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A STUDY OF POSSIBLE RELATIONSHIP BETWEEN VITAMIN A AND SOME HEMATOPOIETIC FACTORS

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ABSTRACT

In a survey of 148 subjects (72 females and 76 males) in 3 villages and one city in Isfahan province, plasma vitamin A, hemoglobin concentration and hematocrit were determined in all subjects, and serum iron was measured in 19 persons, in order to investigate the possible relationship between vitamin A and hematopoietic factors.

A positive correlation existed between plasma vitamin A and hemoglobin concentration. People with acceptable hemoglobin values had significantly higher plasma vitamin A levels compared to those with less-than-acceptable hemoglobin values.

A direct correlation between plasma vitamin A and serum iron was also observed.

The evidence gathered in this study supports the hypothesis that there is a direct relationship between anemia and vitamin A status of the subjects.

INTRODUCTION

Nutritional anemia and vitamin A deficiency are among the most prevalent problems in most developing countries and even some developed nations. Since may individuals, especially in the vulnerable groups are prone to these two diseases, many researchers in recent

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years have postulated that there may be a relationship between vitamin A and hematopoietic factors.

Chopra et al (1970) have suggested that a plasma retinol concentration of less than 20µg/dl in more than 15% of the population is an alarming sign from a public health point of view.

In a study by Hodges (1978) a group of subjects with low vitamin A intake were monitored. Although the iron intake was sufficient, yet two-thirds of the subjects gradually developed mild anemia.

A survey of 15 to 45-years-old women from 9 countries (Hodges 1978) revealed those with adequate iron but with insufficient vitamin A intake, had high incidence of anemia. McLaren et at (1965,a) noticed that children with severe vitamin A deficiency suffered from anemia as well. This, of course, might have been due to a general state of malnutrition in these children. This occurence has also been observed in laboratory animals. In a study by Toole et al (1974) it was reported that experimental anemia could be produced in monkeys by feeding them a diet deficient of vitamin A. Amine (1970) and Hodges (1978) also reached the same finding.

In some hematologic studies, direct relationships between vitamin A or plasma retinol with hemoglobin and hematocrit have been claimed. For example Hodges (1978) reported an increase in hemoglobin concentration after adding vitamin A and β-carotene to the diet of a group of subjects.

Majia (1977) observed a direct relationship between hemoglobin and plasma retinol in children 5 to 12 years old, as long as plasma retinol was below 30 µg/dl, but when plasma retinol passed this level, the hemoglobin concentration remained constant. Mohanram (1977) also found a similar relationship in children who had hemoglobin values of less than 11 group per 100 ml. Positive relationships between vitamin A and hemoglobin as well as hematocrit in animals have also been observed (Amine et al 1970-and Toole et al 1974); McLaren, et al (1965,a) have observed an inverse relationship between plasma vitamin A and hematocrit and hemoglobin, in a way that hematocrit and hemoglobin values in children with severe vitamin A deficiency and malnutrition were considerably higher than those with the same degree of malnutrition but without clinical symptoms of vitamin A deficiency. This phenomenon was also observed in laboratory animals, that is, rats with vitamin A deficiency had higher hemoglobin and hematocrit values compared to control groups (McLaren et al, 1965 b, and Corey et al, 1972). Mee, et al (1974) and Nockels et al (1967) observed a similar relationship between hematocrit and vitamin A in laboratory animals. In Mee's studies, however, the inverse relationship existed only when plasma vitamin A was below 40µg/dl.

Majia et al (1977) have reported this inverse relationship between plasma vitamin A and hemoglobin concentration in 1-4 year-old children. It is interesting that in some studies (Hodges et al, 1978- and Majia et al, 1977) therapeutic iron without vitamin A intake could not cure anemia, while vitamin A alone was effective in alleviating anemia.

The reason for such an inverse relationship in the above mentioned studies has been attributed to the hemoconcentration phenomenon due to vitamin A deficiency. Therefore, the increase in hematocrit and hemoglobin levels causes the anemia to be masked biochemically.

In regard to the effect of vitamin A deficiency on hemoglobin and hematocrit, various theories have been postulated. McLaren et al (1965,b) assert vitamin A deficiency indirectly affects the seral phase of the blood and causes its relative reduction. Mee et al (1974) attribute this phenomenon to the dehydration and a water imbalance in the animal body. Corey et al (1972) believe hemoconcentration is due to a reduction of plasma volume. Majia et al (1977) suggest vitamin A deficiency may not affect hemoglobin directly but is effective on the availability of iron for hemoglobin synthesis. Mohanram et al (1977) could not find a clear reason for this occurence.

PURPOSE AND METHOD OF STUDY

The purpose of this survey was to study the relationship between plasma vitamin A with some hematopoietic factors.

SUBJECTS

This study was part of a more comprehensive survey carried out in Isfahan province.

This province was selected because of its various ecologic conditions. The subjects were chosen from the following areas:

a) Amirabad village which is close to Najafabad city. Its inhabitants had been agricultural workers in the past, but were working in industry at the time of this survey.

b) Hajiabad village which is an agricultural-industrial village.

c) Afjan village which is distant from the city and its dwellers are solely farmers.

d) Najafabad city.

All the village population and 50 families in the city of Najafabad were surveyed.

Altogether 4000 people were studied in the province, from whom 445 people accepted to donate blood samples. From these samples 148 specimens were randomly selected for vitamin A assay. The subjects were between one and 61 years old. They were placed in 4 age groups.

The health status of the subjects who accepted to donate blood was not inferior to those who did not give blood samples according to the clinical examinations conducted on all the subjects. Therefore this sample is a good representative of the total population.

Vitamin A was measured fluorometrically (Thompson, 1973). Hemoglobin and hematocrit were determined by cyanmethemoglobin (Hainline, 1958) and microcentrifuge methods, respectively Serum iron was assayed on 19 out of 148 samples using TPTZ (Caraway, 1963).

Subjects were clinically examined by the survey team physicians. The vitamin A, hemoglobin, hematocrit and serum iron values were categorized into three groups, namely, acceptable, low and deficient, using standard guidelines of O'Neal et al (1970), (see table 2 and 3).

RESULTS

Mean and standard deviation for plasma vitamin A, hemoglobin and hematocrit according to age groups are presented in table 1. All age groups had mean plasma vitamin A values above acceptable levels.

Hemoglobin in relation to plasma vitamin A

From 148 hemoglobin measurements 99 had acceptable values, 11 were deficient and 38 had low hemoglobin concentrations. In other words, 33 percent of the subjects possessed below normal hemoglobin values. The regression line for the correlation of plasma vitamin A and hemoglobin disclosed that the two factors were directly related ($r = 0.19$, $p<0.05$, $n = 148$).

A comparison between plasma vitamin A in subjects with acceptable hemoglobin values and those with less than acceptable hemoglobin levels, by employing Z-test, revealed a significant difference ($p < 0.001$), that is, the group with acceptable hemoglobin values had higher plasma vitamin A levels than the group with less-than-acceptable hemoglobin concentration values.

Hematocrit in relation to plasma vitamin A

From the total of 148 subjects whose hematocrit had been measured 130 had acceptable and 18(12%) less than acceptable hematocrit levels. Of the latter, 3 were in the deficient and 15 in low category.

No significant correlation existed between plasma vitamin A and hematocrit values.

Serum iron and vitamin A

Serum iron was measured in 19 subjects. All had serum iron values above standard levels (O'Neal et al, 1970). Regression line showed a direct correlation between plasma vitamin A and serum iron values ($r = 0.59$, $p < 0.001$, $n = 19$).

DISCUSSION

A positive correlation between vitamin A and hemoglobin concentration was proven to exist.

This correlation has been reported in literature both in human and animal subjects (Hodges, et al, 1978-Amine, et al, 1970-Majia, et al, 1977-Mohanram, et al, 1977).

In this study a relationship between plasma vitamin A and hemoglobin concentration was established and those with acceptable hemoglobin values possessed significantly higher, plasma vitamin A levels. Of all subjects only 6 subjects were biochemically vitamin A deficient, five of whom were in adolescence age (11-14 years). It is interesting to note that 4 of these subjects were also hemoglobin-deficient, which further confirms the relationship between vitamin A and hemoglobin.

A positive correlation existed between serum iron and vitamin A which supports Majia, et al (1977) finding.

In this study no evidence for the presence of hemoconcentration due to lack of vitamin A was found. This may be explained by the fact that in the above mentioned experiments, the subjects were fed a severely vitamin A-deficient diet which may have caused the hemoconcentration to be produced. Further more, hemoconcentration occurence due to lack of vitamin A may not persist for a long time. Further studies are needed to clarify the manner with which vitamin A is related to the hematopoietic factors.

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Table 1

SERUM VITAMIN A, HEMOGLOBIN AND HEMATOCRIT LEVELS OF THE SUBJECTS

Age groups (year)	Number of persons	Vit. A (μ/100)	Hemoglobin (gm/100)	Hematocrit (percent)
		mean SD	mean SD	mean SD
1–5 *	16	42.3 ± 10.6	11.5 ±1.9	37.2 ± 3.8
6–12	38	46.4 ± 9.3	12.7 ± 1.4	41.0 ± 2.7
13–16 (men)	10	37.9 ± 10.2	12.9 ± 0.7	41.3 ± 2.2
13–16 (women)	5	47.2 ± 15.9	13.2 ± 1.8	38.6 ± 6.7
16+ (men)	37	39.3 ± 7.6	14.8 ± 1.8	47.2 ± 4.6
16+ (women)	42	40.7 ± 10.5	12.2 ± 2.1	41.8 ± 5.3
Total	148	42.1 ± 10.0	13.0 ± 2.0	42.3 ± 5.3

*Age group distribution is according to international standards, (as the number of subjects from 1 to 5 years were not sufficient to be categorized in two ago groups they were placed in a single group from 1 to 5 years).

Table 2

STANDARD TABLE FOR HEMOGLOBIN, HEMATOCRIT AND SERUM IRON FOR DIFFERENT AGE GROUPS.

Age groups	Deficient	Low	Acceptable	Deficient	Low	Acceptable	less than acceptable	Acceptable
6-23 (mon.)	<9	9—9.0	⩾10	<28	28—30	>31	< 30	>30
2-5(yr.)	<10	10-10.9	⩾11	< 30	30—33	>34	< 40	>40
6-12 (yr.)	<10	10-11.4	⩾11.5	< 30	30-35	>36	< 50	> 50
13-16 (men)	<12	12-12.9	⩾13	<37	37—39	>40	above	
13-16 (women)	<10	10-11.4	⩾11, 5	<31	31—35	>36	12 yr. <60	>60
+ 16(men)	<12	12-13.9	⩾14	<37	37-43	>44	(men)	
+ 16 (women)	<10	10-11.9	⩾12	< 31	31-37	>38	above <40 12 yr. (women)	> 40

Table 3

VIT. A STANDARD TABLE FOR DIFFERENT AGE GROUPS

Age groups	Plasma vit. A (μ/100) Deficient	Low	Acceptable
0-5 (mon.)	10	10—19	20
0.5—17 (Yr.)	20	20—25	30
Adults	10	10—19	20

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