levels were generally higher on the study days during the second company than on identical days during the first company (See Figure 2).

Comparisons between the group of 46 successful CC and the seven men who were dropped from CCS due to unsuitability indicated a significant difference between mean CCS-1 serum cholesterol levels, but not for mean CCS-1 serum uric acid levels. Mean serum cholesterol for the successful CC was 212 mg% compared to 249 mg% for those who were dropped from CCS ($t = 2.09$, $df = 51$, $p<.05$). This comparison remained significant ($p<.05$, one-tailed) even after controlling for possible confounding effects of age and body mass. Although the successful CC had a slightly higher mean serum uric acid (5.58 mg%) than the unsuccessful CC (5.07 mg%), this difference was not statistically significant ($t = .94$, $df = 51$, ns).

A scattergram of within-person correlations for serum uric acid and perceived job stress along with those for serum cholesterol and job stress for the 34 men studied across two companies is presented in Figure 3. The correlations seen between serum uric acid and job stress clustered around zero (average $r = 0.04$). The correlations found between serum cholesterol and job stress were shifted in the negative direction (average $r = -.29$). Hays' $\underline{V}$ statistic was nonsignificant for both sets of correlations indicating that the men could be regarded as coming from single populations with common "true" correlations.

[Insert Figure 3 about here]

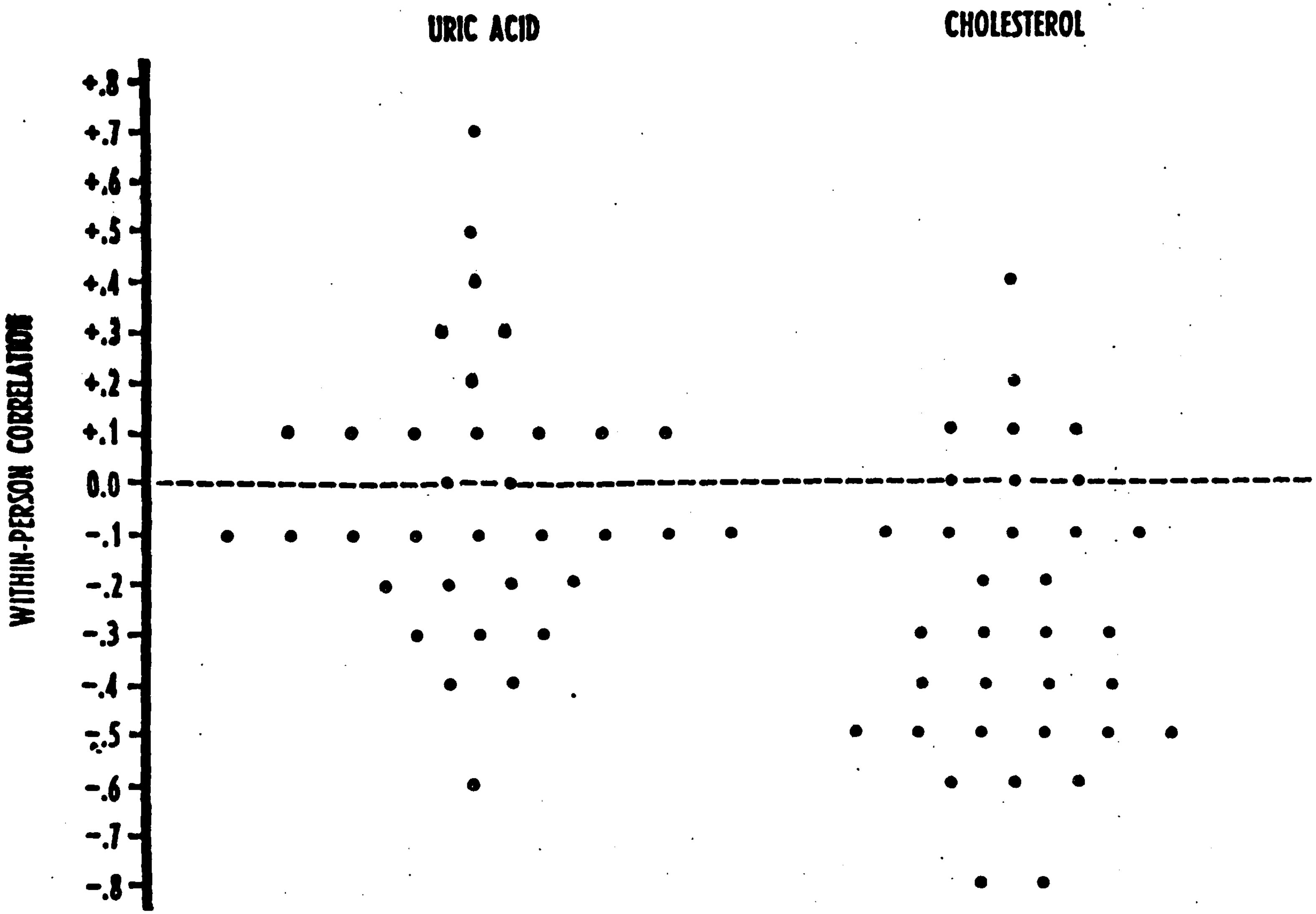

Figure 3. Distribution of within-person correlations between job stress and serum levels of uric acid and cholesterol for the 34 CC followed across all study days.

DISCUSSION

The relationships of serum uric acid and serum cholesterol variability to job stress appeared to be both consistent and specific. Readily apparent consistency was seen in both biological response profiles over the first and second recruit companies for those men studied twice. Specificity was evidenced in that serum uric acid was responsive to the very early days of new job stress while serum cholesterol showed a relatively late response to high job stress. Discussion of each response pattern will be taken in turn.

The early response of serum uric acid to new job stress was seen in both first and second companies, over the first two study days of the training cycle. This elevation was significantly greater for the first recruit company than for the second in men studied twice. This finding might be explained by the fact that although the recruits in the second company were new to the CC, the requirements of his job were now familiar to him. Thus, the newness of his job challenge was reduced accordingly. The likelihood that anticipation stress is involved is borne out by the observation that the two-week high job stress period failed to sustain these early (first two study days during training) elevations in serum uric acid. We conclude that the serum uric acid elevations seen in men at the beginning of a period of high job stress are intimately related to their anticipation of and early experience with the novel as well as the challenging aspects of their work.

Possible physiological mechanisms accounting for serum uric acid elevation in relation to starting a new job are far from clear. One intriguing possibility is a link with serum epinephrine. In animal studies, a serum epinephrine infusion led to a subsequent significant serum uric acid elevation (23). In human studies, the psychological description of subjects experiencing serum epinephrine elevations prior to taking on challenging task demands is extremely similar to what we observed above for persons showing serum uric acid elevations (24-26). Taken together, these studies support the notion that a key psycho-biological mechanism in serum uric acid elevation may be an antecedent secretion of epinephrine.

The serum cholesterol results in this study speak to both immediate and long-term biological responses. As in previous studies of serum cholesterol and job stress, we found that those men who were ultimately poor performers were discriminated from successful CC on the very first day of Company Commander School. This predictive utility for serum cholesterol supported the previously mentioned observations on medical student final exam performance and serum cholesterol (11). Long-term serum cholesterol response, however, presented quite a different pattern. The significant fall seen for serum cholesterol (in successful CC), beginning about the second week of training and not returning to baseline until near the end of the ninth week, was consistent across both companies for men studied twice. This pattern of serum cholesterol variability throughout a prolonged (3 week) interval of high job stress was previously seen in our own investigation of day and night aircraft carrier operations in a group of highly qualified naval aviators (27). Additionally, a study of successful competitors (top place finishers) completing a three-week dog sled race between two major cities in Alaska found a similar fall in the men's serum cholesterol

(28). Thus, a profile of a significant reduction of serum cholesterol in men who succeed under prolonged job stress appears to be a long-term stress response heretofore generally unrecognized.

Possible mechanisms responsible for the observed fall in serum cholesterol are several. First, weight loss must be considered. Whereas the dog sled competitors in the study mentioned above actually lost a good deal of body weight throughout their experience, weight loss in CC did not appear to be sufficient to explain the sizable fall in serum cholesterol level. During both training companies, CC lost an average of only four pounds from the first study day (I-1 and II-1) to the study day showing the maximum fall in serum cholesterol level (I-4 and II-4). Furthermore, after I-4 the men's average weight continued to drop another three pounds by I-6 despite a return of serum cholesterol to the original (I-1) mean level. A shift in dietary intake was a possible "real life" complication of around-the-clock CC duties. Shifts in eating pattern and composition of food intake might have resulted in a metabolic shift towards increased fat metabolism, leading to decreased body stores of cholesterol and a resultant fall in serum concentration. Finally, other real life confounding variables, such as sleep loss, increased physical exercise, increased coffee intake, cigarette smoking, and so on, may have played varied roles. In a future report we plan to look for possible significant covariation of many of these potentially confounding behaviors with not only serum cholesterol, but with all seven of our biological responses of job stress examined in this study.

A critical concept we are attempting to define in the overall CC study is what might be called "psychobiological responsivity." In the current report the issue is responsivity of the men's serum uric acid and cholesterol to the stresses of a new job. Moreover, attenuation of responsivity should provide an estimate of adaptation. For example, if CC responsivity of serum uric acid is, in part, due to the newness of the job demands then familiarization with these demands during the second company should result in attenuated uric acid responsivity. It is fascinating to speculate whether or not a quantitative comparison of first and second company responsivity could provide a quantitive estimate of adaptation.

To pursue such a quantitation of adaptation, serum uric acid and cholesterol data for the 34 men studied over two companies were examined. The only study day not affected by either the early response of serum uric acid or the later response of serum cholesterol was study day 6. Thus, we chose study days I-6 and II-6 as our baseline levels for these metabolites for the first and second companies, respectively. Next, for each company, the differences between "baseline" levels and maximal deviations seen of these two metabolites was computed as our measure of responsivity. For serum uric acid, the maximal elevation was seen on study day I-2; it was 12% higher than the baseline value for that company. For the second company maximal uric acid elevation seen on this same study day (II-2) was 1% higher than baseline for that company. For serum cholesterol, the maximal fall was seen on study day I-4; it was 17% lower than baseline for the first company. The level of cholesterol on the same study day (II-4) during the second company was 13% lower than baseline. Adaptation was estimated by comparing responsivity seen for the second company to that seen for the first. For serum uric acid adaptation was 12% minus 1% divided by 12%, or 92%. Adaptation for serum cholesterol was 17% minus 13% divided by 17%, or 24%.

The relevance of estimating psychobiological responsivity and adaptation for biological responses of job stress becomes clear when issues of illness risk are considered. For example, chronic elevation of serum uric acid levels is an established risk factor for both gout and coronary heart disease (29,30). If serum uric acid levels in individuals undergoing job stress remained elevated over weeks to months, due to lack of psychobiological adaptation, this biological response to job stress would represent an illness risk. However, in the present study, the pronounced adaptation observed between the first and second companies (92%) connoted essentially no illness risk to participants. In this study even the moderate adaptation seen for serum cholesterol was interpreted as no illness risk, in light of the very few studies suggesting that low serum cholesterol levels represent a substantative medical concern (31).

Within-person correlations between job stress and serum concentrations of uric acid and cholesterol were computed since mean values can mask important individual differences (32). That is, a subset of "responders" might show a particular biological response to job stress while others do not. This did not appear to be the case for serum uric acid and serum cholesterol in relation to the job stress measure used in this report. A few significant within-person correlations were observed for serum uric acid and job stress, but these could have occurred by chance alone given the total number of correlations computed. In contrast, the number of significant within-person correlations for serum cholesterol was greater than chance, assuming the null hypothesis of a "true" zero correlation. This seemed to reflect a general tendency across the entire sample as the average within-person correlation was considerably larger than zero and

and the dispersion of correlations was too small to conclude that this was due to a subgroup of "responders."

Within-person findings suggested that serum uric acid was not responsive to job stress as measured in this investigation. However, serum uric acid appeared to be closely related to other dimensions of job stress, such as anticipation of a new challenge. In contrast, serum cholesterol levels consistently varied with our stress measure across both time and sample. Thus, whatever the physical explanations of serum choelsterol fall during prolonged stress may be, perceived job stress appeared to be an important psychological dimension helping to explain serum cholesterol variability.

SUMMARY

This report examined serum uric acid and serum cholesterol variability in response to job stress in U.S. Navy recruit company commanders. This was a longitudinal, prosepctive study where these biological responses and job stress estimates were measured repeatedly in 46 men throughout their first experience leading a recruit company and in 34 of these same men throughout both their first and second companies. Major findings were:

1. CC serum uric acid concentrations showed consistent, significant, early elevations immediately prior to and on the first day of high job stress.

2. CC serum uric acid elevation was significantly greater for the first recruit company, compared to the second, in men studied twice.

3. CC serum cholesterol concentrations on the first day of Company Commander School were significantly lower for 46 men who ultimately led at least one company to completion than for 7 men who quickly proved unsuitable and were dropped from the school.

4. CC serum cholesterol levels showed a consistent, significant decline during the latter part of the high stress period, with an ultimate return to original levels by the end of training.

5. CC serum cholesterol variability showed a similar pattern over two recruit companies in men studied twice.

6. CC serum uric acid and cholesterol responsivity were analyzed, for men studied over both their first and second companies, to arrive at estimates of psychobiological adaptation. Adaptation was seen to be pronounced for serum uric acid and modest for serum cholesterol.

7. Within-person analyses of CC subjective job stress ratings and serum uric acid and cholesterol showed that only serum cholesterol exhibited significant covariation, across time, with the stress measure.

8. No evidence was found, by within-person correlational analyses, for a subset of "responders" who differed from the group as a whole in their covariation of these two serum metabolites with our measure of perceived job stress.

References

1. Ward HW, Rahe RH, Conway TL, et al: Navy company commanders: A psychobiological study of stress and adaptation. Report No. 79-25, Naval Health Research Center, P.O. Box 85122, San Diego, CA 92138
2. Rahe RH, Arthur RJ: Life change and illness studies: Past history and future directions. J Hum Stress 4:3-15, 1978
3. Clark DE, Foulds A, Brown DM, et al: Serum urate and cholesterol levels in Air Force Academy cadets. Aviat Space Environ Med 46: 1044-1048, 1975
4. Kasl SV, Sandler DP: An epidemiologic study of serum cholesterol and serum uric acid in a population of healthy young men. Milit Med 142:853-857, 1977
5. Thomas C, Murphy E: Further studies on cholesterol levels in the Johns Hopkins medical students: The effect of stress at examinations. J Chron Dis 8:661-668, 1958
6. Wertlake PT, Wilcox AA, Haley, MI, et al: Relationship of mental and emotional stress to serum cholesterol levels. Proc Soc Exper Biol & Med 97: 163-165, 1958
7. Kasl SV, Cobb S, Brooks GW: Changes in serum uric acid and cholesterol levels in men undergoing job loss. JAMA 205:1500-1507, 1968
8. Rahe RH, Arthur RJ: Stressful underwater demolition training. Serum urate and cholesterol variability. JAMA 202:1052-1054, 1967
9. Rahe RH, Rubin RT, Gunderson, EKE: Measures of subjects' motivation and affect correlated with their serum uric acid, cholesterol and cortisol. Arch Gen Psych 26:357-359, 1972
10. Rahe, RH, Biersner RJ, Ryman DH: Serum uric acid, cholesterol and psychological moods throughout stressful naval training. Aviat Space Environ Med 47:883-888, 1976

11. Bloch S, Brackenridge CJ: Psychological performance and biochemical factors in medical students under examination stress. J Psychosom Res 16:25-33, 1972

12. Brooks GS, Mueller E: Serum urate concentrations among university professors. JAMA 195:415-418, 1966

13. Biersner RJ, Ryman DH, Rahe RH: Physical, psychological blood serum, and mood predictors in preliminary underwater demolition team training. Milit Med: 142:215-219, 1977

14. Mefferd RB, Jr: Structuring physiological correlates of mental processes and states: The study of biological correlates of mental processes. In Cattell RB (Ed.), Handbook of Multivariate Experimental Psychology. Chicago: Rand McNally & Company, 1966, pp. 684-710

15. American Monitor Corporation, P.O. Box 68505, Indianapolis, Indiana, 46268

16. Abbott Laboratories, Diagnostics Division, 820 Mission St., So. Pasadena, California 91030

17. Winer BJ: Statistical Principles in Experimental Design. New York, McGraw-Hill, 1962, pp. 302-318

18. Greenhouse SW, Geisser S: On methods in the analysis of profile data. Psychometrika 24:95-11, 1959

19. Kirk RE: Experimental Design: Procedures for the Behavioral Sciences. Belmont, CA, Brooks/Cole Pub. Co., 1968, pp. 298-307

20. McNemar Q: Psychological Statistics. New York, John Wiley & Sons, Inc., 1969, pp. 157-158

21. Hays WL: Statistics. New York, Holt, Rinehart, and Winston, 1963, p. 532

22. Feller W: An Introduction to Probability Theory and its Applications. New York, John Wiley & Sons, Inc., 1968, pp. 146-150

23. Sumi T, Umeda Y: Adrenergic regulation of the plasma levels of purine metabolites in the rat. Europ J Pharmacol 46:243-247, 1977

24. Theorell T: Psychosocial factors in relation to the onset of myocardial infarction and to some metabolic variables--A pilot study. From the Department of Medicine, Seraphimer Hospital, Karolinska Institutet, Stockholm, Sweden, 1970

25. Dimsdale JE, Moss J: Plasma catecholamines in stress and exercise. JAMA 243:340-342, 1980

26. Klimmer F., Rutenfranz, J. Rohmert W: Investigations on physiological and biochemical indicators for differentiation of mental and emotional strain in psychical efforts. Int.Arch Occup Environ Health 44: 149-163, 1979

27. McHugh WB, Brictson CA, Naitoh P: Emotional and Biochemical Effects of High Work Load. Paper presented at NATO AGARD ASMP Specialist meeting, Oslo, Norway, April 22-24, 1974

28. Stillner V, Popkin MK, Pierce CM: Biobehavioral changes observed in prolonged competitive stress. Paper presented at 1979 American College of Sports Medicine Annual Meeting and Pan Pacific Conference, May 24-26, Honolulu, Hawaii

29. Seegmiller JE, Laster L, Howell R: Biochemistry of uric acid and its relation to gout. New Eng J Med 268: 712-716, 764-773, 821-827, 1963

30. Fessel WJ: High uric acid as an indicator of cardiovascular disease. Independence from obesity. Amer J Med 68: 401-404, 1980

31. Foulkes MA, Prior IAM, Eyles EF: Cholesterol and mortality in New Zealand Maoris. Brit Med J 280: 285-287, 1980

32. Conway TL, Vickers RR,Jr, Ward HW, et al: Occupational stress and variation in cigarette, coffee, and alcohol consumption. Submitted for publication to J Heal Soc Behav

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Navy company commanders, the senior enlisted men responsible for initial training of recruits, were selected for a longitudinal psychobiological study of occupational stress. These men were not selected for this job by rigid screening; therefore they represented typical men exposed to new, and at times, extreme job stresses. Forty-six company commanders were followed during a six-month period while they completed schooling for this job and successfully trained their first company of recruits. Of these, 34 volunteered to be studied during their second company as well, thereby providing data pertinent

20. Abstract (continued)

to psychobiological adaptation to stress. The study design included assessments of psychological and physiological variables on two occasions during company commander school and on six separate days during each recruit training cycle. Study days were selected to represent a range of job stress. This report describes the study design and the biographical, personality, stress, and strain measures employed. Strains included behavioral and physiological variables which presumably link stress to illness. Analyses confirmed that stress varied significantly and systematically during recruit training cycles. This finding provides the background for future reports on behavioral and physiological strains; adaptation to repeated stress; and life history, social support, and personality variables which buffer or exacerbate the effects of job stress.

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