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DIETARY HABITS AND RELATED FACTORS IN FBM CREW MEMBERS

by

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Bureau of Medicine and Surgery, Navy Department
Research Work Unit MR005.19-6024.07

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SUMMARY PAGE

THE PROBLEM

Detailed knowledge concerning the dietary habits of FBM crew members is required for proper personnel maintenance. Factors related to diet such as changes in taste discrimination need exploring in an attempt to explain variations found during patrol.

FINDINGS

(1) This study indicates that submerged patrol does alter the dietary routine as reflected in the weight-appetite pattern, food selection, and meal distribution; however, an increase in refined carbohydrate consumption, as anticipated from World War II reports, does not occur.

(2) Citric acid taste thresholds were variably increased in approximately two-thirds of the men tested. Sucrose thresholds were affected to a much lesser and probably insignificant degree. Smoking appears to accentuate these changes.

APPLICATIONS

This study adds to the general knowledge concerning the effects of long submerged operations, presents data which may be of some value in menu planning, and suggests an approach to effective weight control in the FBM program.

ADMINISTRATIVE INFORMATION

This study was conducted in conjunction with the Dental Branch, Submarine Medical Research Laboratory, as a partial fulfillment of requirements for qualification of LT James K. Summitt, MC, USN, as a submarine medical officer.

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ABSTRACT

A dietary study was conducted on board the USS CASIMIR PULASKI (SSBN 633) (Blue) during patrol. Sixteen crew member volunteers provided data concerning daily food intake, daily meal and snack distributions, weekly appetite changes, weekly food preferences, pure taste thresholds and body weight values.

The eating patterns tended to change to a reduction in the number of regular meals and an increase in the number and amount of between meal snacks. The late evening "soup down" accounted for the major part of the between meal eating. Food preferences showed little change as the patrol progressed and certainly did not reflect the predilection of submariners for sweets alluded to in some previous diary type reports. Appetite and weight gain showed a positive relationship and both tended to decrease as the patrol progressed. Taste thresholds to citric acid were increased and thresholds to sucrose were unchanged as the patrol progressed.

It is concluded that the dietary patterns of submariners are not remarkably changed on patrol. The changes that do occur are difficult to relate to any one aspect of the environment; but in any event, are of a nature not considered alarming.

DIETARY HABITS AND RELATED FACTORS IN FBM CREW MEMBERS

INTRODUCTION

The nutritional status of submariners on patrol, and the associated area of weight control, has been of interest for many years; however, little objective information has been gathered to date. Martin (1) reported the prominence of between meal snacks in the submarine routine during World War II, but he included no data in his report to substantiate this impression. In 1950, Schute (2) published a dietary study conducted aboard a submarine deployed to the Arctic. He made no attempt to record food selection habits but did report a protein-carbohydrate-fat ratio (1:4:1 by weight) which deviated somewhat from the 1:3.6:1.5 ratio of the master menu of the U. S. Army (3).

These studies indicate a change in dietary pattern and, while they are products of the "conventional boat" era, it can be assumed that a similar change occurs on nuclear submarines. Of course, the reasons may be different and, in either case, may be difficult to define. Taste discrimination plays some part in food selection (4) and it has been postulated that elevated concentrations of carbon dioxide might alter this function. Indeed, a crude determination of the taste thresholds of two individuals in a pressure chamber breathing three percent carbon dioxide (5) and a study in FBM crew members (6) showed some changes in sour (citric acid) taste discrimination. Other atmospheric contaminants, even strong odors, might also have a significant effect.

Another important aspect of diet is related to weight control, a problem that is receiving more and more attention in both military and civilian circles. It is recognized that obesity, of all the health defects in the United States, is the most common reason for the refusal of standard risk life insurance (7). Based on statistical studies (8), it can reasonably be stated that even minor degrees of corpulence (10 to 15 percent above optimum weight) are accompanied by lower productivity, higher incidence of illness, and higher mortality rates.

It is hoped that this paper will offer insight into these questions and contribute some knowledge to our understanding of weight control, diet adequacy, etc.

MATERIALS AND METHODS

Twenty members of the Blue Crew of the USS CASIMIR PULASKI (SSBN 633) were selected at random for this study. Although, as stated, no special criteria was established for participation, personnel on voluntary diet restriction for weight control at any time during the patrol were excluded. This reduced the final number of participants to sixteen. In general, data were collected four times during the prepatrol-patrol period.

A. **Taste Thresholds.** Taste threshold determinations for sucrose and citric acid were performed during the prepatrol period (to establish a control value) and then repeated during the second, fifth, and seventh weeks of patrol. A refined technique modified after Henkin (9, 10) was used for measuring the taste threshold and is described as follows:

> First, each individual's approximate taste threshold was determined using an array of solution concentrations covering the complete spectrum of normal threshold ranges reported in literature. The definitive taste threshold was then established employing four groups of medicine cups, each group consisting of three cups. One of these groups was employed as a placebo or control group in which all three cups contained distilled water. Each of the other three groups contained one taste sample and two distilled water samples to eliminate guessing by the subject. The three taste sample concentrations used were as follows: One in the concentration of the previously determined approximate threshold; one each .00025M above and below this value for citric acid; and one each .005M above and below for sucrose.

B. **Dietary Questionnaire.**

1. Detailed daily dietary questionnaires (Appendix I) were administered dur-

ing the seven day period immediately prior to the patrol and then were repeated during the second, fifth, and seventh weeks of patrol. The data were recorded and organized, for the purposes of this paper, into the following groups:

a. **Meal distribution:** A list of the major meals eaten during the specified periods was compiled. This included the normally recognized breafast, lunch, and dinner plus "soup down" at 2300. It was noted that "soup down" does, in fact, take on the prominence of a major meal in the shipboard routine.

b. **Between meal eating:** List of the number of between meal snacks eaten during the specified periods, including a semi-quantitative estimate of the amount ingested with each snack. From this information the number of between meal snacks per day per man and the number of "helpings" per snack were calculated.

c. **Food selection:** A list of the "best liked" and "least liked" dishes served at lunch and dinner was compiled. This section of the questionnaire was to be left blank if there was no definite preference or dislike. Relative frequencies of selection were then determined by comparisons with the number of times each item appeared on the menu. Breakfast and "soup down" were excluded from this part because of the narrow and unvaried selection routinely available.

d. **Between meal food selection:** This consisted of a list, by name, of the foods eaten between meals. The frequency each item was mentioned is also tabulated.

2. Once during each of the specified periods, each man was asked to express a subjective evaluation of his appetite using his predeployment appetite as a comparison reference.

C. Weight.

Each man's weight was recorded once during each of the specified intervals. Age and height are included for comparison purposes.

RESULTS

Taste thresholds.

The citric acid threshold data are tabulated in Table I. The reported normal threshold for citric acid is 0.00043-0.00190M. All subjects except one (case #16) were within this range during the control (prepatrol testing). Case #16 was also noted to be the only man to demonstrate progressive deterioration of taste sensitivity through the entire patrol.

The data of Table I were analyzed employing the paired t test. Only the mean differences between the first patrol samples were significantly different from the prepatrol values. Comparison on an individual basis revealed two men recording one test value for the entire series, six men recording two test values, and two men recording all three test values higher than their control values. Ten men (63%) showed some degree of deterioration in citric acid taste sensitivity during the patrol. In contrast, only one man recorded lower values, i.e., increased taste sensitivity, and five men (31%) showed no change when compared to the corresponding control values.

Table I. — Taste Thresholds for Citric Acid

Case #	Pre-patrol (Control)	2nd Week	5th Week	7th Week
1.	.00075M	.00075M	.00075M	.00075M
2.	.00075M	.00075M	.00075M	.00075M
3.	.00075M	.00125M	.00075M	.00100M
4.	.00100M	.00100M	.00125M	.00100M
5.	.00150M	.00100M	.00100M	.00100M
6.	.00150M	.00150M	.00150M	.00150M
7.	.00150M	.00200M	.00250M	.00200M
8.	.00075M	.00100M	.00100M	.00075M
9.	.00075M	.00150M	.00075M	.00100M
10.	.00100M	.00125M	.00125M	.00100M
11.	.00100M	.00100M	.00100M	.00100M
12.	.00125M	.00150M	.00125M	.00125M
13.	.00150M	.00150M	.00250M	.00200M
14.	.00150M	.00150M	.00150M	.00150M
15.	.00125M	.00200M	.00125M	.00150M
16.	.00200M	.00250M	.00300M	.0030+M
Mean	.00118	.00138	.00138	.00131
Mean differences from prepatrol		+.00020*	+.00020	+.00013
Standard deviation of the difference		±.000281	±.000387	±.000292

*Significantly different from prepatrol values $p<.05$.

Note: Cases 1-7 are nonsmokers and cases 8-16 are smokers.

There were some differences in citric acid taste between smokers and non-smokers. The smokers accounted for approximately 75% of the increased threshold (decreased sensitivity) values; however, mean differences between smokers and non-smokers were not statistically significant for any test period (Table II).

Table II. - Citric Acid Taste Thresholds (Smokers versus Non-Smokers)

	N	Prepatrol (Control)	2nd week	5th week	7th week
Nonsmokers	7	.00111* ± .00038**	.00118 ± .00045	.00121 ± .00064	.00114 ± .00045
Smokers	9	.00122 ± .00040	.00153 ± .00047	.00150 ± .00075	.00144 ± .00069

*Mean taste threshold
**Standard deviation.

The data for taste thresholds to sucrose are given in Table III. In general, there was no remarkable changes noted between the test periods. Again, the threshold values differed between smokers and non-smokers. The smokers' mean thresholds were significantly higher (decreased sensitivity) than were the non-smokers for all test periods (Table IV).

Table III. — Taste Threshold for Sucrose

Case #	Pre-patrol (Control)	2nd Week	5th Week	7th Week
1.	.005M	.005M	.005M	.005M
2.	.005M	.005M	.005M	.005M
3.	.010M	.015M	.010M	.010M
4.	.010M	.010M	.010M	.010M
5.	.010M	.015M	.005M	.010M
6.	.015M	.015M	.015M	.015M
7.	.020M	.020M	.020M	.020M
8.	.015M	.010M	.010M	.010M
9.	.015M	.010M	.015M	.010M
10.	.020M	.020M	.020M	.020M
11.	.015M	.020M	.025M	.020M
12.	.015M	.020M	.015M	.015M
13.	.015M	.010M	.015M	.015M
14.	.015M	.015M	.015M	.015M
15.	.015M	.015M	.015M	.015M
16.	.03+M	.03+M	.03+M	.03+M
Mean	.014M	.015M	.014M	.014M

Note: Cases 1-7 are non-smokers and cases 8-16 are smokers.

Table IV. - Sucrose Taste Thresholds (Smokers versus Non-Smokers)

	N	Prepatrol (Control)	2nd week	5th week	7th week
Nonsmokers	7	.011* ± .0054**	.012 ± .0057	.010 ± .0057	.011 ± .0054
Smokers	9	.017 ± .0051	.017 ± .0066	.018 ± .0062	.017 ± .0062

*Mean taste threshold
**Standard deviation

Meal distribution.

Table V outlines the number of meals eaten, including between meal snacks, and gives an overall picture of eating distribution during the specified intervals. For easy reference, this is also expressed as the percentage of men eating each major meal.

During the prepatrol (control) period lunch and supper were the dominant "favorite" meals with breakfast and "soup down" about equally distributed at a lower level. As the patrol progressed a rather marked shift in meal distribution was observed as reflected in the progressive decrease in the number eating breakfast, lunch, and supper associated with a corresponding increase in the number eating "soup down." Indeed, "soup down" becomes the favorite meal during the last half of the patrol.

At first glance, there also seems to be an **unexplained** drop in the number of between meal snacks during patrol; however, if the average number of meals per day per man and the average number of between meal snacks per day per man are compared graphically (Figures 1A and 1B) a reciprocal relationship is noted which is quite similar to the one associated with the meal distribution shift. In addition, it is noted that not only the number of between meal snacks but also the average number of "helpings" per snack varies inversely with the number of regular meals eaten (Figure 1C).

Food selection.

Tables VI and VII illustrate the categories of food chosen as "best liked" and "least liked" during each of the seven day periods covered by the study. Predictably, meat products dominate (78.8%) the "best liked" list and vegetables dominate (81%) the

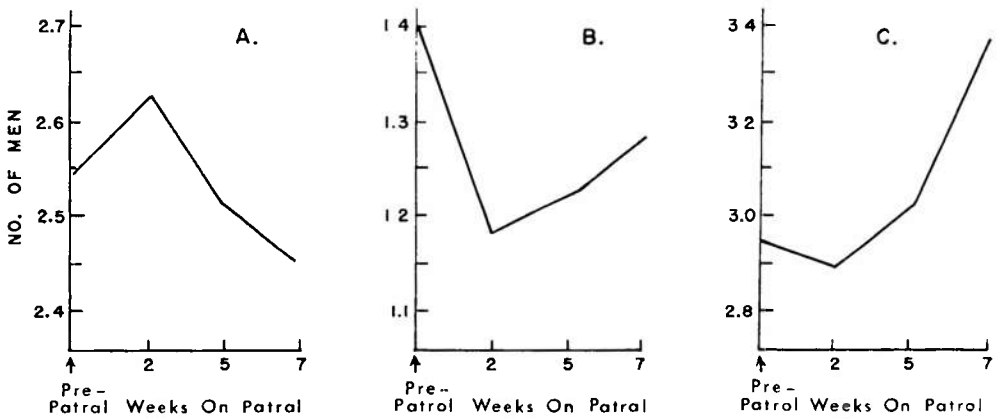

Figure 1.—Meal Distribution:

A. Average number of meals per day per man;

B. Average number between-meal snacks per day per man;

C. Average number helpings of between-meal snacks.

"least liked" list. In addition, Table VI shows a consistent **relative** increase (74% to 81%) in the selection of meat as the "best liked" food during patrol as compared to the prepatrol period. A corresponding feature is noted in Table V which indicates a persistent and **slightly progressive** increase (15.8% to 30.0%) in the selection of carbohydrate type vegetables as the "least liked" food.

Interestingly, desserts (refined carbohydrates) are more frequently mentioned as "least liked" than "best liked" foods when served with the regularly scheduled meals. In any case, they aren't mentioned often at either extreme and they don't show a change in selection pattern as the patrol progresses.

Tables VIII and IX contain data concerning the "best liked" and the "least liked" foods along with the number of times each item was selected and a percentage comparison with the number of times they were offered on the menu. It is interesting to note that hamburgers and cheeseburgers hold the highest position of popularity.

Table X is a list of items eaten at between meal snacks ranked in order of decreasing frequency. The total number of "helpings" eaten is also included in the values. Coffee, tea, and other drinks are not included but certainly amount to considerable quantities as reflected by the 1,487 pounds of coffee, 33 pounds of tea, and 39 gallons of concentrated coca cola mix consumed by the entire crew during the patrol.

Weight and Appetite.

1. Table XII charts the recorded weights of each individual at each specified time interval and, as you might expect, there is almost an even distribution of men losing weight, gaining weight, and showing no change in weight over the **entire refit-patrol cycle.** However, these same values plotted graphically (Figure 2) for each time interval demonstrate a dominance of men gaining weight during the refit and early patrol period followed by an almost complete reversal during the last half of the patrol.

Table V. — Meal Distribution

Meal	Pre-patrol (Control)	2nd Week	5th Week	7th Week
Breakfast	56(50%)	47(42%)	46(41%)	45(40%)
Lunch	88(79%)	75(67%)	65(58%)	56(50%)
Supper	94(84%)	92(82%)	82(73%)	77(69%)
"Soup Down"	47(42%)	81(72%)	90(80%)	96(86%)
"Snacks"	156	133	137	143

Table VI. — Best Liked Food Selections (General)

Selection	Pre-patrol (Control)	2nd Week	5th Week	7th Week
Meats	115	117	119	108
Green-yellow Veg.	19	9	10	11
Carbohydrate Veg.	14	13	12	11
Legumes	2	2	2	2
Dessert	5	2	4	6
Total Selections	154	142	146	135

Table VII. — Least Liked Food Selections (General)

Selection	Pre-patrol (Control)	2nd Week	5th Week	7th Week
Meats	23	18	9	16
Green-yellow Veg.	82	65	66	57
Carbohydrate Veg.	23	37	38	40
Legumes	9	12	11	11
Total Selections	146	139	133	133

Table VIII. — Best Liked Food Selections (Specific)

Selection	No. of Times Selected	Percentage Comparison With Item's Appearance on Menu
Hamburgers-cheeseburgers	43	67.2%
Turkey	20	62.5%
Ham	37	57.8%
Steak	116	55.8%
Roast Beef	44	55.0%
Chicken	44	45.8%
Meat Loaf	32	40.0%
Pork Roast	18	37.5%
Shrimp	16	33.1%
Spare Ribs	5	31.2%
Pork Chops	14	29.0%
Fish	12	25.0%
Liver	4	25.0%
Pizza	4	25.0%
Duck	4	25.0%
Veal Roast	11	23.0%
Egg Fu Young	7	21.8%
Pork/Beef Chop Suey	7	21.8%
Lobster	7	21.8%
Beef Pie (Stew)	11	17.2%
Beef Noodle Casserole	2	12.5%
Chili	2	12.5%
*Spaghetti	10	31.2%
Mixed Vegetables	9	28.0%
Brussels Sprouts	6	12.5%
*Rice	18	11.2%
*Macaroni	2	6.2%
Tomatoes	2	4.1%
Corn	11	4.0%
Broccoli	6	2.8%
Green Beans	6	2.8%
Other Beans	8	2.6%
Cauliflower	4	2.5%
Peas	6	2.3%
*Potatoes	20	1.4%
Peach Cobbler	5	7.8%
Fruit Jello	4	2.5%
Ice Cream	4	2.3%
Cake	2	0.5%

*Vegetables classified as carbohydrate vegetables for the purposes of this study.

Table X. — Between Meal "Snacks"

Item	No. of Times Listed
Ice Cream	359
Cookies	314
Cake (Pie)	217
Sweet Rolls	182
Crackers	156
Sandwich	72
Peanut Butter	66
Nuts	58
Candy	20
Chewing Gum	0

Table IX. — Least Liked Food Selections (Specific)

Selection	No. of Times Selected	Percentage Comparison With Item's Appearance on Menu
Mixed Vegetables	18	56.4%
Brussels Sprouts	14	43.7%
Hominy	12	38.5%
Peas	48	31.0%
Asparagus	21	26.2%
Spinach	11	23.0%
Beets	7	22.0%
*Potatoes	118	19.7%
Carrots	27	18.7%
Other Beans	45	15.8%
Cabbage	5	15.5%
Tomatoes	7	14 5%
Broccoli	21	13.9%
Cauliflower	12	13.8%
Onions	4	12.5%
Squash	2	12.5%
*Rice	18	11.2%
Corn	26	11.1%
Green Beans	15	9.7%
Mushrooms	8	8.7%
*Noodles	2	4.2%
Salad	6	0.7%
Liver	7	43.6%
Duck	4	43.6%
Frankfurters	4	25.0%
Fish	7	14.5%
Rabbit	2	12.5%
Meatballs	2	12.5%
Beef Ravioli	4	12.5%
Beef Casserole	2	12.5%
Veal Roast	5	10.4%
Steak	18	8.6%
Lobster	2	6.3%
Chop Suey	2	6.3%
Chicken	4	4.2%
Beef Pie (Stew)	2	3.1%
Meat Loaf	2	2.5%
Pudding	4	5.0%
Cake/Pie	26	3.9%
Ice Cream	2	1.1%

*Vegetables classified as carbohydrate vegetables for the purposes of this study.

2. In addition, each man was asked to express a subjective evaluation of his appetite at the specified intervals using his predeployment appetite as a comparison reference. In general, a tendency to an increased appetite is the rule during the refit and early patrol followed by a decreased appetite during the remainder of the patrol. These are presented in Table II and, when graphed against time (Figure 3), show a

Table XI. — Appetite Chart

Case #	Pre-patrol Control	2nd Week	5th Week	7th Week
1.	N	I	D	D
2.	I	I	D	D
3.	N	N	N	N
4.	N	N	N	D
5.	I	N	N	N
6.	D	D	D	D
7.	I	N	N	N
8.	I	I	D	D
9.	I	N	D	D
10.	N	N	N	N
11.	D	D	D	D
12.	I	N	N	D
13.	N	N	N	D
14.	I	I	I	I
15.	N	D	D	D
16.	N	N	N	N

Note: N = Normal Appetite
I = Increased Appetite
D = Decreased Appetite

striking relationship to the weight graphs, i.e., an increased appetite is associated with weight gain, and a decreased appetite is associated with weight loss.

DISCUSSION AND CONCLUSIONS

The examination of the relationship between **changes** in dietary habits and taste thresholds during patrol was one of the major objectives of this study. Unfortunately, relating the food habits of human adults is an extremely complex problem and final answers cannot be firmly established.

An increase in citric acid taste thresholds was demonstrated in approximately two-thirds of the men tested. Sucrose thresholds were affected to a much lesser and insignificant degree. Coincident with the taste changes we noted a decrease in the selectivity of carbohydrate (starch) vegetables and an increase in the selectivity of meat products. The fact that these two events occurred simultaneously does not mean they have to be related; however, the possibility reasonably exists. Certainly taste does play a significant role in the selection of food (4). Indeed, some authors suggest that it is a sure guide to the choice of dietary elements needed for maintaining nutritional well-being. Even if one accepts the general way in which taste affects the selection of food, however, it is difficult to correlate a specific change in taste-diet pattern with a physiologic change secondary to the environment. In the first place, tests used to measure taste thresholds deal with "pure taste sensation," i.e., salt, sweet, bitter, and sour; while most foods give a combination of these sensations. In addition, other sensations such as touch, temperature, and smell — all of which are

Table XII. — Height and Weight Chart

Case #	Age	Ht.	Weight				
			Pre-Deploy	Pre-Patrol	2nd Week	5th Week	7th Week
1.	22	72″	185lb	186lb	188lb	186lb	182lb
2.	29	71½″	190lb	196lb	198lb	196lb	190lb
3.	23	69″	168lb	165lb	167lb	166lb	164lb
4.	24	69″	134lb	135lb	135lb	134lb	133lb
5.	23	71″	145lb	150lb	149lb	150lb	150lb
6.	34	73″	189lb	185lb	185lb	183lb	180lb
7.	42	69″	151lb	153lb	152lb	150lb	151lb
8.	21	71″	135lb	140lb	143lb	142lb	140lb
9.	31	71″	135lb	140lb	146lb	144lb	142lb
10.	20	67″	144lb	145lb	145lb	145lb	146lb
11.	25	67″	162lb	158lb	159lb	154lb	152lb
12.	27	70″	178lb	185lb	183lb	184lb	178lb
13.	37	71″	162lb	163lb	164lb	162lb	162lb
14.	22	71″	190lb	202lb	204lb	208lb	210lb
15.	22	69″	200lb	191lb	188lb	184lb	179lb
16.	28	66″	140lb	140lb	139lb	139lb	140lb

Note: Cases 1-7 are nonsmokers and cases 8-16 are smokers.

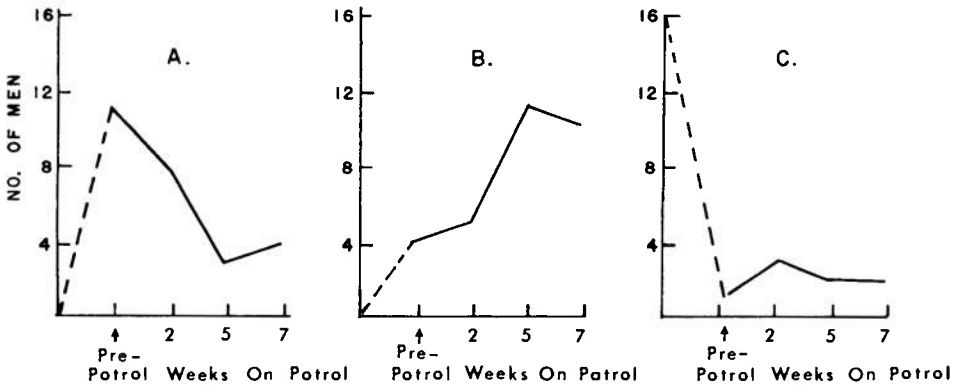

Figure 2.—Weight Graphs:
A. Number of men gaining weight;
B. Number of men losing weight; and
C. Number of men with no change in weight.

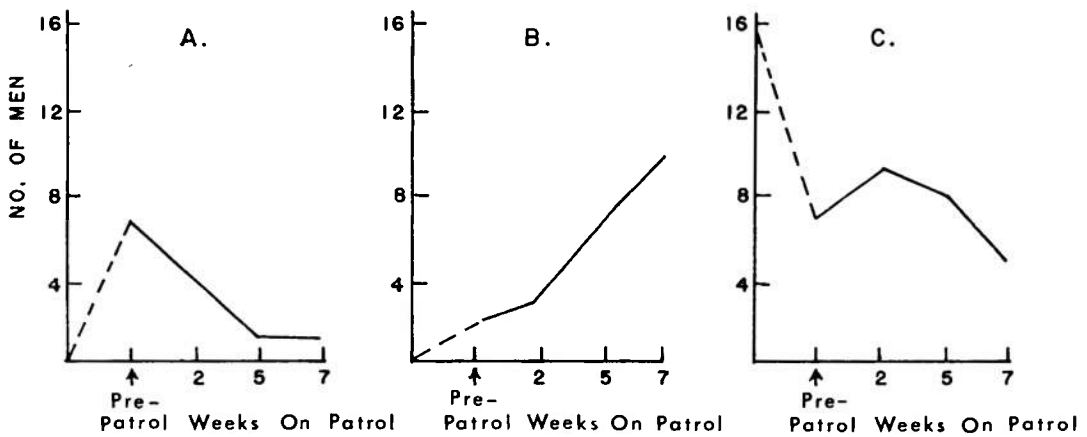

Figure 3.—Appetite Graphs:
A. Number of men with increased appetite;
B. Number of men with decreased appetite; and
C. Number of men with normal appetite.

probably dulled by prolonged exposure to strong odors, smoking, and other environmental factors — can significantly modify the sensation one describes as "flavor."

One of the most obvious environmental changes during submerged patrol is the continuous exposure to high concentrations of atmospheric carbon dioxide (1.0 — 1.5 percent). Schaeffer and co-workers (11, 12) demonstrated significant biochemical changes in the body fluids under such conditions. Since the taste buds are chemically sensitive nerve endings continuously bathed in body fluids it is plausible that alteration in body fluid chemistries might change this sensitivity. Experimentally taste does provide the basic signal for the preference response noted in salt-deficient animals, i.e., low serum sodium (13); however, this signal appears to be secondary to a change in the reactivity of the central nervous system rather than to a change in the threshold of the taste buds (4). In this regard, Pfaffmann and Bare (14) recorded the electrical impulses from the sensory nerves of taste and found the nerve response curve (discharges per unit time) to be relatively stable and fixed characteristic of the taste receptor regardless of the serum sodium levels. Whether this would be true for other electrolytes and the pH is not known.

A possible explanation of the changes

noted in citric acid thresholds is the fact that one might expect an increase in the bicarbonate content of the saliva along with changes in body fluid composition. This, in turn, would increase the saliva's buffering capacity and, at least theoretically, require higher acid concentrations to deliver the same stimulus to the taste buds.

Another possibility that must be considered is the presence of a normal diurnal variation in taste sensitivity. Chauncey (15) did demonstrate an objective effect on salivary flow following stimulation of the taste buds by various substances and there is a known diurnal variation in salivary flow (15). The change in food selectivity therefore may reflect merely a mismatch between the normal variation in taste sensitivity and the eating routine, the causative factor being a change in meal distribution imposed by the shipboard routine.

In this study, an effort was made to perform the taste threshold tests at the same hour of the day each time. Frequently, it was impossible and we don't know whether some of the changes recorded actually represent a normal variation. Such an explanation may also account for the almost opposite threshold variation of this study compared to that of Hutchinson (6). The final answers, of course, are still to be found.

The marked shift in food intake distribution is the most prominent and reliable change in dietary habits demonstrated by this study. Tabulation of this distribution by major meals and between meal snacks gives both a qualitative and semi-quantitative estimate of food intake on a week by week basis and accentuates the remarkably consistent reciprocal relationship between the various phases of eating. We can suppose that this represents the well known tendency toward homeostasis and, indeed, it probably does; however, a superimposed decrease in physical activity, as we will discuss later, dictates a decrease in caloric intake which is not well reflected in the distribution pattern itself. We can only guess, but it seems probable that, if the patrol were extended for an indefinite period of time, all of these factors would reach a point of equilibrium resulting in a constant ratio between food intake, physical activity, and weight change.

The major factor involved in the shift noted above is probably the changing of the ship's routine from a day-night arrangement in port to a rigid watch schedule at sea. However, if this were the only factor we would expect the redistribution to give equal weight to each of the four major meals. This doesn't occur and other factors, such as the availability of between meal snacks and the "midnight movie schedule," possibly provide the variables causing diminution in the popularity of breakfast, lunch, and dinner and the establishment of "soup down" as the most popular meal at sea.

Food selection is a highly individualized system which is strongly influenced by cultural, religious, and socio-economic factors. Different groups chosen for study, even within the same ship at the same time, would yield a different set of base line numbers, though qualitatively they might be similar. In this case, we note the well known American preference for meat products and the culturally biased selection of hamburgers and cheeseburgers.

More important are the changes in meat and carbohydrate vegetable selectivity which may reflect the submerged submarine environment. Again, the factors involved must be multiple and an attempt to quantitate the biochemical or physiological role of any one given factor would be nearly impossible. The taste threshold change for citric acid noted previously may well be very important but the degree and mechanism of action by which it could have this particular effort is not known; besides, the strong dependence on frozen and dehydrated foods, the preparation of a particular dish, the high probability that smell is also altered by the close atmosphere environment, and the skill of the cook may be much more important in the selectivity of a given item.

The weight-appetite aspect of the study reflects a very interesting pattern, particularly in view of the popular image of the submariner rapidly gaining weight on the

excellent food and frequent between meal snacks that are "so much a part of life at sea." The majority of men in this study experienced, along with the redistribution of food intake, a generalized progressive decrease in physical activity, appetite, and weight during patrol. Conversely, the reverse appears to be true during the off-crew and refit periods.

The decrease in physical activity can be easily explained by the limited confines of a submarine at sea, but the disproportionate decrease in appetite resulting in weight loss is not so easily explained. In fact, it's contrary to previously published observations by Young (16). In discussing the prevention of obesity, she observed that as the activity of the adult male is reduced there is a concurrent reduction of food intake (appetite) but not to the same degree, and the net result is progressive development of the so-called "middle age obesity." Of course, a FBM sailor is not an "average adult male" in that his life is, of necessity, very cyclic. One, Understandably, expects a certain amount of over indulgence during the off-crew period, whether the parameter be food, drink, or sex; however, the reversal of this trend during patrol must have another explanation and most likely involves the general psychological impact of extended submerged and isolation. There is little doubt that emotional factors are generated and probably influence either or both sides of the energy equation: activity and food intake. While most of the investigative work in this regard has been related to obesity, there are numerous examples, i.e., depressed states, anorexia nervosa, etc., in which activity and appetite are subdued simultaneously with resultant weight loss, sometimes severe.

Another important factor may be an individual's "sleeping pattern." It is well known that both eating and sleeping are occasionally utilized as psychological defense mechanisms and, if time is made available for excessive sleep, i.e., a six and twelve watch schedule, it could play a significant role in the dietary routine.

The primary value of these observations may rest in their application to an effective weight control program, i.e., more direct attention to weight control during the off-crew/refit periods and less during patrol. Certainly, for the majority, the use of "diet pills" and "crash diets" is unwarranted during patrols and may be dangerous. In any case, they require very careful supervision if the adequacy of the diet is not to be compromised.

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Appendix I

Date: _____

Name _____ Rate _____ Service Number _____

Eating and Drinking Habits.

1. On the average, how many cups of liquid have you drunk per day during the past week? (Include water, coffee, milk, etc.). 1 glass = 1 cup; one trip to the scuttlebut = 1 cup.

   a. 20 cups or more b. 16 cups c. 12 cups d. 8 cups e. 4 cups or less

2. How has your appetite been the last month?

   a. Much better than usual
   b. Somewhat better than usual
   c. No different than usual
   d. Somewhat poorer than usual
   e. Much poorer than usual

3. Have you needed to drink liquids to wash down dry food?

   a. All the time
   b. Almost all the time
   c. Sometimes
   d. Almost never
   e. Never

4. Do you take vitamins?

   a. Each day b. 3 times a week c. 2 times a week d. Once a week e. Never

5. Do you eat between meals?

   a. Each day b. Almost every day c. Almost never d. Never

6. Have you eaten candy or had soft drinks -

   a. Each day b. Almost every day c. Almost never d. Never

7. Did you chew gum?

   a. Each day b. Almost every day c. Almost never d. Never

8. How many cups of cocoa do you drink?

   a. 5 or more each day b. 3-4 each day c. 1-2 each day
   d. Less than 1 each day e. None

9. How much coffee or tea do you drink?

   a. More than 10 cups each day
   b. 9-10 cups
   c. 7-8 cups
   d. 5-6 cups
   e. 3-4 cups
   f. 1-2 cups
   g. Less than 1 cup
   h. None

10. How much sugar do you use in each cup of coffee or tea?

a. 4 teaspoons b. 3 teaspoons c. 2 teaspoons d. 1 teaspoon e. None

11. How much cream do you use in each cup of coffee or tea?

a. A lot of cream b. Moderate amount of cream c. Very little cream d. None

12. If you could order dinner from the below menu, what would your choices be?

a. Appetizer (choice of 1)
___ Kadota figs
___ Seafood cocktail
___ Herring and sour cream

b. Salad (choice of 1)
___ Potato aspic salad
___ Avocado salad
___ Red kidney bean salad

c. Soup (choice of 1)
___ Heavy cream of tomato
___ Beef broth
___ Potato soup

d. Entree (choice of 1)
___ Spaghetti with tomato sauce
___ Cold cuts of meat
___ Fried pork sausages

e. Vegetables (choice of 2)
___ Rice
___ Spinach
___ Buttered carrot sticks
___ Boiled cabbage
___ Corn
___ Buttered broccoli
___ Boiled potatoes

f. Beverage (choice of 1)
___ Black coffee
___ Coffee with sugar
___ Coffee with cream

g. Desserts (choice of 1)
___ Banana pudding
___ Assorted cheeses
___ Assorted nuts

Smoking Habits.

13. How many cigarettes do you smoke each day?

a. Over 2 packs b. Over a pack c. About a pack d. about $\frac{1}{2}$ pack
e. Less than $\frac{1}{2}$ pack f. None

14. How many cigars do you smoke each day? a. 10 or over b. 7-8 c. 5-6
d. 3-4 e. 1-2 f. Only occasionally g. Never

15. How many pipefuls of tobacco do you smoke each day? a. Over 8 b. 8 c. 6
d. 4 e. 2 f. Only occasionally g. Never

16. Do you feel that your smoking has increased in the past week? Yes No Don't know

17. Do you routinely smoke before breakfast? Yes No

18. How many years have you been smoking? Over 10 years, 5-10 yrs., 2-4 yrs., 1 yr., Less than 1 yr., Not at all

19. Do you chew tobacco? Yes, routinely; Occasionally; Never

20. How often do you brush your teeth?
a. Seldom
b. Usually one time each day
c. At least once each day
d. Twice each day
e. Three or more times a day

Appendix I

Date: _____

Name _____ Rate _____ Service Number: _____

1. This morning did you eat the regularly served breakfast? Yes No

2. Which of the following did you eat for breakfast?
   a. A meat c. Toast e. Sweet rolls
   b. Eggs d. A fruit or juice f. Cereal

3. Did you eat anything between breakfast and lunch? Yes No

4. How many or how many helpings did you eat of the following between breakfast and lunch?

____ Sweet rolls	____ Crackers	____ Ice cream
____ Candy	____ Peanut butter	____ Nuts
____ Cookies	____ Fruit	____ Chewing gum
____ Cake or Pie	____ Sandwich	____ Soup

5. Did you eat the regularly served lunch? Yes No

6. What lunch dish did you like best? _____

_____

7. What lunch dish did you like least? _____

_____

8. Did you eat anything between lunch and supper? Yes No

9. How many or how many helping did you eat of the following between lunch and supper?

____ Sweet rolls	____ Crackers	____ Ice cream
____ Candy	____ Peanut butter	____ Nuts
____ Cookies	____ Fruit	____ Chewing gum
____ Cake or Pie	____ Sandwich	____ Soup

10. Did you eat the regularly served dinner/supper? Yes No

11. What supper dish did you like most? _____

_____

12. What supper dish did you like least? _____

_____

13. Did you eat anything after supper? Yes No

14. How many or how many helpings of the following did you eat after supper?

____ Sweet rolls	____ Cake or Pie	____ Fruit	____ Nuts
____ Candy	____ Crackers	____ Sandwich	____ Chewing gum
____ Cookies	____ Peanut butter	____ Ice cream	____ Soup

15. When did you brush your teeth today?
   a. Didn't brush d. Mid morning g. Mid afternoon j. Before bedtime
   b. Before breakfast e. Before lunch h. Before dinner
   c. After breakfast f. After lunch i. After dinner

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13 ABSTRACT

A dietary study was conducted on board the USS CASIMIR PULASKI (SSBN 633) (Blue) during patrol. Sixteen crew member volunteers provided data concerning daily food intake, daily meal and snack distributions, weekly appetite changes, weekly food preferences, pure taste thresholds and body weight values.

The eating patterns tended to change to a reduction in the number of regular meals and an increase in the number and amount of between meal snacks. The late evening "soup down" accounted for the major part of the between meal eating. Food preferences showed little change as the patrol progressed and certainly did not reflect the predilection of submariners for sweets alluded to in some previous diary type reports. Appetite and weight gain showed a positive relationship and both tended to decrease as the patrol progressed. Taste thresholds to citric acid were increased and thresholds to sucrose were unchanged as the patrol progressed.

It is concluded that the dietary patterns of submariners are not remarkably changed on patrol. The changes that do occur are difficult to relate to any one aspect of the environment; but in any event, are of a nature not considered alarming.

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Dietary habits						
Weight control						
Taste						
Preventive dentistry						
Food selections						