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HEMATOLOGICAL PARAMETERS AND LIPID PROFILES OBSERVED IN CADETS AT THE UNITED STATES MILITARY ACADEMY, WEST POINT, NEW YORK

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PRESIDIO OF SAN FRANCISCO, CALIFORNIA 94129

Hematological Parameters and Lipid Profiles Observed in Cadets at the United States Military Academy, West Point, New York--Sauberlich et al

Human Subjects participated in these studies after giving their free and informed voluntary consent. Investigators adhered to AR 70-25 and USAMRDC Reg 50-25 on the use of volunteers in research.

Joel Marshall J 14 June 82

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In the Spring of 1979, a study was conducted to obtain information on the hematological parameters and lipid profiles of a group of cadets at the United States Military Academy, West Point, New York. The group studies consisted of 72 female cadets and 160 male cadets. Fasting blood samples were collected from each cadet and analyzed for hemoglobin, hematocrit, serum iron, serum total iron binding capacity, serum iron saturation, serum ferritin, serum folacin, red blood cell folacin, serum triglycerides, serum total cholesterol, serum high density lipoprotein cholesterol, serum low density

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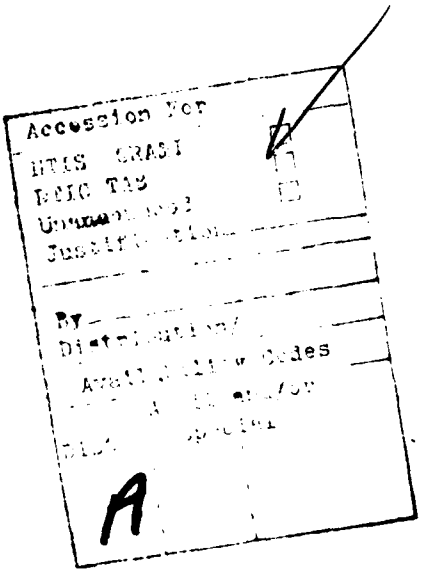
lipoprotein cholesterol, cholesterol risk factor, and serum free fatty acids. Evidence of anemia was observed among the cadets, particularly in the female cadets. The anemia appeared to be related to inadequate intakes and body stores of iron as reflected in the biochemical results. Serum lipids profiles, with few exceptions, were normal in the female cadets. In the male cadets, however, elevated serum triglycerides were noted in 20 % of those studied. Approximately 10 % of the male cadets had a cholesterol risk factor slightly above average. The results suggest that modifications in the diets are necessary to increase the intakes of folacin and iron.

ABSTRACT

In the Spring of 1979, a study was conducted to obtain information on the hematological parameters and lipid profiles of a group of cadets at the United States Military Academy, West Point, New York. The group studies consisted of 72 female cadets and 160 male cadets. Fasting blood samples were collected from each cadet and analyzed for hemoglobin, hemotcrit, serum iron, serum total iron binding capacity, serum iron saturation, serum ferritin, serum folacin, red blood cell folacin, serum triglycerides, serum total cholesterol, serum high density lipoprotein cholesterol, serum low density lipoprotein cholesterol, cholesterol risk factor, and serum free fatty acids. Evidence of anemia was observed among the cadets, particularly in the female cadets. The anemia appeared to be related to inadequate intakes and body stores of iron as reflected in the biochemical results. Serum lipids profiles, with few exceptions, were normal in the female cadets. In the male cadets, however, elevated serum triglycerides were noted in 20 % of those studied. Approximately 10 % of the male cadets had a cholesterol risk factor slightly above average. The results suggest that modifications in the diets are necessary to increase the intakes of folacin and iron.



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During the Spring of 1979 (April-May), a nutrition study was conducted at the United States Military Academy (USMA), West Point, New York. The primary purpose of the study was to investigate whether or not an obesity problem existed among the cadets at the USMA. In connection with this study, a small investigation was conducted to obtain information on hematological parameters and lipid profiles in a group of the cadets. The results of this adjunct biochemical study are the subject of this report. The results of the major study are to be presented separately in other documents.

METHODS

The population studied consisted of 72 female cadets and 160 male cadets. The female group consisted of 64 Caucasians, 2 Blacks, 2 Oriental, and 4 others (Hawaiian, Puerto Rican, etc.) The male group consisted of 144 Caucasians, 9 Blacks, 3 Oriental, and 4 others. For the female groups, 27 were from the Class of 1980, 17 from the Class of 1981, and 28 from the Class of 1982. For the male group, 26 were from the Class of 1979, 39 from the Class of 1980, 48 from the Class of 1981, and 47 from the Class of 1982.

The subjects in a fasting state arrived at the laboratory in the morning at 0430 hours for the blood collection. The blood samples were drawn in Vacutainer tubes; one tube contained heparin as an anti-coagulant and the other tube used without an anticoagulant for serum preparations. Hemoglobin and hematocrit determinations were performed immediately at West Point, while the remaining samples were processed and air-shipped refrigerated to San Francisco, California, for further analyses. The hemoglobin (Hb) values were determined by the cyanmethemoglobin method and hematocrit values were established by a microhematocrit method. Serum iron and total iron binding capacity (TIBC) were measured by the method of Wise et al. (1). The transferrin saturation was derived from the latter two indices. Serum ferritin was determined with the use of a radioimmunoassay procedure (2). Folic acid (folacin) analyses were performed by methods previously described from this laboratory (3). Lipid profile evaluations included serum triglycerides, serum total cholesterol, serum high density lipoprotein cholesterol, serum low density lipoprotein cholesterol, cholesterol risk factor, and serum free fatty acids. Serum triglycerides were measured by an enzymatic cholesterol procedure (4); serum total cholesterol was determined by an enzymatic method adapted for use with a centrifugal analyzer (5,6); and serum high density lipoprotein cholesterol was estimated with the use of a precipitation procedure (7). The low density lipoprotein cholesterol was derived as follows (all values were expressed in mg/dl):

LDL cholesterol = total cholesterol - (HDL cholesterol +$\frac{\text{triglycerides}}{5}$)

The cholesterol risk factor is equal to (8):

$$\text{Cholesterol Risk Factor} = \frac{\text{Total cholesterol (mg/dl)}}{\text{HDL cholesterol (mg/dl)}}$$

The guidelines used to evaluate the biochemical data are summarized in Table 1.

RESULTS

The results of the biochemical measurements are presented in tables 2 through 5. Evidence of an unsatisfactory iron status was observed in a significant number of the female cadets. The low hemoglobin values correlated with low hematocrit levels (r = 0.81). Two of the female cadets had hemoglobin values of less than 10.0 g/dl. The anemia observed appeared to be associated mainly with inadequate iron nutriture as evidenced by the number of female cadets with low levels of serum iron and ferritin and the low serum iron saturation values. A negative correlation existed between serum ferritin and total iron binding capacity (r = -0.52). A secondary factor may have been the low folacin status of the cadets that was reflected in 14% with low serum folacin levels. One cadet had a red blood cell folacin level that fell into the deficient category. Serum folacin levels correlated to some degree with the red blood cell folacin levels (r = 0.45).

The serum lipid profiles for the female cadets are summarized in Table 3. Only one subject had serum total cholesterol and serum low density lipoprotein cholesterol values outside of the desirable level. Elevated serum triglycerides were observed in 6 of the 70 female cadets. Only two subjects had a cholesterol risk factor above average.

The hematological values for the male cadets are summarized in Table 4. Five of the 161 men had hemoglobin values less than desired. Hemoglobin values correlated only moderately with hematocrit values (r = 0.56). A few individuals had serum iron, total iron binding capacity, and iron saturation values less than acceptable. This appeared to be reflection of low body stores of iron as evidenced by 12.7% of the subjects with low serum ferritin values. Some correlation existed between serum ferritin values and total iron binding capacity (r = -0.32). Low serum folacin levels were observed in 17% of the male cadets studied. As with the female cadets, serum folacin levels had some degree of correlation with the red blood cell folacin levels (r =0.31).

Table 5 summarizes the serum lipid data for the male cadets. Approximately 20% of the subjects had elevated serum triglyceride levels. However, only four of the 163 subjects studied had serum total cholesterol levels above normal. Four subjects had unusually low levels of high density lipoprotein cholesterol. An above average cholesterol risk factor existed for 15 of the 158 subjects studied (10%). No correlations were noted between body weight or per cent body fat vs. serum triglycerides, serum total cholesterol, high density lipoprotein cholesterol, low density lipoprotein cholesterol, or serum free fatty acids in either the male or female cadets.

DISCUSSION

From the data obtained, some anemia existed among the cadets at the USMA, West Point, New York. Although overt anemia was observed in only a few subjects, a subclinical condition existed in a larger population. This was reflected in the low iron reserves as revealed in the low serum iron levels, low iron saturation values, and low serum ferritin values. Although the nutritional risk was greatest among the female cadets, some iron insufficiency appeared also in the male cadet population. The reason for the low iron nutriture observed in the male cadets is unexpected and difficult to explain. The iron requirements of the adult male are generally considered to be considerably less than that of the female. Heavy exercise or athletic activities may induce an anemia (referred to as "sports anemia"). Controversy exists over the occurrence of such an anemia. The low serum folacin levels suggest that the intakes of this vitamin were marginal and could aggravate the onset of anemia. A low red blood cell folacin level was observed in one female cadet. Below normal red blood cell folacin levels usually reflect a prolonged period of low intakes of folacin. Dietary modifications could increase the intakes of both nutritionally available iron and folacin. As a partial alternative suitable iron supplements could be utilized.

The lipid profiles of the female cadets appeared normal. In only a few instances were elevated serum triglyceride values observed. Overall, this was reflected in the excellent cholesterol risk factors noted for the majority of the female cadets. In the male cadets, approximately 20% had elevated triglycerides. A few individuals had serum total cholesterol values above normal. Ideally, such subjects should be made aware of these findings, and appropriate dietary modifications or other measures introduced to lower their risk of coronary heart disease. The majority had favorable cholesterol risk factors. Less than 10% had factors slightly above normal. This may reflect the benefits of an effective exercise and physical fitness program at the Academy.

CONCLUSIONS

Evidence of anemia was observed in a study of the cadets at the United States Military Academy, West Point, New York. As would be expected, the anemia was more apparent among the female cadets. The anemia appeared to be related to inadequate intakes and body stores of iron that was reflected in low serum values for iron, iron saturation, and ferritin. Evidence of low folacin nutritional status was also noted.

Serum lipid profiles, with few exceptions, were normal in the female cadets. In the male cadets, however, elevated serum triglycerides were noted in 20% of those studied. A small number had elevated serum total cholesterol or below normal levels of serum high density lipoprotein cholesterol. Approximately 10% of the male cadets had a cholesterol risk factor slightly above average.

RECOMMENDATIONS

- Menus should be modified so that the sources and intakes of available iron and of folacin (folic acid) are increased.

- If necessary, iron supplements or the fortification of selected foods to increase the intake of iron, especially for the female cadets, should be considered.

- Nutrition education and nutrition awareness to assist in the maintenance of health in the cadet should be increased.

- Periodic assessment of the nutritional status of the cadet should be conducted. As a minimum, hematological parameters as performed in this report should be evaluated.

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Table 1. Biochemical Guidelines Used to Evaluate Data
(Ages 18 to 24 Years)

Parameter	Male		Female	
	Deficient	Acceptable	Deficient	Acceptable
Hemoglobin (g/dl)	12.0	14.0	10.0	12.0
Hematocrit (%)	37	44	31	38
Serum iron (ug/dl)	<50	50	<50	50
TIBC (ug/dl)	(250 - 410)		(250 - 410)	
Iron saturation (%)	<15	15	<15	15
Serum ferritin (ng/ml)	<10	10	<10	10
Red cell folacin (ng/ml)	140	160	140	160
Serum folacin (ng/ml)	3.0	6.0	3.0	6.0
Serum triglycerides (mg/dl)		<150		<150
Serum total cholesterol (mg/dl)	(115 - 215)		(120 - 240)	
Serum HDL cholesterol (mg/dl)	<30	30	<35	35
Serum LDL cholesterol (mg/dl)		<170		<170
Cholesterol risk factor				
½ average	<3.5		<3.3	
½ to average	3.5 - 5.0		3.3 - 4.5	
Average to 2X average	5.0 - 9.5		4.5 - 7.0	
>2X average	>9.5		>7.0	
Serum free fatty acids (mEq/l)		<1.0		<1.0

Table 2. Hematological Values Observed in Female Cadets at the West Point Military Academy (1979)

Parameter	Mean ± SD	Median	No. Studied	No. at Risk	% at Risk
Hemoglobin (g/dl)	13.3 ± 1.2	13.3	72	6	8.3
Hematocrit (%)	39.1 ± 2.3	39.0	72	17	23.6
Serum iron (ug/dl)	80 ± 38	73	69	16	23.2
TIBC (ug/dl)	344 ± 44	345	56	7	10.6
Iron saturation (%	23.0 ± 11.2	21.0	66	18	27.3
Serum ferritin (ng/ml)	25 ± 11	17	30	10	33.3
Red cell folacin (ng/ml)	431 ± 138	415	70	1	1.4
Serum folacin (ng/ml)	11.7 ± 6.2	10.6	70	10	14.3

Table 3. Lipid Profiles Observed in Female Cadets At the West Point Military Academy (1979)

Parameter	Mean ± SD	Median	No. Studied	No. At Risk	% at Risk
Serum triglycerides (mg/dl)	93 ± 46	80	70	6	8.6
Serum total cholesterol (mg/dl)	170 ± 26	170	70	1	1.4
Serum HDL cholesterol (mg/dl)	55 ± 10	53	70	0	0
Serum LDL cholesterol (mg/dl)	98 ± 25	97	70	1	1.4
Cholesterol risk factors	3.20 ± 0.64	3.17	70		
≤½ average			(50)		
½ to average			(18)		
Average to 2X average			(2)		
>2X average			(0)		
Serum free fatty acids (mEq/1)	0.60 ± 0.22	0.60	70	3	4.3

Table 4. Hematological Values Observed in Male Cadets at the West Point Military Academy (1979)

Parameter	Mean ± SD	Median	No. Studied	No. at Risk	% at Risk
Hemoglobin (g/dl)	15.6 ± 0.95	15.7	161	5	3.1
Hematocrit (%)	44.8 ± 2.67	45.0	161	45	28.0
Serum iron (ug/dl)	95 ± 31	94	156	5	3.2
TIBC (ug/dl)	333 ± 35	331	128	4	3.1
Iron saturation (%)	28.6 ± 10.2	28.0	127	5	3.9
Serum ferritin (ng/ml)	48 ± 23	34	63	8	12.7
Red cell folacin (ng/ml)	363 ± 105	348	158	0	0
Serum folacin (ng/ml)	9.2 ± 3.9	8.6	158	27	17.1

Table 5. Lipid Profiles Observed in Male Cadets at the West Point Military Academy (1979)

Parameter	Mean ± SD	Median	No. Studied	No. at Risk	% at Risk
Serum triglycerides (mg/dl)	122 ± 77	105	156	32	20.5
Serum total cholesterol (mg/dl)	164 ± 25	163	158	4	2.5
Serum HDL cholesterol (mg/dl)	45 ± 9	44	158	4	2.5
Serum LDL cholesterol (mg/dl)	95 ± 24	93	156	0	0
Cholesterol risk factor	3.80 ± 0.88	3.65	158		
≤½ average			(67)		
½ to average			(76)		
Average to 2X average			(15)		
>2X average			(0)		
Serum free fatty acids (mEq/l)	0.61 ± 0.20	0.59	157	6	3.8

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