調 査

農村の貧血婦人と非貧血婦人における摂食状況と 血液値に関する栄養学的検討

石黒 弘三, 伊藤 静子*

宮城教育大学食品栄養研究室

*宮城学院女子大学公衆栄養研究室

Nutritional Studies on Food Intake and Blood Contents of Anemic and Non-anemic Women in a Farm Village

Kozo Ishiguro and Shizuko Ito*

Laboratory of Food and nutrition, Miyagi College of Education,

*Laboratory of Public Health Nutrition, Miyagi Gakuin Women's College

農村婦人に多発的傾向の貧血の要因を解明する目的で、東北地方の1農村に在住する貧血婦人の栄養摂取状況を血液値との関連でとらえ、かつそれらを同地域の非貧血婦人のものと比較する調査を実施した。

貧血婦人は一般にビタミン B₁、エネルギーおよびたん白質の摂取量が少なく、とくにビタミン B₁ 摂取量は非貧血者に比して有意に低値であり、エネルギー摂取量も平均で 150 Cal 不足していた。鉄摂取量は成分表から計算された値では充足されていたが、実測値ではかなり低値であった。この点は将来さらに検討する必要がある。

貧血、非貧血婦人をまとめた全対象者において、ヘモグロビンは血清鉄のみならず、血清コレステロールおよび血清たん白質との間においても有意の正相関を示した。

これらの成績から、農村婦人に高頻度にみられる貧血を改善するためには、鉄や動物性たん白質の摂取量を増すことに加えて、脂肪およびたん白質摂取を含めた日々の食事におけるエネルギー摂取量に十分な考慮がはらわれなければならないものと考ええる。

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Ever since a decade, many reports^{1)~3)} on anemia among women in farm villages of Japan have been published. However, anemia still remains tenacious among these women.

A survey on the state of the nutritional intake in relation to blood contents of anemic women living in a farm village, who were exclusively engaged in paddy rice cultivation, in Miyagi Prefecture, North-east Japan, was carried out in order to elucidate the reason for such situation. The results were compared with those of non-anemic women of the same area.

Subjects and Methods

The subjects were 34 women aged 25 to 60 years residing in a farm village usually engaged in farming and who were neither pregnant nor suffering from any disease causing secondary anemia.

The nutritional survey and blood sampling were conducted in July, 1975. The subjects were divided into three groups from the results of previous surveys on anemia carried out in July, 1972 and July, 1973.

Groups A and B consisted of 10 and 11 subjects who showed hemoglobin contents less than 10 g/dl and 10.0 to 11.9 g/dl, respectively, at previous observations (anemic groups). Thirteen subjects belonging to Group C showed hemoglobin contents of 12 g/dl and over at both times (non-anemic group). The average age, stature and body weight of each group were similar (age; 42-44 years; stature; 149-152 cm; body weight; 49-52 kg), and no difference was found among the three groups.

The daily diet of these subjects was observed by interviewing for 2 days and hemoglobin (Hb), blood specific gravity (SG), hematocrit (Ht), serum iron, serum cholesterol, serum protein and serum A/G ratio were measured. Hb content, SG and Ht values were examined by the cyanmethemoglobin method, copper sulfate method and capillary tube method, respectively. Serum iron concentration was estimated by atomic absorption analysis, and the serum cholesterol content was estimated by the o-phthalic aldehyde method. Serum protein content and A/G ratio were determined by the burette method. Furthermore, in order to compare with calculated values, iron content of the diet was estimated by two methods, atomic absorption analysis and the o-phenanthroline method.

Results

Fig. 1 shows the mean values Hb, SG and Ht of subjects by each group. In the figure, the horizontal bars in the middle of rectangles give mean values, and lower and upper bars give the lower and upper limits of means at the significance level of $P=0.05$.

The mean values of Hb were 8.5, 10.9 and 12.2 g/dl for Group A, B and C, respectively, and the difference between Group A and the other two groups was significant at the 5 per cent level. For mean values of SG and Ht, a similar tendency was also observed among the

Fig. 1 Mean values of hemoglobin, blood specific gravity and hematocrit of subjects by group at the present survey

Table 1 Mean values of nutritional intake per day by each group

		A	B	C
Energy	(Cal)	1,774±272	1,795±228	1,934±321
Protein	(g)	71±12.0	72±13.6	79±14.6
Animal protein	(g)	36±6.4	36±13.6	40±8.8
Calcium	(mg)	577±210	510±101	596±329
Phosphorus	(mg)	1,043±152	1,052±152	1,144±212
Iron	(mg)	15.3±2.30	13.9±2.66	16.1±3.94
Vitamin A	(IU)	1,416±512	1,385±395	1,248±725
Vitamin B ₁	(mg)	0.56±0.13	0.57±0.10	0.77±0.18*
Vitamin B ₂	(mg)	0.76±0.22	0.74±0.17	0.79±0.23
Vitamin C	(mg)	62±24.5	56±14.6	55±16.5

Figures show the mean±standard deviations.

* $P < 0.05$

Table 2 Comparison of dietary iron content between calculated and estimated values by atomic absorption analysis in diet of 4 subjects

Subject		Calculated (mg)	Estimated		Ratio (%)
			Before cooking (mg)	After cooking (mg)	
Anemic	Breakfast	4.0	2.0 (3.0)	1.9	50
	Lunch	7.7	4.1 (2.9)	3.1	53
	Dinner	5.7	1.3 (1.8)	1.5	23
Anemic	Breakfast	5.2	1.7 (1.8)	2.5*	33
	Lunch	6.1	4.9 (4.2)	6.0*	80
	Dinner	7.2	4.6 (4.1)	4.4	64
Non-anemic	Breakfast	2.5	1.2	1.3*	48
	Lunch	3.6	1.9	2.2*	53
	Dinner	5.1	3.8	3.7*	75
Non-anemic	Breakfast	7.0	5.1	4.0	73
	Lunch	8.8	3.4	3.8*	39
	Dinner	9.9	8.3	6.7	84

* Iron utensils were used in cooking.

Figures in parentheses show the values estimated by the o-phenanthroline method.

three groups.

The mean values of nutritional intake in the daily diet are presented in Table 1. Vitamin B₁ intake of anemic groups was significantly lower than that of the non-anemic group, and intakes of energy and protein also tend to be low in anemic groups. Especially in energy intake, although the difference is not significant, anemic women (Groups A and B) appeared to be about 150 Cal insufficient on the average compared with non-anemic women (Group C). On the contrary, the daily intake of vitamins A and C seemed to be abundant in Group A.

Table 3 Mean values of serum contents

Group	A	B	C
Serum protein (g/dl)	6.32±0.26 (6.14~6.50)	6.77±0.43 (6.48~7.06)	7.32±0.65 (6.93~7.71)
A/G ratio	1.48±0.36 (1.22~1.73)	1.58±0.12 (1.50~1.67)	1.46±0.23 (1.32~1.60)
Serum cholesterol (mg/dl)	149±28 (129~168)	167±26 (150~185)	218±39 (195~242)
Serum iron (μg/dl)	60.5±17.1 (48.5~72.5)	87.4±28.6 (68.3~106.5)	139.2±37.2 (116.7~161.7)

Figures in the upper column show the mean±standard deviation.

Figures in parentheses show the 95% confidence limits of mean.

Table 4 Correlation coefficients between intake of nutrients and blood content (N=34)

Blood Content	Intake		
	Energy	Protein	Iron
Hemoglobin	0.152	0.168	0.159
Serum protein	0.042	-0.012	0.115
Serum cholesterol	0.300	0.168	0.127
Serum iron	0.281	0.325*	0.253

* $P < 0.05$

Daily iron intake calculated from the iron contents of individual foodstuffs met the nutritional allowance of the adult woman (12 mg per day), even in the anemic subjects, as seen in Table 1. Therefore, an attempt to analyse iron contents in diets prepared according to the recipes of 4 subjects (2 anemic and 2 non-anemic) was made before and after cooking. The result is shown in Table 2. In comparison of calculated values and estimated values by both different analytical methods, the latter level was about 60 per cent lower on the average as compared with the former. Moreover, it was observed that a loss of 5 to 25 per cent in iron content of the diet was caused by cooking except when iron utensils were used.

Mean values of serum contents by group are presented in Table 3. The levels of serum protein, serum cholesterol and serum iron were highest in Group C and lowest in Group A, and the differences of serum cholesterol and serum iron between Group C and the other two groups were significant. However, in regard of the A/G ratio, such a tendency among groups was not found.

In relation between the nutrient intake and blood content, protein intake showed a positive correlation with serum iron at the level of significance of 5 per cent, and energy intake also showed a tendency of positive correlations with serum cholesterol and serum iron (Table 4). In addition, protein intake showed significant positive correlations with intakes of energy and iron ($\gamma=0.768$, $P < 0.01$ and $\gamma=0.716$, $P < 0.01$), respectively.

In the relation between each serum content, as shown in Figs. 2, 3, 4 and 5, Hb showed positive

correlations not only with serum iron but also serum cholesterol and serum protein at the level of significance of 1 per cent, and serum protein also showed a positive correlation with serum cholesterol at the 5 per cent level of significance. The slow rise of the serum cholesterol content with advanced age has been observed in the previous reports⁴⁾⁵⁾, but as shown in Fig. 6, such a trend could not be confirmed among the subjects in the present survey.

Discussion

It is said that anemia is not revealed in the early stage of shortage of any nutrient, but firstly occurs after the depression of the nutrient in the body. As shown in Fig. 1, Hb values of Groups A and B divided by the results of the past two times still remained at significantly low levels. This may suggest that anemia is not so much improved during a short period.

It has been pointed out that the nutritional factors causing anemia among women in the farm village of Japan were mainly the low intake of protein, especially animal protein, energy and iron⁶⁾⁷⁾. In our present studies, vitamin B₁ intake of anemic groups was significantly less than that of the non-anemic group. In addition, the energy intake of anemic groups was considerably less than the nutritional allowance of the adult woman and appeared to be about 150 Cal insufficient compared with the non-anemic group, although observations were made during the leisure season in summer. It is well known that the requirement of vitamin B₁ is affected by the energy intake, therefore, it is suggested that the poor energy intake accompanied with the low intake of vitamin B₁ has caused the anemic tendency in women, rather than the suggestion that the low vitamin B₁ intake has directly caused anemia among them. Further, intakes of protein and iron were also closely connected with energy intake.

The finding that the observed daily iron intake based on the estimated values was considerably less than that assumed from the calculated values gave us the impression of the necessity for analysing iron contents of many kinds of diet and foodstuffs. Furthermore, it may also be necessary to examine in detail how much iron is lost during cooking and in respect to iron absorption into the body⁸⁾ whether iron retained in foods is either heme or non-heme.

In our previous report⁹⁾, the author found that the fall of SG after the busy farming season is accompanied with the decrease in serum protein among women in a farming village. In the present survey, it was observed that the levels of serum protein, serum cholesterol and serum iron were highest in Group C and next in Group B (Table 3); in addition, the relationships among Hb, serum protein, serum cholesterol and serum iron are evident (Figs. 2, 3, 4 and 5). From these findings it is suggested that the low value of Hb prevalent in farm women accompanies decreased values of serum contents which are effected by the daily intake of nutrients such as energy, protein and fat.

In conclusion, to improve the prevalent anemic tendency of these women, it seems to be important not only to increase the daily iron intake but also to improve their diets including energy, protein and so on which are generally considered to be poor among women in farm villages.

Fig. 2 Correlation between hemoglobin and serum iron

Fig. 3 Correlation between hemoglobin and serum cholesterol

Fig. 4 Correlation between hemoglobin and serum protein

Fig. 5 Correlation between serum protein and serum cholesterol

Summary

To account for the high incidence of anemia among women living in farm villages, studies were made on the state of the nutritional intake in relation to blood contents of anemic women living in a farm village of the north-eastern district of Japan, and the results were compared with similar values of non-anemic women.

It was found that anemic women generally had a small intake of vitamin B₁, energy and protein, especially vitamin B₁ intake of anemic women showed a significant low level and their energy intake on the average showed to be about 150 Cal insufficient compared with non-anemic women. Calculated amount of iron intake seemed to be sufficient, but estimated values were considerably lower and this

point requires further examinations. From the blood contents, hemoglobin showed a significant positive correlation not only with serum iron but also serum cholesterol and serum protein, in both anemic and non-anemic women.

From these findings, it is suggested that the amount of energy intake in the daily diet, including intakes of fat and protein, should be taken into consideration, in addition to the increase in the intake of iron and animal protein, for improving anemia which was found to occur very frequently in the farm village women.

Fig. 6 Correlation between serum cholesterol and age

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